The Impact of Human Capital Endowments on International Competitiveness, with Special Reference to Transition Economies

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Abstract

The aim of this thesis is to investigate the impact of human capital endowments on international competitiveness, with special reference to transition economies. This investigation is based on country, industry and firm level estimations using longitudinal and cross section data for the period 1995-2010 and 2011-2014, respectively. The theoretical framework informing this empirical investigation proposes a relationship between human capital and international competitiveness through the underlying mechanism of labour productivity and innovation. More educated and higher skilled individuals are more likely to innovate and/or adopt and use efficiently new sophisticated technologies which, consequently, boosts labour productivity. In turn, more productive firms and countries are more likely to maintain and/or develop their international competitiveness. In this investigation, the degree of international competitiveness is measured by *export market share, relative export advantage, the share of medium and high tech exports, export sophistication, and export intensity*. Human capital is represented by *educational attainment, the quality of education, and provision/participation in training programmes*. To empirically test the human capital-international competitiveness nexus, a diversified modelling strategy has been employed. In line with theoretical underpinnings, human capital endowments appear to exert a positive and significant impact on export market share at both country and industry levels, though this effect is not replicated when the relative export advantage index is taken as the measure of international competitiveness. The share of the population with tertiary education seems to exert a positive impact on the share of medium and high-tech manufactures exported by the EU-27, the impact being relatively stronger in the high tech category. No supporting evidence is found for the influence of the quality of education, irrespective of the international competiveness measure used. In the export sophistication sub-analysis, the estimated results suggest that the share of population with tertiary education has a positive impact only on the level of export sophistication of the EU-17. Consistent with previous research, the firm level results suggest that having a more educated workforce exerts a positive and statistically significant impact on the export intensity and export market share of firms in 30 transition economies. Mixed evidence is found for the role of on-the-job training programmes and years of experience of the top manager. The empirical evidence obtained in this investigation has potentially useful policy implications for European and Euro-Asian countries seeking to sustain or increase their international competitiveness.

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Abbreviations

ALL – Adult Literacy and Lifeskills Survey

BEEPS –Business Environment and Enterprise Performance Survey

CEE – Central and Eastern Europe

CEEC – Central and East European Country

CEPII – Centre d'Études Prospectives et d'Informations Internationales

CIS – Commonwealth of Independent States

CVTS – Continuing Vocational Training Survey

EBRD – European Bank for Reconstruction and Development

ETE – European Transition Economy

EU – European Union

FDI – Foreign Direct Investment

FE – Fixed Effects

FEVD - Fixed Effects Vector Decomposition

GDP – Gross Domestic Product

GLS – Generalized Least Squares

GMM – Generalized Method of Moments

HT – Hausman and Taylor

IAEP – International Assessment of Educational Progress

IALS – International Adult Literacy Survey

IEA – International Association for the Evaluation of Educational Achievement

ISIC – International Standard Industrial Classification

IV – Instrumental Variable

LSDV – Least Squares Dummy Variable

MAR – Missing at Random

MCAR – Missing Completely at Random

MICE – Multiple Imputation using Chained Equations

MLE – Maximum Likelihood Estimator

MNAR – Missing not at Random

MNE – Multinational Enterprise

MVN – Multivariate Normal Regression

N-ETE – non-Transition Economy

OECD – Organisation for Economic Co-operation and Development

OLS – Ordinary Least Squares

PIAAC – Programme for the International Assessment of Adult Competencies

PIRLS – Progress in International Reading Literacy Study

PISA – Programme for International Student Assessment

R&D – Research & Development

RE – Random Effects

SITC – Standard International Trade Classification

SME – Small and Medium Enterprise

TIMSS –Trends in International Mathematics and Science Study

UNCTAD – United Nations Conference on Trade and Development

UNESCO – United Nations Educational, Scientific and Cultural Organization

VIF – Variance Inflation Factor

WDI – World Development Indicators

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I dedicate this thesis to my beloved parents, Servete and Ramiz.

Chapter 1

HUMAN CAPITAL AND INTERNATIONAL COMPETITVENESS: INTRODUCTION AND CONTEXT

Contents

1.1 Introduction

The aim of this introductory chapter is to provide a discussion on the characteristics and evolution of international competitiveness and human capital across transition countries since the beginning of the transformation from centrally planned to market economies. The link between international competitiveness and the process of transition is analysed in the light of the data provided by the World Bank and the UNCTAD. Initially, the transformation process has been covered and its impact on the integration of these countries into the global economy is discussed. The evolving performance and pattern of exports in European and Central Asian transition economies since mid-1990s is presented and discussed, followed for comparative purposes by an overview of the performance of 18 European countries, henceforth refered as EU-18[1] over the same time span. The change in the compositional structure of exports in transition economies, and their convergence towards the structure typical of high income countries is placed at the centre of our debate. Particular attention is paid to the high technology-intensive exports and their evolution during the course of transition. This part of the chapter also focuses on the re-orientation of the export flows from transition countries towards Western Europe since the beginning of the transformation process.

The following section of this chapter focuses on the development of human capital in the former socialist countries of Central and Eastern Europe and Central Asia. It provides a discussion on the evolution of the human capital stock since the beginning of transition by focusing on the level of education attainment, quality of education and training incidence. Furthermore, it describes the key characteristics of the educational system of the region before and during the reform process with particular emphasis on different types of schooling, skill upgrading and teaching approaches. The remaining gaps with respect to the EU-18, skill and qualification mismatches and other transition-related subjects are also elaborated in this chapter. The last section of the chapter outlines the aim of the thesis, the key research questions and the structure of the thesis.

[1] EU18 refers to 17 non-transition member countries of the European Union (Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden and the United Kingdom) and Norway. EU-17, on the other hand, refers to all the above mentioned countries excluding Malta.

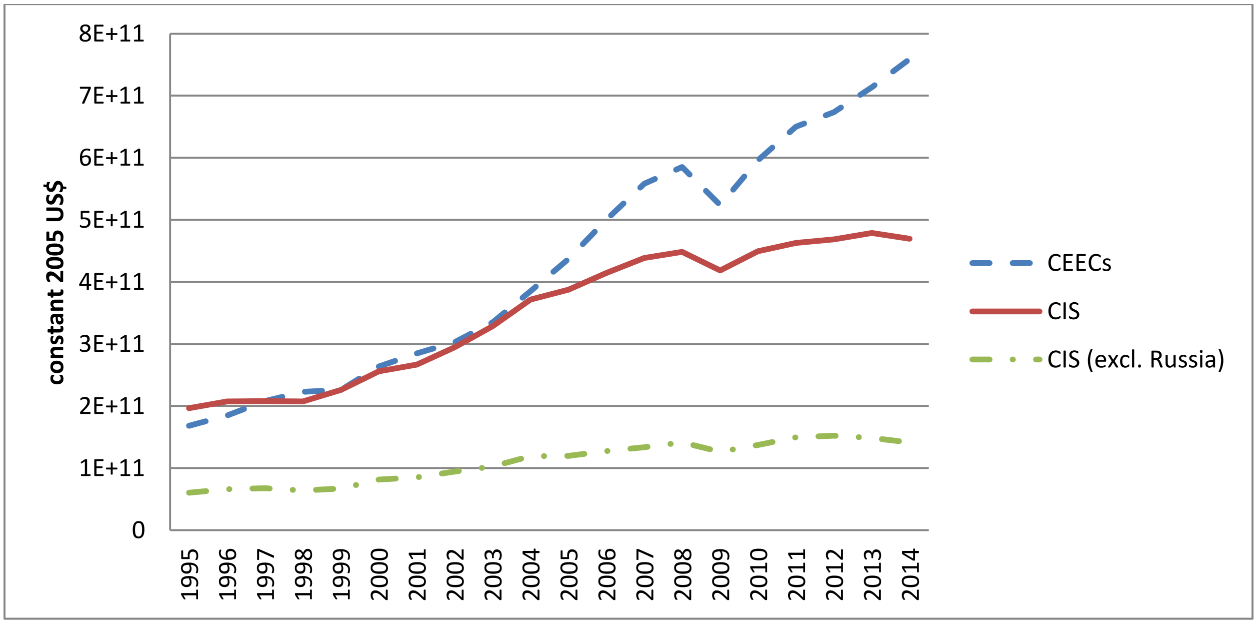
1.2 International competitiveness and the transition process

The transformation of the Central and Eastern Europe and Former Soviet Union from a centrally planned economic regime to a market oriented system has been associated with a deeper integration of this region into the global economy. Increased openness and international integration through trade have been key outcomes of the transition process in the former socialist countries. Integration into the world economy through trade has also been closely related to integration via labour and capital flows. Increased movement of capital and labour are regarded to play a key role in promoting wider integration and in enhancing the performance of transition economies (EBRD, 2003). During the course of transition, movement of capital was mainly achieved by increased foreign direct investment and cross-border bank flows (Roaf et al., 2014). However, in order for this region to be able to realise greater integration, increased policy cooperation and other adjustments were required to take place. Membership in international institutions, such as World Trade Organization (WTO) has assisted these countries significantly in harmonising their legislation and political frameworks (Roaf et al., 2014).

The increased trade liberalisation which started after the fall of the Berlin Wall and the end of the Soviet Union has been characterized by an improved export performance in the majority of these countries. In a globalized economy, maintaining and increasing international competitiveness is a major challenge for most countries, particularly for developing and transition economies. Over the transition period, the majority of transition countries have managed to increase their engagement with international markets and in turn enhanced their international competitiveness. As a complex and multifaceted concept, international competitiveness has been elaborated quite extensively in the literature; however, its definition and measurement still remain contentious. Various definitions and measurement approaches at both macro and micro levels of aggregation have been proposed and used in the literature with no agreement on any single one. Since the ability to compete in international markets is regarded as an important indication of the economic performance of countries, this section will focus primarily on export based indicators. Greater integration into international markets has been followed by faster productivity growth in most of these countries, thus, narrowing, the previously wide productivity gap with the EU-15 and other developed countries. As already postulated in the literature, international trade is perceived to facilitate technological transfer, which in turn plays a key role in increasing productivity, particularly in developing countries (Choudhri and Hakura, 2000). The benefits of fuller international integration for productivity improvement in transition economies have been more prevalent in the new EU member states, with their productivity levels being twice as high, in 2005, as those in several CIS economies (Alam et al., 2008). The impact of trade and FDI on productivity enhancement appears to have been mainly channelled through technological transfers and innovation promotion. Note that productivity growth in some services industries, over the period 1997 to 2004 has significantly exceeded the comparable growth rates in the EU-15 (Broadman, 2005, Alam et al., 2008). However, in spite of the evident convergence, there is still a significant gap in productivity levels of the region relative to those found in high income countries. The aim of this section is to assess and discus the evolving performance and pattern of exports in European and Central Asian transition economies since mid-1990s. A comparative analysis of this region's export performance with that of EU-18 is also presented and debated in this section. Particular attention is paid to the change in the composition of exports, i.e. the movement towards technology intensive (more sophisticated goods), and the extent to which these countries have converged in this respect with the EU-18.

Since the start of transition, the region has witnessed a rapid and significant growth of exports, which has been accompanied by increasing market shares in world markets. In 2014, the total exports of Central and East European countries (CEECs) and the Commonwealth of Independent States (CIS) accounted for approximately 1,228 billion (constant) US dollars, which represents an increase of 235 percent from 1995 (an annual average rate of 6.6 percent). Data on the EU-18, on the other hand, reveals just a 126 percent increase in total exports of goods and services during this period (World Bank, 2016a). It is pertinent to note that the transition progress and consequently the international integration have been uneven among transition countries. Important discrepancies in the speed and degree of integration and export restructuring have been observed between countries in Central and Eastern Europe (CEECs) and Former Soviet Union (CIS). The highest average growth rate in total exports of goods and services among transition economies was recorded in the region of Central and Eastern Europe. From 1995 to 2014, the exports of the CEECs increased by 351 percent, as compared to 138 percent for the CIS. It is also worth noting that these high growth rates are partly a result of the lower levels of international integration of these countries prior to transition. While, the majority of countries from the former group have finalised the transformation process and have joined the European Union, many countries from the CIS are still lagging behind in terms of their reform and transformation progress. Many of the CEE countries have had bilateral trade agreements with the EU since the mid-1990s, whereas, the trade agreements of CIS with the EU are much weaker in terms of the degree of liberalization (Roaf et al., 2014). Geographical proximity, initial economic conditions, transformation progress and their prevailing policy regime have been considered as the main sources of the faster integration of the former region into the EU markets and beyond (Roaf et al., 2014). Figure 1.1, presented below, shows how the total exports of these transition economies have evolved from mid-1990s to 2014. It is important to note that the share of Russia's exports in total exports of Commonwealth Independent States (CIS) is quite large; hence, driving the total export figures considerably. After excluding Russia from the calculations, the export value of CIS drops significantly and the gap between the latter and CEECs widens further (see Figure 1.1). However, it should be emphasized, that many countries from the former Soviet Union are highly engaged in exporting primary goods due to their natural resource abundance, thus making it difficult to compare their export performance with that of the CEECs.

Figure 1.1 Export patterns across transition economies (1995-2014)



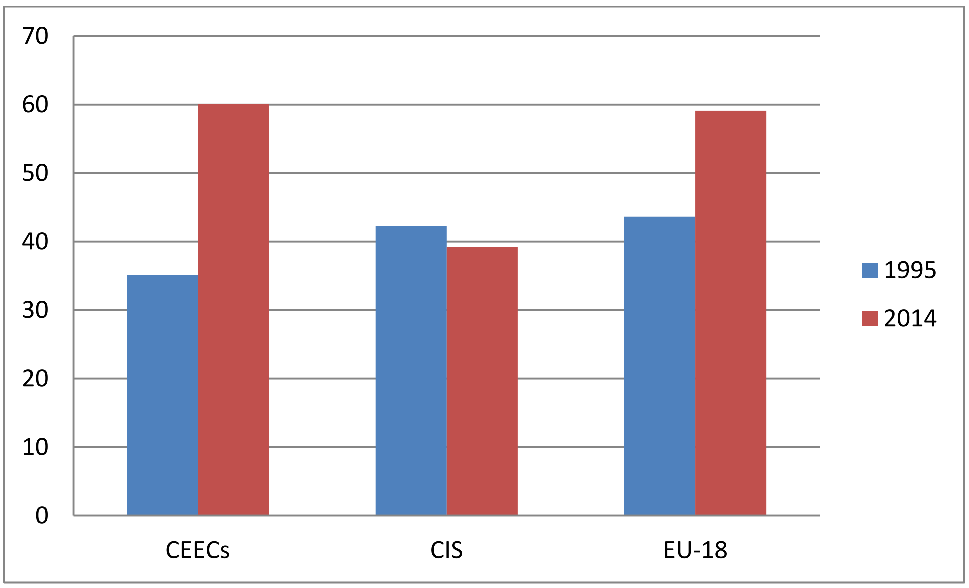
Data Source: World Bank - World Development Indicators (Exports of goods and services, constant 2005 US$)

In spite of the relatively high average growth rate recorded in the CEECs, diverse exporting performances have been witnessed across the region. While, Poland, the Czech Republic, Hungary, the Slovak Republic, and Romania appear to be the top five export performers, countries from the Western Balkan region seem to lag behind and thus are positioned at the lower end of the ranking. However, it is worth emphasizing that countries such as Albania and Serbia have experienced exceptionally high rates of growth in their exports from 1995 to 2014, i.e. 792.9 and 905.5 percent increase, respectively. The violent dissolution of former Yugoslavia has been regarded as one of the potential causes for the slower integration of many of the Western Balkan countries (EBRD, 2003).

Regarding the export performance of the former Soviet Union countries (i.e. CIS), Russia, Kazakhstan, Ukraine, Azerbaijan and Belarus appear to be the top five exports performers, whereas, Armenia, Kyrgyz Republic and Tajikistan are ranked amongst the countries with the weakest export performance. Countries that experienced the highest rate of (positive) change over the period 1995-2014 were Azerbaijan and Georgia (over 800 percent). It is important to note that the overall positive trend of transition economies was hampered by the global financial crisis 2008-09, which affected to a large extent the exporting sector. The entire region suffered an 8 percent decline in its exports of goods and services in 2009 as compared to a 11.8 percent fall in the EU-18. However, their overall exports recovered rapidly in 2010, with a rate of increase of 13.7 percent in CEECs and 7.4 percent in the CIS (World Bank, 2016a).

The overall increase in exports over time has been accompanied by a significant expansion in the exports to GDP ratio. From the two sets of transition economies, countries from the Central and Eastern Europe appear to have witnessed the highest growth rates since mid-1990s. On average, CEECs' total exports in 2014 accounted for 60 percent of GDP, as compared to about 35 percent in 1995, reaching the EU-18 level by the end of this period. It is pertinent to note that countries such as the Slovak Republic, the Czech Republic, Hungary, and Estonia in 2014 recorded relatively high export ratios, thus, outperforming most of the EU-18 countries. A completely different story is portrayed when the CIS' export to GDP figures are assessed. With an initial rate higher than the average of CEECs, these countries have recorded a decrease of 7 percent on their export shares in GDP from 1995 to 2014 (World Bank, 2016b). The first two decades of transition for these countries have been followed by high volatility in their export to GDP ratios. Among the potential causes for the limited degree of integration of many of these countries, their less favourable geographical position, high transportation and transit costs, and the poor quality of institutions and policies have been highlighted (EBRD, 2003). The composition and quality of exports might be another potential reason for their lower rates of participation in western markets. The change on the export to GDP ratio from 1995 to 2014 across these countries is presented in Figure 1.2.

Figure 1.2 Export to GDP ratio by country group



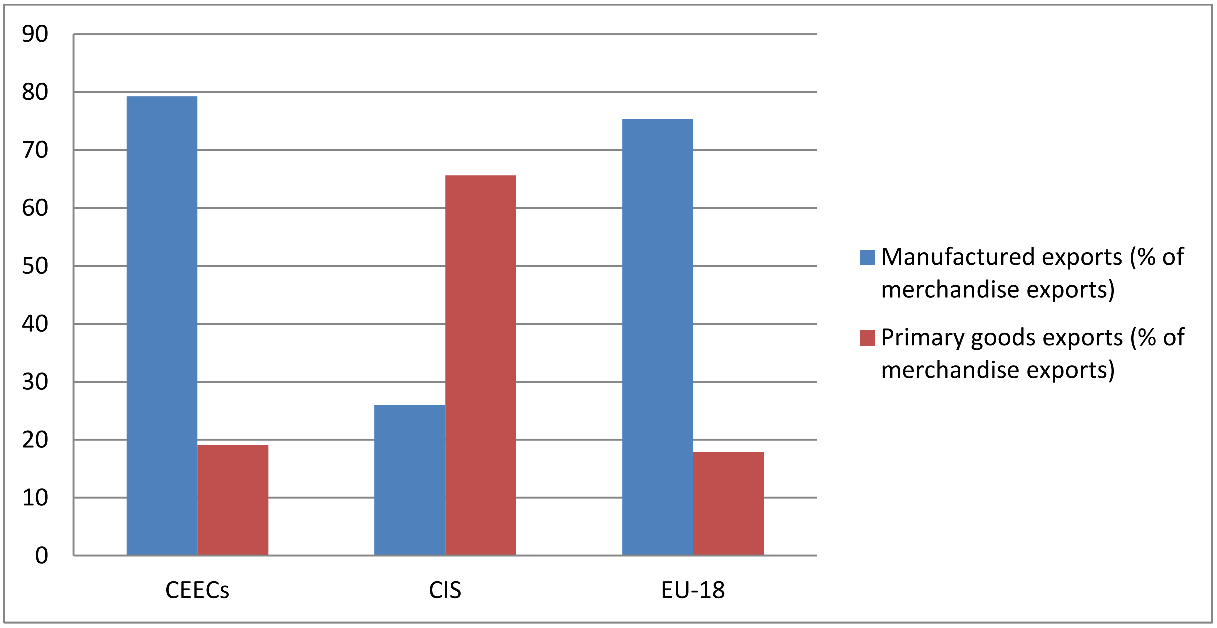
Data Source: World Bank- World Development Indicators (Exports of goods and services % of GDP)

A separate assessment of goods and services export data (in current US dollars) during 1995-2013, reveals an extremely high growth rate in the export of goods (i.e. 618%), followed by an almost equally impressive growth rate in the services sector (i.e. 507%). The highest average growth rate, in the export of services, was recorded in the CIS region, i.e. a growth rate of 647%, as compared to 368% percent in CEECs and 257 percent in the EU-18. While the share of goods in total exports during the same period increased slightly in CEECs, both the CIS and EU-18 experienced a decline in this ratio by approximately 10.7 percent and 16.6 percent, respectively. Differences in the contribution of services to total exports (i.e. services as a % of total exports), on the other hand, has been more evident in the CIS region. While countries from Central and East Europe have experienced a negligible increase in this share over time, i.e. a 1.4 % increase from 1995 to 2013; countries from the former Soviet Union, have recorded an average rate of change as high as 93.7%. The share of services in total exports for EU-18 went up as well. At the same time, this set of countries has witnessed an average share of 37.8%, representing a change of 37.7 percent since 1995 (UNCTAD, 2016b).

A further disaggregation of the data extracted from the UNCTAD has helped us to assess the evolution of the share of manufactured and primary goods in merchandise exports across the region during the course of transition. The new data show large differences between the two transition subgroups in terms of their engagement in exporting these particular product groups over the past twenty years. While, the share of manufactured goods[2], in CEECs, in 2014, appears to be as high as 78.3 percent (exceeding this share in the EU-18), the CIS has recorded a share as low as 19.5 percent, which represent a decline of approximately 37% since 1995. The EU-18's share has slightly declined over the same period of time (i.e.3.8%), though it still remains high with a current value of around 72.5%. The contribution of primary commodities[3] to their export baskets, on the other hand, has grown in both the CIS and EU-18 countries, by 39.8 percent and 26.3 percent respectively, while it has dropped by 20.3 % in European transition economies. It is worth noting that the engagement of the latter group of transition countries (i.e. CEECs) together with the EU-18 in this sector, has not been very substantial, as indicated by their relatively low shares (19-21%), whereas, the average share of the same product group, in the former Soviet bloc in 2014 was recorded to be around 77% (UNCTAD, 2016a). Overall, data seem to suggest that the latter set of countries have experienced in the last two decades a significant shift of exports away from manufacturing industries and towards primary commodity exports. It is worth noting that, reliance on primary products tends to be associated with a real appreciation of a country's exchange rate, a contraction of other exportable sectors, i.e. the "Dutch disease" problem, and greater trade volatility. The average shares of merchandise exports by product group, during 1995-2014, are presented graphically in Figure 1.3.

[2] UNCTAD data based on SITC 5 to 8 (less 667 and 68)
[3] UNCTAD data based on SITC 0 + 1 + 2 + 3 + 4 + 68

Figure 1.3 Merchandise exports by product group (1995-2014)



Data Source: Author's calculations based on UNCTAD's Merchandise: Trade matrix by product groups, exports in thousands of dollars, annual, 1995-2014.

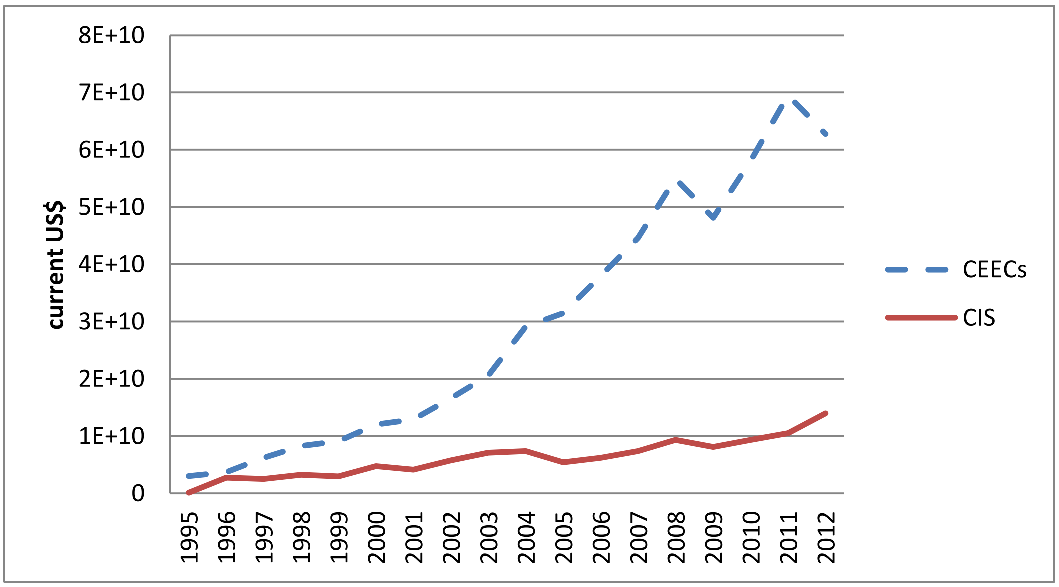
The rapid export growth in transition countries has also been accompanied by re-orientation of their export flows towards Western Europe. Data on the export direction reveal that the EU-15 has become the main destination for these countries' exports, particularly for CEECs (UNCTAD, 2016a). Note that, the pre-transition period was characterized by countries exporting predominately within their own region, particularly for the Soviet Union economies. In 1990, Russia was the most important destination (approx. 80 percent) for the Baltic and Commonwealth of Independent States (CIS) exports (Roaf et al., 2014). However, despite the overall increased diversification of the export destinations, there are still significant differences in the extent of this reorientation across countries from the Central and Eastern Europe and those from the CIS. Data on merchandise exports to the EU-15 and EU-28 (% of total merchandise exports)[4] show relatively high rates for CEECs as compared to the CIS bloc (UNCTAD, 2016a). During 1995-2014, the exports of CEECs to EU-15 accounted for approximately 60.3 percent of their total exports, while the average share of exports absorbed by the EU-28 was 78.1 %. It is pertinent to note that this export trend, particularly to the EU-15 has not been very stable during

[4]Merchandise exports to EU-15 and EU-28 are defined as the value of merchandise exports from CEECs and CIS to EU-15 and EU-28 as a percentage of total merchandise exports by these countries. These are the author's own calculations based on UNCTAD's Merchandise: Trade matrix by product groups, exports in thousands of dollars, annual, 1995-2014, database (UNCTAD, 2016a).

the course of transition. A general positive tendency was witnessed until yearly 2000s, followed by a 1.73 percent average annual contraction in the subsequent years. The share of CIS's merchandise exports to these two markets, on the other hand, has been less impressive. During the same time span, countries from the former Soviet Union appear to have had relatively lower shares of merchandise exported to EU countries. CIS's exports to EU-15 and EU-28, on average, accounted for 31.4 and 44.3 percent of their total exports, respectively. While, their initial low shares to EU-15 increased by 4.6 percent, the same was not experienced regarding the EU-28. Their share of merchandise exports to the latter market fell by 16.7 percent, i.e. from 35.5 percent, in 1995 to 29.6 percent in 2014. It is also worth highlighting that in the last 20 years, these countries experienced a volatile trend, with the lowest share of exports recorded in 2014 (UNCTAD, 2016a).

Competing successfully in terms of the quality of exports rather than just quantity appears to be at the centre of many current economic debates. Highly sophisticated and technology-intensive exports are considered a key source of sustainable economic growth and international competitiveness given the rapidly increasing global demand for these products. It has been postulated that what countries export rather than how much is likely to matter more for economic development and growth. Specializing in certain products might have a stronger impact on growth than specializing in others (Hausmann et al., 2007). In other words, focusing on products that rich countries export, keeping everything else unchanged, tends to have a stronger impact on growth compared to specializing in other (less sophisticated) products (Hausmann et al., 2007). The authors explain the influencing mechanism by arguing that, the reallocation of resources from lower productivity products to higher productivity ones tends to yield a positive impact on economic performance and growth. Hence, amid growing global competition, many transition countries managed to change their initial export structure and move towards more knowledge and technology intensive goods and services, which, in turn has increased their relative competitive positions within these industries. The data extracted from the World Bank, World Development Indicators, show an overall positive trend towards an increasing specialisation in high technology goods. Note that, a deeper analysis on the export specialization of selected transition economies using various measures and indices of the quality and sophistication of exports will be presented in Chapter 5. In this section, a particular focus will be paid to the evolvement of high technology exports during the process of transition. On average, total high technology[5] exports appear to have increased in most transition economies, though; the rates of change are not uniform across them. In 2013, countries from Central and Eastern Europe have experienced growth rates as high as, 1,674 percent, i.e. from around 3.699 billion (current) US dollars in 1996 to approximately 65.656 billion in 2013. This was followed by a 439 percent raise in the CIS block, i.e. from 2.748 billion dollars, in 1996 to 14.819 billion in 2013 (World Bank, 2016c). The overall positive trend of high technology exports is also presented in Figure 1.4.

Figure 1.4 High-technology exports by country group (1996-2013)



Data Source: World Bank - World Development Indicators (High-technology exports, current US$)

These high growth rates of exports have been also followed by an increased share of high-technology exports in total manufactured exports, particularly in the CEECs. During 1996-2013, transition countries from the Central and Eastern Europe experienced, on average, an increase of 90 percent in their share of high technology exports (World Bank, 2016d). Countries with the highest high-tech export shares recorded in 2013 were Hungary (16 %), Czech Republic (14 %), Latvia (13 %), Estonia (10.5 %), Lithuania (10.3 %) and Slovak Republic (10.1 %), whereas, countries that displayed the highest growth rates in exporting this product group, over the same period of time, were Romania, Slovak Republic, Lithuania and Albania. The average rate of

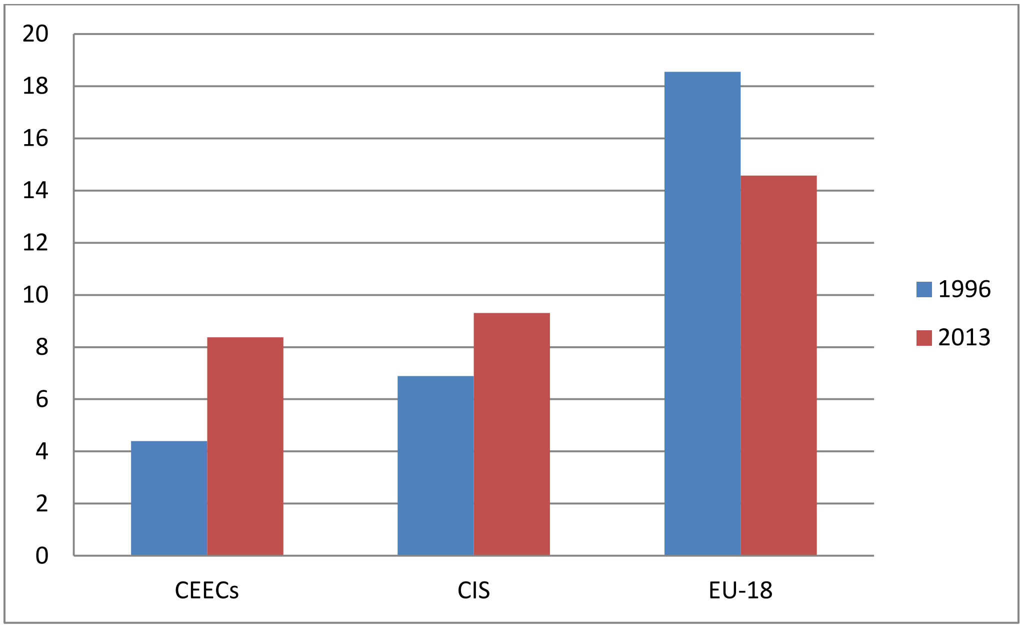
[5] According to the World Bank, **High-technology** exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.

change for CIS countries, for the same time span, on the other hand, appears to be relatively lower (i.e. 35 %) compared to the former group of transition economies. Kazakhstan led the top performers group, in 2013, with a relatively high share of high technology exports (i.e. 36%), followed by Azerbaijan (13.4 %), and Russia (10 %). It is worth stressing that, with the exception of Kazakhstan and Azerbaijan, the remaining set of countries from the former Soviet Union[6] have experienced either small or negative[7] changes over the period 1996-2013. The actual outcome implies that there are large differences in the structure and level of sophistication of the export baskets between the countries in this region. Furthermore, the exclusion of Kazakhstan's exports, as an outstanding performer, from the total CIS exports, turns the rate of change to negative, implying a decline on the average share of high technology exports in this region by around 18%. After excluding Kazakhstan from the total exports of CIS, the average rate of change in the region becomes negative (i.e. 18 %). Note that, Kazakhstan's technology based exports as a share of manufactured exports are the highest in the context of transition economies and well above the EU-18 export shares (World Bank, 2016d).

Despite its relatively high level of export sophistication, the EU-18 has, on average, experienced a negative trend in high technology exports since early 2000s, with very few annual exceptions. However, it is worth emphasising that there are significant variations across the region, with some of the countries experiencing positive or lower negative rates as compared to others. In sum, in spite of the positive tendency of transition economies to converge, there are still striking differences between the export structure of the latter and that of the EU-18. This further reinforces the importance of assessing the potential determinants of their diverse export baskets, with special focus on the role of human capital endowments. A regression analysis examining the impact of human capital endowments on the technology intensive exports of EU-18 and selected European transition economies will be conducted in Chapter 5. Differences in the share of high technology exports as a percentage of total manufacturing exports across CEECs, CIS, and EU-18 are exhibited also graphically in Figure 1.5.

[6]Data for Tajikistan, Turkmenistan and Uzbekistan are largely missing.
[7] Armenia, Kyrgyzstan, and Moldova.

Figure 1.5 High-technology exports (% of manufactured exports)



Data Source: World Bank – World Development Indicators

1.3 Human capital development in transition economies

The shift towards knowledge-based economies, greater participation into international markets and continued transition-related structural changes has increased profoundly the demand for highly qualified labour in the former socialist countries of Central and East Europe and Central Asia. Switching to market economies has brought the need for a new set of skills that were not promoted and developed in the former planned economic system. This section describes the evolution of the human capital stock in transition economies, since the beginning of the transformation and reform process. It focuses on three key dimensions of the human capital: education attainment, quality of education and training incidence. Furthermore, it presents the key characteristics of the educational system before and during the transition with particular emphasis on different types of schooling, i.e. vocational versus general, non-cognitive skills development and the main pedagogical approach adopted. While, there are several approaches to defining and measuring human capital, a particular focus in the literature has been placed on education as a key source of human capital accumulation. In accordance with the conventional human capital theory (see Schultz, 1961, Becker, 1964), education is regarded as a key component of human capital development, assessed primarily through its role in boosting labour productivity. In recent years, the potential importance of the quality of education has also become a subject of considerable debates amongst researchers, particularly in the growth literature. Another important component, albeit, less frequently assessed in the empirical literature, is the provision of on- and off-the-job training programmes. It should be acknowledged that the measurement of these human capital dimensions faces many challenges, particularly related to data restrictions. Hence, by making use of the available data, this section provides a comparative assessment of different measures of the stock of human capital since early 1990s. The transition of the Central and East European countries (CEECs) and the Commonwealth of Independent States (CIS) towards market economies was accompanied by numerous changes in their educational systems. The pre-transition period in these countries was primarily associated with larger shares of resources being invested in heavy industries and agriculture (Brunello et al., 2010). Intellectual work was valued relatively less than physical work, whereas, the socialism period was associated with low wage differences between skilled and unskilled workers (Munich et al., 2005). This encouraged the overwhelming majority of students to pursue vocational studies and/or leave school after the completion of the secondary level of education (Brunello et al., 2010). Their educational system was dominated by vocational schooling as compared to a general type of education. In 1989, countries from the European and Euro-Asian transition region witnessed a very high proportion of students enrolled in vocational studies, i.e. an average of 61.3 percent. A particularly high prevalence of vocational secondary students was found in CEECs, i.e. over 70 percent of total students (Murthi and Sondergaard 2012).

This period was also associated with an authoritarian administration of education institutions – strictly centralized, old-fashioned curriculum with no emphasis on creative judgment and problem-solving skills, and restricted monitoring of learning outcomes (OECD, 2011a). A stronger emphasis was placed on technical skills as compared to business-relevant skills (Kertesi and Köllő, 2002). According to Radó (2001), a key feature of the communism era was the lack of interest in the "pedagogical added-value" of teaching, with participation rates and talented students' achievement being the main quality indicators assessed. Teaching approaches in CEECs and CIS before the collapse of the planned economic system were mainly teacher centred as compared to the student-centred approach in the EU-18. The traditional pedagogy in these countries discouraged interactive discussion and treated students as strictly passive learners.

Students were not encouraged to make their own choices, judgments and problem formulations, thus were unable to learn from their mistakes (Berryman, 2000).

However, when the restructuring process started in early 1990s, the situation changed significantly, shifting the focus from vocational upper secondary towards general education. Student enrolments in the former type of schooling, during the period 1989-1999 decreased significantly, i.e. from 60 to 40 percent of total enrolments (Arias et al., 2014). The expansion of the services and the contraction of the agriculture sector were associated with a profound change in the composition of skills demanded in the market. A shift in the demand towards highly educated employees has been prevalent in the majority of these countries. In particular, the structural changes were reflected in a reduction in the demand for agricultural and manual skills and a growing demand for services and professional skills (Murthi and Sondergaard 2012). However, it is important to note that the reform process did not evolve evenly in all transition economies, partly due to their varying initial economic and political conditions (Botezat and Seiberlich, 2011). The economic transition has posed new challenges regarding the adaptability of pre-transition educated labour force. There is a large number of studies that have assessed the issue of skills "obsolesce" in the former socialist countries, with many of them having found supporting evidence regarding skills devaluation since the beginning of transition (e.g. Vecernik, 1995, Rutkowski, 1996, Burda and Schmidt, 1997, Kertesi and Köllő, 1999).

During socialism, vocational education and training was provided solely by education institutions or in collaboration with the industry. While, the former was mainly organized in the school settings, the latter also involved learning in the workplace, i.e. the so called, "a dual-system" (Kogan et al., 2008). However, the reform and privatization process in the CEECs has led to a considerable reduction in the provision of apprentice and training programmes by enterprises, primarily due to the lack of infrastructure and finance. This, in turn, caused chaos in the education and training systems followed by broken links between schools and the industry (Kogan et al. 2008). Influenced by the Austro-German tradition, countries such as Hungary, Slovakia and the Czech Republic have continued to operate their dual education systems-apprentice practices, though their nature has changed remarkably over time, losing their similarity with Western European counterparts (Horn, 2013). Poland appears to have a larger apprenticeship sector, followed by less significant provisions in Latvia, Slovenia and Croatia. Regulation of apprenticeship programmes have been recently introduced in Estonia, Lithuania, and Romania, albeit their implementation has been very restricted (West, 2013). It is worth noting that the lack of data on apprenticeships and the lack comparability of these programmes across countries have made their assessment much more complex.

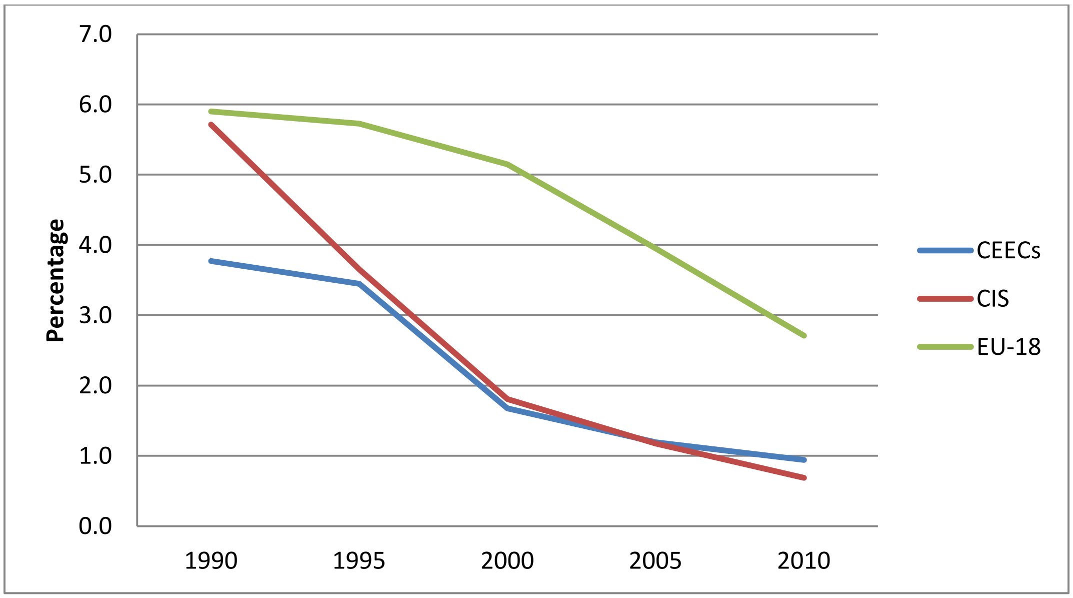
The transition process appears to have been associated with changes in the duration of compulsory schooling as well. Across the transition region, the years of compulsory education range between eight and eleven, with the majority of countries having extended the duration of this type of education over the course of transition. Compulsory schooling for the EU-18, on the other hand, lasts from nine to thirteen years, with an average of 10.5, 13 percent higher than the transition average (UNdata, 2016). The importance of starting to learn at an early age has been highly emphasised in the literature (see Heckman, 1999). Compulsory schooling in majority of transition economies starts at primary level, commencing at the age of six or seven (generally higher than in developed countries), albeit, in countries such as Bulgaria, Latvia, Hungary and Poland, the pre-primary level of education has become mandatory as well (Eurydice, 2012).

The distribution of educational attainment of the population aged 15 and over across transition countries is presented using Barro and Lee's (2014) data. Stock figures extracted from their most recent dataset show that transition economies[8] have managed to successfully reduce their no schooling rates over the period 1990-2010[9] (see Figure 1.6). The proportion of population aged 15 and over, with no completed schooling, on average, decreased significantly by 82.8 percent, i.e. from 4.7 percent in 1990 to 0.8 percent in 2010. With a relatively high proportion of the population without an education in 1990 compared to the CEECs, the CIS region has witnessed a sharp decline of 88 percent. For the same period of time, countries from Central and Eastern Europe have experienced a slightly lower rate of change, though it is worth noting that both sets of countries, on average, have outperformed the EU-18. In 2010, among the countries with the lowest no schooling rates, i.e. proportion of population 15 and over without any level of schooling, were Lithuania, Estonia, Czech Republic, Hungary, Latvia, Kazakhstan and

[8] Educational attainment data for Azerbaijan, Belarus, Georgia, Uzbekistan, Bosnia-Herzegovina, Kosovo, Macedonia, and Montenegro are missing hence are not included in our calculations.
[9] Data are not available after 2010.

Tajikistan. The proportion of population aged 15 and over who have completed primary education as their highest level of education attainment in transition economies also decreased significantly from 18.9 percent in 1990 to just 5.0 percent in 2010, on average. However, it is pertinent to note that a greater reduction in the proportion of the individuals with primary education (as their highest level completed) was recorded in CEECs as compared to the former Soviet Union countries, though the latter started from a lower base.

Figure 1.6 Percentage of population aged 15 and over with no completed schooling

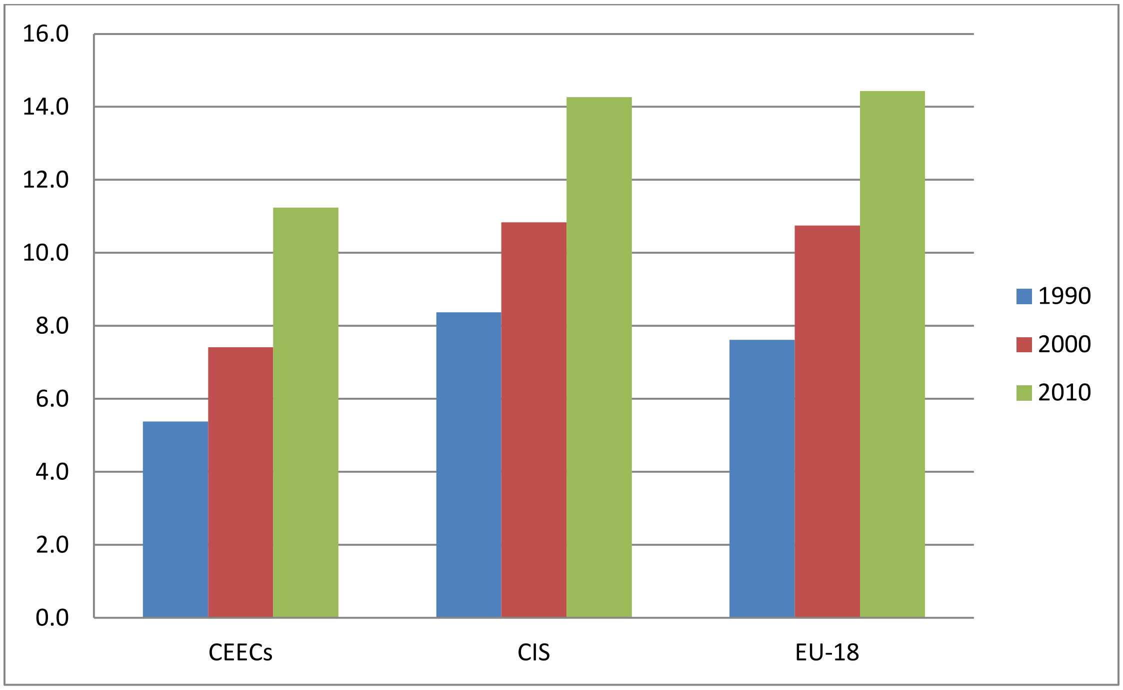


Data Source: Barro and Lee (2014)

With initially on average higher rates compared to the EU-18, the transition region experienced a significant improvement in the proportion of the population who completed secondary education during the course of transition. A positive trend in the proportion of population who have attended and completed secondary education has been recorded in the entire region since the early 1990s, though the magnitude is significantly higher in the CEE region. A rate of approximately 43 percent was recorded for the percentage of the population 15 and over who have attended secondary education in European transition economies (CEECs), while the growth rate for population with completed secondary education (as their highest level attained) was 70 percent whereas, the corresponding rates for the CIS region, on average, were 8.6 percent and 19.2 percent, respectively. In 2010, the average proportion of individuals who have attended (but not completed) secondary education, in the entire transition region was 70.7 percent, whereas the proportion of population who have completed the entire cycle of secondary education was 52.4 percent. The corresponding average rates for EU-18, for the same time span were 55.1 percent and 33.6 percent respectively. It is worth noting that these figures represent the proportion of population who have completed secondary education as their highest level attained rather than total stock of population with secondary education. The latter values are relatively higher for both sets of countries.

A rapid expansion was also recorded in the attainment of tertiary education of the population aged 15 and over, albeit, there is considerable variation across the region. Data extracted from Barro and Lee (2014) reveal positive trends since the beginning of the transformation process in the majority of transition economies. In 2010, the transition region experienced an increase of 80.5 - 85.5 percent in the stock of population who have attended and completed tertiary education, the rate being higher for the CEECs. The CEECs' figures seem to confirm a converging pattern towards the EU-18 region, though, slight difference are still persistent. While, the CIS region, on average, appears to have continuously outperformed the EU-18, this has been mainly driven by the very large rates of Russia and Ukraine. Regarding the transition economies of Central and Eastern Europe, in spite of their average rapid growth rate, in 2010, a gap of 28 percent was prevalent with respect to the EU-18. In 2010, countries with highest stock of population with higher education were: Estonia, Hungary, Lithuania, Armenia, Russia and Ukraine. The improvement in the completion of higher levels of education among the population aged 15 and over has also contributed to rising the average years of schooling. Barro and Lee's stock data show that, since the beginning of transition, the average years of total schooling has increased by 21 percent, i.e. from 9.2 percent, in 1990 to 11.2 percent, in 2010. The transition region and CEECs in particular, appears to have persistently recorded high average years of schooling, overtaking the EU-18. While there are variations across the countries, the Czech Republic, Estonia and Slovakia have been positioned on top of the ranking list. Figure 1.7 illustrates the evolution of the stock of population with tertiary education across countries during the transition period.

Figure 1.7 Percentage of population aged 15 and over who have completed tertiary education



Data Source: Barro and Lee (2014)

It is pertinent to note that the consistency of the education stock figures available is highly dependent on the data sources used. A comparison at a glance of educational attainment data provided by Barro and Lee with the OECD reveals an overall lack of correspondence between the two. As Barro and Lee (2000, 2013) emphasise, the difference between the two outputs stem from the different data sources used, i.e. while their figures are constructed primarily based on UNESCO national censuses, OECD data are extracted from labour force survey on samples of households/individuals. This is also accompanied by differences in the classification of education systems used by the two sources. Furthermore, it is important to note that the labour force surveys utilized by OECD do not cover the population aged 15-24 and over 65, making thus a comparison inherently difficult. Note that, excluding the percentage of population with generally lower education attainment (i.e. 65 and over) tends to inflate the overall average attainment figures (Barro and Lee, 2000).

A complementary discussion regarding the proportion of the labour force with different levels of educational attainment is presented below. The World Bank's World Development Indicators (WDI) provides data on the proportion of the labour force with primary, secondary and tertiary education across the region. In 1995, the percentage of labour force with tertiary education entering the labour market in transition economies was 18.5, though data coverage was limited to a handful of countries. The percentage increased to 19.5 in 2002, when additional transition economies entered the calculations, with the CIS average being relatively higher. In recent years, the country coverage has improved significantly, albeit, missing data are persistent, particularly for countries from the former Soviet Union. In 2012, 26.3 percent of labour force had completed tertiary education. The corresponding values for the EU-18 were 19.9, 23.8 and 32.1 percent, respectively. In spite of the slight yearly changes, the percentage of labour force that attained or completed secondary education remained generally unchanged during the course of transition. In 2012, transition economies, on average, recorded a share of 58.3 percent of labour force with secondary education as the highest level of education completed as compared to 43 percent in EU-18. The process of structural transformation was also associated with decreasing rates in the labour force flows with only completed primary education. In 1995, the average labour force with only primary education (% of total) in eight transition economies was 22 percent, dropping steadily over time. Data from a more completed set of countries[10] collected in 2012 show an average share of 14.4 percent in the transition region as compared to the 23.4 percent in EU-18 (World Bank, 2016e).

However, in spite of the rapid growth of the higher education sector, the lack of suitable skills to meet the needs of the market economies appears to be a persistent issue in many transition economies. Following firm surveys conducted in the transition region, skill mismatches have been identified as a key impediment to firms' growth (see World Bank's reports by Arias et al., 2014, and Murthi and Sondergaard 2012). The labour force's lack of adequate skills has been regarded as an important obstacle to doing business by firms in the majority of transition economies (EBRD, 2014). In addition to the relevance of cognitive skills, employers in these countries have also highlighted the importance of hiring employees well endowed with non-cognitive (soft) skills (Arias et al., 2014). For instance, employee's behavioural skills (e.g. job attitudes, teamwork and other related skills) are perceived by firms in Kazakhstan and Poland to be as important as knowledge and generic cognitive skills (Murthi and Sondergaard 2012). While, the majority of countries from the region have recognized the importance of developing

[10]Excluding Belarus, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

skills to match the upgraded demand through introducing different reforms to their education systems, the key focus seems to remain on imparting facts and knowledge, as opposed to critical thinking and problem-solving skills (Murthi and Sondergaard 2012). In addition, business related and entrepreneurial skills, previously ignored, started to receive greater attention during the course of transition, albeit, significant gaps remain with respect to developed countries. Among CEECs, Slovenia, Estonia and Latvia seem to have started to integrate entrepreneurial and business start-up skills into their educational programmes (Mojsoska-Blazevski, 2006). Universities in South Eastern Europe have also started to establish stronger links with the private sector and to develop relevant partnerships that can assist technological diffusion (Potter and Proto, 2005).

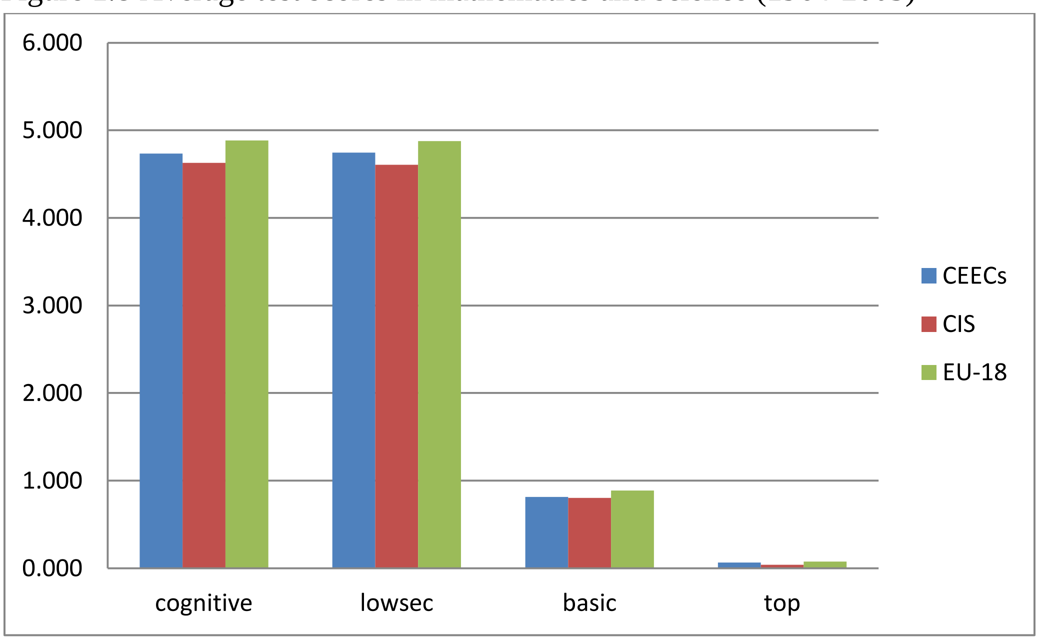
In addition to skill mismatch, there is evidence of shortages in certain professions in the region. Occupations that are essential to international competitiveness, particularly in knowledge-intensive industries, such as those related to science, technology, engineering, and mathematics appear to be deficient in many transition countries (Arias et al., 2014). A decreasing share of graduates in science and engineering in transition economies was accompanied by a significant rise in business, law, social sciences, and service-related ones (Arias et al., 2014). A study conducted in Croatia by Rutkowski (2008a) revealed that there is a lack of engineers and an excess of lawyers and art designers among employees with higher education (Murthi and Sondergaard, 2012).

The discussion presented above has provided evidence that the stock of educated individuals in transition economies has increased significantly over the last two decades, however, the quality of education is another key dimension of human capital accumulation that requires a deeper analysis. Hanushek and Woessmann (2009) provide a quality measure that is constructed by averaging international mathematics and science test scores over the period 1964-2003 for a sample of 50 countries. The cognitive skills indicator measured by the average test scores, primary through to the end of secondary school in the entire transition region[11] is 4.71. The CEECs average is 4.73 as compared to 4.88 in the EU-18, though; countries such as Estonia have

[11] It is worth noting that very few countries from the former Soviet Union have been covered (e.g. Armenia, Moldova and Russia).

recorded higher test scores than many OECD developed countries, outperforming Finland and other highly ranked performers. The Czech Republic, Slovakia and Hungary are also ranked amongst the high performing countries in the region with international comparable scores. Countries such as Albania and Macedonia, on the other hand, have been listed in the lower end of the distribution. Russia appears to be among the best scoring economies from the CIS region, albeit, the region has largely not been covered in this dataset. More specific measures, such as the average test score in mathematics and science, only for lower secondary education, reveal an average of 4.74 in Central and East Europe, which is 2.68 percent lower than the average EU-18. The share of students reaching basic literacy is 0.81, whereas the share of top-performing students is 0.066 for CEECs and 0.039 for CIS as compared to 0.076 in EU-18. Best performers from the transition region in the latter dimension are the Czech Republic, Slovakia, Hungary and Poland, while, participating countries from the CIS, such as Moldova and Armenia have recorded relatively low average test scores. The different components of the quality of education across countries are also illustrated graphically in Figure 1.8.

Figure 1.8 Average test scores in mathematics and science (1964-2003)



Data Source: Hanushek and Woessmann (2009)

Since the above analysed indicators reflect student test scores averaged only up to 2003, the latest available data provided by PISA, TIMSS and PIRLS are presented below. The results from the Programme for International Student Assessment (PISA) during 2000-2012 show an improvement in the performance of 15 year old school students in transition economies, though, not all countries have taken part in all the assessment rounds. In 2012, the CEECs average test scores in reading, science and mathematics were lower than the average EU-18 by a range of 4.8-6.0 percent. As previously emphasised, the CIS region has not been highly represented in PISA, with only Russia and Kazakhstan participating in the most recent round of assessment, (i.e. 2012). Notwithstanding the differences, several countries from the former set of transition economies have performed above the average EU-18. For instance, Estonia and Poland appear to lead the ranking list in the three fields, whereas, countries such as, the Czech Republic, Latvia and Slovenia have higher scores in mathematics and science than the average EU-18. Data from the Progress in International Reading Literacy Study (PIRLS) in reading achievements of 4th grade students, in 2011, show negligible differences between the two groups of countries. Comparable data on mathematics and science achievements of 4th and 8th grade students have been provided by Trends in International Mathematics and Science Study (TIMSS). The results from the most recent round of assessment (i.e. 2011) show a remaining gap in student scores between transition economies and EU-18, the gap being slightly wider for the former Soviet Union countries (with the exception of Russia). In addition, the achievement gap appears to be wider for the 8th grade students as compared to their younger cohorts (4th grade), indicating a relatively good quality of education at the early – elementary level. However, it is important to note that number of participants from the CEECs and EU-18 region in TIMSS 8th grade student assessment is very low, hence, making this contention more difficult to confirm. In a recent study on education quality, Lassibille (2015) has questioned the reliability of student achievements in international tests in developing countries given potential mismatches between the contents of the tests and curricula. The quality of human capital of the adult labour force, on the other hand, has started to become part of various International Adult Literacy surveys, however, their time span and country coverage are still very limited.

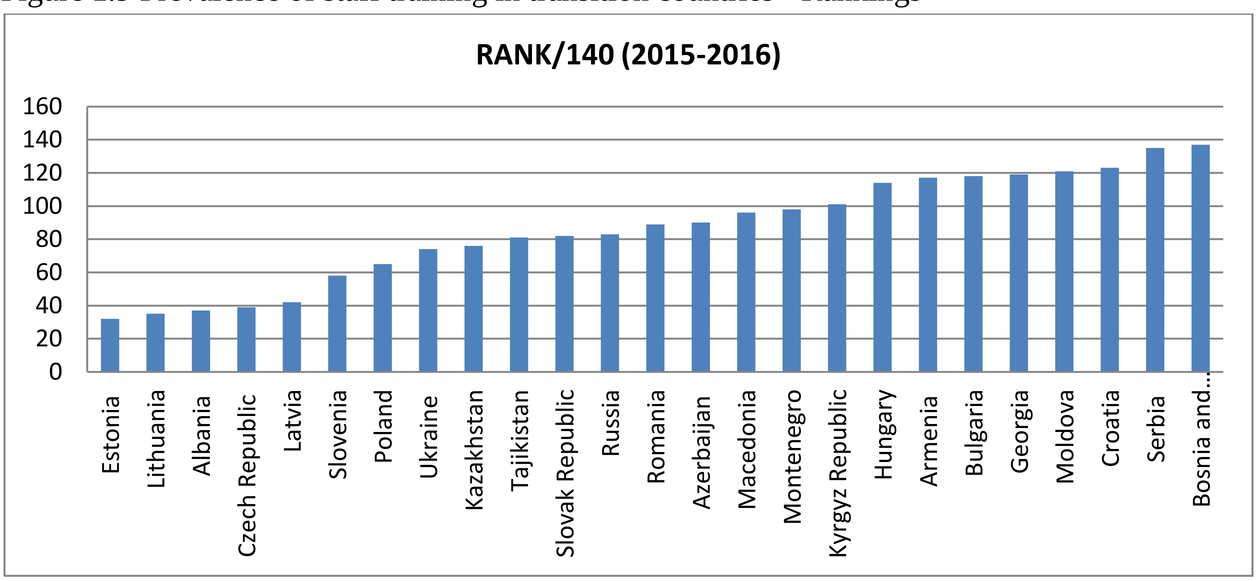
The overview of schooling data presented above shows that the process of transition was associated with decreases in the proportion of population 15 and over with no completed schooling as well as those with primary education as their highest level attained. A positive trend was witnessed, on the other hand, in the proportion of population who have attended and completed secondary education, the magnitude being significantly higher in the CEECs as compared to CIS. The largest growth rate was recorded in the sector of tertiary education, albeit, considerable variations across the region are observed. In spite of the converging tendency, a significant gap with respect to the EU-18 still exists. The growth in higher levels of education was also reflected in increases in the average years of total schooling. However, notwithstanding the rapid growth of the stock of population with tertiary education, the issue of skill mismatch appears to be prevalent in the region. The labour force's lack of suitable skills has been emphasised as an obstacle to doing business by many firms in transition countries. Furthermore, skill shortages, particularly, in the fields of science, technology, and engineering are also present in many transition economies of the Central and East Europe and Central Asia. The quality of education proxied by average student test scores in reading, mathematics and science (see Hanushek and Woessmann, PISA, TIMSS and PIRLS) appears to be relatively lower than the average EU-18, though, there are economies from the region that outrank many high performing countries. It is important to note that the gap becomes less significant for younger cohorts, i.e. early grade students, implying a better quality of schooling at the primary level, while information on the quality of schooling of the actual labour force is very restricted.

Training as an important source of human capital development in transition economies has increased significantly over time, though; it remains low compared to developed countries standards (Arias et al., 2014). The assessment of this important dimension has been hindered by the restricted availability of data, primarily at the macro level. A survey on Continuing Vocational Training (CVT) made available by Eurostat was launched in 1999, providing information on training enterprises as a percentage of all enterprises and the percentage of employees (all enterprises) participating in CVT courses. During 1999-2010, European transition economies (CEECs[12]), on average, seem to have witnessed a significant growth rate in the former component of vocational training, i.e. an increase of 67.1 percent. With a higher base rate, the percentage of employees participating in CVT courses in the region, on the other hand, appear to have grown relatively slowly (i.e. 15.5%). The increased percentage of training enterprises and participating employees during the period 1999-2010 has contributed to the gap reduction between transition economies and non-transition economies. The initial gap(s) of 52.3

[12] Note that the survey did not cover countries from the Western Balkans, with the exception of Croatia in the latest round of data (i.e. 2010).

percent and 35.2 percent respectively recorded in 1999 had narrowed to 22.5 percent and 29 percent by 2010. Furthermore, countries such as the Czech Republic, Slovakia and Slovenia appear to be on par with, or higher than, many countries from the EU-18. The Business Environment and Enterprise Performance Survey (BEEPS) conducted by the EBRD and the World Bank provides data on the provision of training programmes by firms in CEECs as well as in CIS. A review of the data on the share of employees trained in the region shows an average of roughly 34 percent of production employees participating in training in 2008 as compared to 24.5 percent in 2005. The corresponding rates for the share of non-production workers were 24.5 percent in 2008 and 59.3 percent in 2005 (World Bank, 2010). World Economic Forum's report on Global Competitiveness also presents data on the extent of staff training, which is defined as the weighted average of the extent firms invest in training and employee development (i.e. 1- not at all, 7- to a great extent). Data from the most recent report on competitiveness (2014-15) show an average value of 3.75 for transition economies as compared to the 4.67 for EU-18, the gap being wider with the CIS region. Note that countries such as Estonia, Lithuania, Albania and the Czech Republic occupy the highest rankings in the transition region (see Figure 1.9). However, it is worth noting that despite the general improvement in the incidence of training programmes in these countries, data on their quality and appropriateness are not yet available.

Figure 1.9 Prevalence of staff training in transition countries - Rankings



Data Source: World Economic Forum: Global Competitiveness Report 2015-2016

In conclusion, it is important to note that, in spite of the ongoing reforms, the differing features of the educational systems in transition economies compared to the EU-18 make cross country assessment much more complicated. Variations in the length of compulsory schooling (starting and leaving ages), national curricula, the provision of vocational versus general/academic programmes, fields of study, training incidence, skill proficiency levels, relative size of public and private sectors, expenditure on education, quality of teachers, family background and parental education and aspirations and other national specific characteristics contribute to differences in the overall educational output. All these varying features highlight the inherent difficulties in assessing the effectiveness of the education systems across countries. To the possible extent, we will try to account for these in our empirical analysis by controlling for the quality of education.

The aim of this section was to provide a discussion of the human capital development in the transition economies of Europe and Central Asia. The key characteristics of their educational and training systems before and during the transformation process have been assessed. A particular focus has been placed on the evolution of educational attainment, quality of education and training incidence since the early 1990s. The remaining gaps with respect to the EU-18, skill and qualification mismatches and other transition-related subjects were also analyzed. The main research questions on the impact of various dimensions of human capital on international competitiveness, with special reference to transition economies, will be established and discussed in the following section.

1.4 Research questions and structure of the thesis

The discussion presented in section 1.2 showed that the increased openness and integration which began with the process of transition has been associated with an improved international competiveness in the majority of the European transition countries. Since sustaining and enhancing international competitiveness in a global knowledge economy is very challenging, the former socialist countries of Central and Eastern Europe and Central Asia started to reform their educational systems in order to be able to meet the upgraded labour market’s needs. The shift in the demand towards more highly educated employees has been accompanied by an expansion of the higher education sector in the majority of transition economies (see section 1.3). Given the positive trends in international competitiveness and human capital since early 1990s, this thesis aims to analyse and assess the relationship between the two. In addition to the educational attainment component, the stock of human capital will be proxied by measures of the quality of education and training incidence. With the purpose of investigating the impact of human capital endowments on international competitiveness, with special reference to transition economies, three key research questions will be addressed in this thesis:

1. Do human capital endowments have an impact on the international competitiveness of EU countries, with special reference to transition economies?
2. Do human capital endowments have an impact on the relative importance of technology-intensive exports of EU countries, with special reference to transition economies?
3. Do a firm's human capital resources have an impact on its export intensity and export market share in transition economies?

In attempting to answer these research questions, this investigation makes use of macro and micro level data and adopts various estimations approaches. The remaining parts of the thesis are organised as follows. Chapter 2 elaborates the complexity of defining and measuring international competitiveness, followed by a comprehensive review of the related theoretical and empirical literature. Chapter 3 presents a discussion of the concept of human capital and its measurement, the mechanisms through which human capital influences productivity, growth and international competitiveness, and a review of contextualised theoretical and empirical studies. Chapter 4 develops and estimates empirical models for assessing the impact of human capital endowments on the international competitiveness of European countries, with special reference to transition economies. The empirical analyses conducted in this chapter make use of country and industry level longitudinal data for the period 1995-2010. In this chapter, international competiveness is measured by export market share and the relative export advantage index, whereas the human capital dimension is proxied by educational attainment indicators, measures of the quality of education and the provision of vocational training. A different regression analysis is performed in Chapter 5 which examines the impact of human capital endowments on international competitiveness with special focus on technology intensive exports. The latter component is proxied by the share of medium and high tech exports, an export specialization index and an export sophistication index.

The hypothesized positive impact of human capital endowments on international competitiveness is also investigated through the analysis of firm level data for 30 transition European and Central Asian countries. This investigation is presented in Chapter 6 and it focuses on the impact of the share of employees with higher education, on-the-job training programmes, education and years of experience of the top manager on firms' export intensity and export market share. Finally, Chapter 7 provides a synthesis of the main findings of this research programme, the contribution of these findings to knowledge and their policy implications, the limitations of the research programme and recommendations for future work.

Chapter 2

ASSESSING THE MULTIDIMENSIONAL CONCEPT OF INTERNATIONAL COMPETITIVENESS

Contents

2.1 Introduction

As elaborated in the introductory chapter of the thesis, increased integration of transition countries into the global economy has been accompanied by an overall improvement in their relative positions in international markets, highlighting the importance of assessing the determinants of their international competitiveness. Hence, the aim of this chapter is to provide a thorough discussion of the complexity and ambiguity of defining and measuring international competitiveness. To provide a deeper understanding of the notion, a broad range of definitions at different levels of aggregation accompanied by a variety of proxy measures are reviewed in the light of the existing theoretical and empirical literature. The remainder of this chapter is structured as follows: section 2.2 presents an overview of the key definitions of international competitiveness with particular focus on the dilemmas and criticisms associated with this concept. In contrast to the micro level perspective, the concept appears to be particularly vague when assessed at more aggregated levels of investigation. Section 2.3 provides a critical assessment of the key measures developed and adopted in the international competitiveness literature and their main limitations. It is pertinent to note that several measurement approaches have been proposed with no agreement on the superiority of any given one. The following section, 2.4, provides a comprehensive review of empirical studies dealing with international competitiveness from two distinct perspectives. The first strand of this literature is particularly concerned with the conceptualization and measurement of international competiveness, providing thus, ranking analyses and comparative assessments of the relative competitive positions of entities. The second set of studies, on the other hand, is mainly focused on the potential determinants of the competitiveness, with less attention being paid to the measurement issue per se. The key purpose of this review is to highlight the underlying conceptualization of competitiveness, its theoretical underpinnings, most frequently employed measures, and to critically analyse their key strengths and weaknesses. The current debate lays the foundations for the specification of international competitiveness in the context of our own empirical investigation. The final section provides a summary of the main findings and general conclusions of the chapter.

2.2 The concept of international competitiveness

The concept of international competitiveness has been widely applied in macro and micro levels of investigation since the early 1980s. Several definitions of competitiveness have been proposed with no general agreement on any single one. According to Latruffe (2010), competitiveness can be defined as the ability to compete, the capacity of ensuring high profitability rates, or the ability to gain market share. In the literature, competitiveness has been assessed by various theoretical perspectives, the most prominent being the international trade economics and strategic management school. One of the most frequently cited definitions in the literature is the one provided by the Organization for Economic Co-operation and Development (OECD). It defines competitiveness as “the ability of companies, industries, regions, nations and supranational regions to generate, while being and remaining exposed to international competition, relatively high factor income and factor employment levels on a sustainable basis” (Hatzichronoglou, 1996, p.20).

Whilst the concept might seem simpler to define and measure at the firm level, it is more difficult at the national level, due to its arguably more complex nature. According to Scott and Lodge (1985, p.3), competitiveness is defined as: “a country’s ability to create, produce, distribute and/or service products in international trade while earning rising returns on its resources”. Whereas, D’Andrea Tyson (1992, p.1) defined a nation’s competitiveness as "the degree to which it can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously expanding the real incomes of its citizens ” According to the EU Commission (2003, p.15), competitiveness implies “high and rising standards of living of a nation with the lowest possible level of involuntary unemployment on a sustainable basis”. By emphasising that countries themselves do not directly produce goods, Storper (1997, p.20) states that: “competitiveness reflects the capability of an economy to attract and maintain firms with stable or rising shares in activity, while maintaining or increasing standards of living for those who participate in it” All these definitions appear to agree that competitiveness of a country reflects its ability to produce goods and services that meet international market requirements, while, earning increasing returns on resources and increasing standards of living for its citizens.

In spite of its popular nature and attractiveness, the concept of competitiveness at the national level has been strongly criticised and contested by some scholars. Krugman (1994) as one of the most critical voices defines the concept as "elusive" and "meaningless". He rejects the supposed equivalence between a country's and a firm's competitiveness by explaining that, while, firms that cannot afford to pay their stakeholders due to weak performance go out of the business; the same does not apply to countries, even when they experience poor economic performance. While, at the micro level, competitiveness refers to the ability of firms to exist, the concept is perceived to be much more complicated at the country level. From a micro perspective, a firm's gain might come at the expense of others, while, for nations, on the other hand, international trade is not a zero-sum game (Krugman, 1994). Furthermore, Krugman also questions the widely used proxy measures of competitiveness (i.e. trade-based performance indicators) by arguing that, in many cases, a trade deficit might be considered an indication of strength, with a trade surplus representing a weakness. For instance, Mexico in the 1980s had to run large trade surpluses in order to be able to pay the interest on its foreign debt, since foreign investors refused to lend additional funds; while, after 1990, it started to run trade deficits, when it became able to borrow abroad. However, it should be noted that, in this case, a better indicator of strength is the ability to sustain trade deficits over time. In an early study, Krugman and Hatsopoulos (1987) also criticised the export based measures, arguing that the failure of the latter to account for imports leads to no inference about the balance of trade and the potential economic strength of a country. Again, given the present floating exchange rates and the large international flows of capital, we argue that the balance of trade does not seem to represent a very reliable indicator of economic strength.

Krugman also argues that for a country that is not involved much in trade, international competitiveness does not make much sense, as it represents just another way of describing productivity. However, it should be noted that given the hypothesised positive impact of international trade on economic growth, nations have persistently increased their participations in international markets, highlighting, thus, the relevance of the concept. As discussed in Chapter 1, international integration through trade, as one of the key outcomes of the transition process, led to a significant improvement in the competitive position of countries from CEE and the former Soviet Union block in the global economy. Krugman considers the concept of competitiveness to be a largely political device used by politicians to defend or avoid hard decisions. He refers to the concept as a wrong and dangerous “obsession” which might lead to misallocation of sources, e.g. governments spending considerable amounts of money to improve the nation’s competitiveness, trade conflicts, and bad economic discussion and policymaking. For instance, during the 1950s, driven by fear of the Soviet Union, in addition to spending on science and education activities, the United States have also engaged in non-competitiveness enhancing activities, e.g. bomb shelters. Furthermore, there has frequently been biasness in government support towards firms engaged in manufacturing (generally perceived to serve more international markets) as compared to services, though the latter has been regarded as a key source of employment and value-added. Krugman also argues that for countries that are not capable of sustaining their competitive positions in global markets, the competitiveness principle might suggest a closure of their borders through protection measures, instead of risking high paid jobs and greater value sectors to be acquired by foreigners. The latter outcome of the competitiveness “obsession” refers to its influence on the quality of the economic debates and polices. That is to say, a misguided policymaking in the context of international competitiveness might distort the quality of other economic policy agendas, even when not closely related to trade Krugman, 1994). Note that the foundation of Krugman’s latter criticisms lies in certain assumptions and conclusions that may not necessarily be applicable to all countries. Besides, potential misuses by governments and politicians are not strictly tied to the competitiveness concept per se. The same applies to the quality of policy agendas argument, hence making the nature of this criticism somewhat general (i.e. potentially applicable to other economic concepts and theories).

The ambiguity and complex nature of the concept of competitiveness has also been raised by Porter (1990, 2002). He claims that, despite the widespread acceptance of its importance, the concept has not yet been well defined or fully understood. He further suggests that the aim of a nation to reach high and rising standards of living depends on the productivity with which a nation employs its human and capital resources, rather than on the unclear concept of competitiveness. High and sustainable levels of productivity require that an economy constantly upgrades itself (Porter, 1990, 2002).

With regard to a firm level definition, competitiveness appears to reflect the ability of firms to produce and sell goods profitably in an open market. According to the Report from the Select Committee of the House of Lords on Overseas Trade (1985), "a firm is competitive if it can produce products and services of superior quality and lower costs than its domestic and international competitors. Competitiveness is synonymous with a firm's long run profit performance and its ability to compensate its employees and provide superior returns to its owners" (Buckley et al. p.176). Similarly, the Department of Trade and Industry (1998) postulates that, "for a firm, competitiveness is the ability to produce the right goods and services, at the right price, at the right time. It means meeting customers' needs more efficiently and more effectively than other firms" (Henricsson et al., 2004, p. 338). The diversity of competitiveness definitions formulated in the literature highlights the multidimensional nature of the concept, thus, making it more difficult to measure and investigate. Hence, the aim of the remaining section is to provide a review of indicators being most commonly used to assess competitiveness at the macroeconomic and microeconomic levels of investigation.

2.3 International competitiveness: key measurement approaches

A review of the existing literature has revealed two approaches to measuring international competitiveness. The first approach, building off several neoclassical theories and the new trade theory, relies on trade performance indicators, whereas, the second approach proposed by the strategic management school, focuses on the structure and strategy of firms (Latruffe, 2010). According to the Heckscher-Ohlin theory, each country trades goods that are intensive in its relatively abundant factor input, while the related theory developed earlier by Ricardo suggests that each country trades goods in the production of which it has comparative advantages. The new trade theory added the possibility of increasing returns to scale and monopolistic competition to the traditional models (Krugman, 1979). The alternative measurement approach, on the other hand, originally proposed by Porter (1990) suggests that there are four country attributes (the 'diamond') that determine the main conditions for the competitive advantages of a nation. These attributes are: factor endowments, demand conditions, related and support industries, and firms' strategy, structure and rivalry. In the trade based approach competitiveness is commonly measured by the real exchange rate, comparative advantage indices, and export or import indices, while the second approach assesses competitiveness through performance indicators such as cost superiority, profitability, productivity, and efficiency (Latruffe, 2010).

The broad range of competitiveness indicators and its potential determinants is another extensively debated issue in the current academic literature. According to Porter (1990), no two research studies in the competitiveness literature have assessed and investigated the same factors, and similarly, Belkacem (2002) claims that the vast majority of studies tend to implement their own concepts and measures of competitiveness. However, in spite of the variety of definitions proposed in the literature, the above overview highlights a mutual objective, i.e. furthering the mission of a firm or a nation. While, the mission of a firm refers to its underlying ability to generate persistently high rates of returns for it owners, the mission of a nation is reaching high and rising standards of living for its citizens. Thus, in this regard, competitiveness refers to the ability of firms and nations to fulfil their mission statements (Henricsson et al., 2004).

The real exchange rate index (RER) has been proposed as a potential measure of the international competitiveness of countries by several economists (Edwards, 1989, Lipschitz and McDonald, 1991). There are two main categories of RER definitions adopted in the literature. The first category defines the real exchange rate based on purchasing power parity (r_{ppp}) as the ratio of the foreign price level to the domestic price level, measured in the same currency (Eq. 2.1). While, the second group defines the RER *(r_r)* as the ratio of the price index of tradable commodities to that of non-tradable ones (see eq. 2.2). Both definitions are extensively employed in the literature, with the latter being more commonly used to measure the level of a country's international competitiveness (Kipici and Kesriyeli, 1997).

$$r_{ppp} = e\frac{P_f}{P} \tag{2.1}$$

Where e denotes nominal exchange rate, P_f represents the foreign price level, while, P is the domestic price level.

$$r_r = \frac{P_t}{P_n} = e\ \frac{P_t^*}{P_n} \tag{2.2}$$

P_t represents the domestic price level of tradable commodities, while P_n and P_t^* denote the price level of non-tradable commodities and the international price level of tradable commodities, respectively.

A decrease in the real exchange rate represents an appreciation of the real exchange rate, which implies a decline in the absolute and relative profitability of tradable commodities, a reallocation of resources from the tradable to the non-tradable sector, and an increase in the domestic costs of producing tradable commodities. All these changes are reflected in a deterioration in international competitiveness (Chowdhury, 2005). Despite this, Di Bella et al. (2007) claim that, an appreciation of the RER does not always result in a loss of international competitiveness, and similarly, a depreciation of RER does not always result in increased level of competitiveness. For illustration, the authors argue that productivity gains in the tradable goods sector might be reflected in an increasing real exchange rate. Besides, even when the productivity gains are more prevalent in the non-tradable sector, the real exchange rate might appreciate if there is a fixed exchange rate system and no adequate government policy (i.e. lack of accommodative monetary policies to keep interest rates low). A common problem associated with the real exchange rates is the difficulty of measuring directly the price of tradable and non-tradable commodities. In spite of the acknowledged limitations, several proxies have been adopted in the literature to measure the price of tradables and non-tradables, e.g., CPI, Unit Labour Cost (ULC), Producer Price Index (PPI) and Wholesale Price Index (WPI).

Besides the difficulty of finding a good price proxy, other limitations restrain the use of the real exchange rate. According to Frohberg and Hartmann (1997), it is not easy to interpret different movements in the real exchange rate between countries, because it is not clear if these movements are a consequence or a cause of the actual change in international competitiveness. Moreover, they suggest that real exchange rates in the short and medium term are mainly affected by capital movements and their impact on the nominal exchange rate, rather than by changes in the competitiveness of the economy. Hence, the relationship between the real exchange rate and international competitiveness cannot be established, if information on the factors that impact the movement of the former is missing (Frohberg and Hartmann, 1997).

Moreover, import and export restrictions, changes in world commodity prices and data limitations may distort RER movements (Harberger, 2004).

A country's assessment of competitiveness has also relied on a wide range of trade performance indicators. The revealed comparative advantage (RCA) index developed by Balassa (1965) is among the most commonly used measures in the competitiveness literature. This index reveals the comparative advantage of a country in an industry or in a specific commodity. It is defined as the ratio of a country's exports of a commodity or industry relative to its total exports and to the corresponding exports of the world or a specific set of countries.

$$RCA_{ij} = (X_{ij} / X_{it}) / (X_{nj} / X_{nt}) \qquad (2.3)$$

Where *X* represents exports, *i* is a country index, *j* is a commodity (industry) index, *t* is a set of commodities (industries) or total exports and *n* is a set of countries. If the value of the index (i.e. RCA) is greater than 1, a given country is considered to exert a revealed comparative advantage in the export of a specific commodity or industry. Conversely, if the value of the index is lower than 1, there is a lack of a comparative advantage in the export of the corresponding commodity or industry. The RCA index can be expressed as: (i) a cardinal measure, i.e. revealing the degree of comparative advantage of a country in a specific commodity; (ii) an ordinal measure, i.e. ranking of countries by their degree of competitiveness in a specific commodity and, lastly, (iii) a dichotomous measure, i.e. differentiating between countries that have comparative advantage in a specific commodity and those that have not (Ballance et al., 1987). In addition, some studies have also used the RCA in econometric analysis, e.g. Galtonian[13] regression analysis. However, despite its frequent use, this measure seems to be problematic when it comes to ordinal and cardinal comparisons of its values (Yeats, 1985, Ballance et al., 1987). To test the consistency between cardinal, ordinal and dichotomous measures, Ballance et al. (1987) proposed a comparison approach of the correlation coefficients for pairs of alternative measures of revealed

[13]This regression analysis analyzes the structural changes of trade performance between two different time periods (Sanidas and Shin, 2010).

comparative advantage. The results of these consistency tests[14] in the majority of cases favoured the dichotomous use of indices relative to the former versions. Furthermore, the index has also been been criticised for its incomparability across time and space, which is primarily due to the asymmetry problem. According to Dalum et al. (1998) the RCA index is asymmetric through the origin, i.e. not comparable on both sides of unity. It ranges from zero to one, if a country does not have comparative advantages in a specific commodity or industry, while it ranges from one to infinity, if a country enjoys a distinct comparative advantage in the corresponding commodity or industry. However, it is important to note that, Dalum et al. (1998) have come up with a solution to this problem, i.e. by adjusting the RCA to the 'Revealed Symmetric Comparative Advantage' (RSCA) index.

$$RSCA_{ij} = (RCA_{ij} - 1)/(RCA_{ij} + 1) \quad (2.4)$$

An alternative solution to the asymmetry problem has been proposed by Vollrath (1991), involving a logarithmic transformation of the original RCA, though, it is worth noting that the latter could be problematic, particularly in a regression analysis, if a country does not export a given commodity or industry. Another problem associated with RCA and other similar comparative advantage indices is that the trade pattern may be distorted by government interventions, e.g. import restrictions, export subsidies and other protectionist policies. In that case, the revealed comparative advantage would be misrepresenting underlying competitiveness (Utkulu and Seymen, 2004). Pitts et al. (1995). Mlangeni and Seventer (2000) argued that an additional problem associated with these indices is that sometimes, certain countries, due to the specificity of their export structures, tend to generate very large index values, thus distorting cross-country assessments. For instance, if exports of a certain commodity form a large share of a country's total domestic exports, but a very small component of total world exports, then extremely high indicator values will be recorded.

The relative export advantage (RXA) is a modified version of Balassa's RCA index developed by Vollrath (1991) and it has been introduced to overcome the issue of double counting between

[14]These tests were conducted to compare alternative RCA indices and assess their consistency in measuring the comparative advantage of countries. For instance, for the cardinal measures a strong correlation coefficient between two alternative indices implied perfectly consistent indices and vice versa (Ballance et al. 1987).

countries and the asymmetry problem. Alternative measures derived from Balassa's original index are, the relative import advantage (RMA) index, and the relative trade advantage (RTA) which is calculated as the difference between relative export advantage (RXA) and relative import advantage (RMA) (Vollrath, 1991).

$$RMA = (M_{ij} / M_{it}) / (M_{nj} / M_{nt}) \quad (2.5)$$

Where *m* represents imports

$$RTA = RXA - RMA = (X_{ij}/ X_{it}) / (X_{nj}/ X_{nt}) - (M_{ij}/ M_{it}) / (M_{nj}/ M_{nt}) \quad (2.6)$$

In contrast to Balassa's RCA index, *t* denotes all commodities other than *j*; *n* denotes all countries other than *i*, thus avoiding double counting. Moreover, as previously emphasised, Vollrath used logarithms to overcome the potential asymmetry problem associated with these indices. Positive values of both, RTA and RXA are an indication of comparative advantage.

Another modified version of Balassa's standard comparative advantage index *(LFI)* is proposed by Lafay (1992). See the equation presented below.

$$LFI_j^i = 1000 * \left(\frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^{N}(x_j^i - m_j^i)}{\sum_{j=1}^{N}(x_j^i + m_j^i)} \right) \frac{x_j^i + m_j^i}{\sum_{j=1}^{N}(x_j^i + m_j^i)} \quad (2.7)$$

x_j^i and m_j^i represent exports and imports of product *j* of country *i* with respect to the rest of the world. *N* represents the number of products or industries. The existence of a comparative advantage is revealed by positive values of the index, whilst, negative values indicate a lack of comparative advantage in a given product or industry (Baumann and Di Mauro, 2007). The main difference between the standard index provided by Balassa and Lafay's index is that the latter also accounts for imports. It is based on net trade flows and is therefore claimed to overcome some of Balassa's index shortcomings in measuring international competitiveness.

These and many other attempts have taken place to measure the comparative advantage of a country in a specific commodity or industry. As Vollrath (1991) asserts, there can be as many indices as there are combinations and transformations of trade indicators (Sanidas and Yousun, 2010). Furthermore, all these indices seem to have their own advantages and disadvantages, thus it is essential to take them into account when conducting empirical analyses. However, despite the criticism, particularly in terms of the specification, the decision on selecting measures of comparative advantage should not be based only on statistical criteria. It is not possible to fully specify empirically suitable measures, hence, it is strongly recommended to base the specification of these measures on established theoretical grounds (Ballance et al., 1987).

Another trade indicator frequently used to assess international competitiveness is the export market share (EMS). The actual indicators may be presented in terms of volumes or values. The export market share in volume, is defined as the ratio of a country's export volumes to the weighted average of the import volumes of major trade partners, while, the market share in value terms is defined as the ratio of a country's exports value to an unweighted measure of the value of world exports. Moreover, export market share indicators tend to differ with respect to the measure of world exports used. These indicators can be computed as the share of a country's exports in the total market for exports, or as an indicator that weights the export markets according to their importance in the exports of a given country (ECB, 2005). An alternative share measure which is more likely to capture the relative competitive position of countries is proposed by European Commission and it has been used to construct export market share indicators by Eurostat and OECD. It is defined as the share of a country's exports over the total exports of the world or a particular region. As constructed, this specification is expected to reflect the degree of international competitiveness of a country in relation to a region or the world. That is to say, sustaining and gaining shares in international markets is an indication of a superior competitiveness position relative to other countries. Alternative, more disaggregated indicators used in assessing international competitiveness are the export market share at the industry and firm levels. A potential limitation of the latter indicator per se is that it does not reveal the truth behind the maintained market share. It could be a result of price cutting, which could as a result affect the performance of the firm negatively in the longer term (Buckley, 1988). Another related trade indicator is the net export index (NX/NEI), which is defined as a country's exports less its imports (i.e. net exports) divided by the total value of trade (sum of exports and imports) (Balassa and Noland, 1989, Banterle and Carraresi, 2007).

$$NX_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} \tag{2.8}$$

Where X denotes exports; M represents imports; while j and i denotes industry/product and country, respectively. The index lies between -1 and 1. If a country imports only, the value of the index will be -1, while, if it exports only, the index will equal to 1. The index will be equal to 0 in the case of equality of imports and exports. The assessment of the relationship between exports and imports appears to be the main advantage of this proxy measure, though the adoption of protective barrier on imports might deteriorate the net export indicators, leading sometimes to very large values of the latter (i.e. 1) (Balassa and Noland, 1989).

The competitive position of countries in international markets has also been assessed through the use of a newly introduced Manufactured Export Competitiveness Index (MECI). MECI focuses on the ability of countries, with special reference to developing ones, to produce manufactures according to world market standards (Wignaraja and Taylor, 2003). It was proposed as a simpler alternative measure to the existing measures of competitiveness performance provided by the World Economic Forum (WEF) and International Institute for Management Development (IMD). The actual index is constructed through a weighted sum of three components of manufactured export performance: *manufactured exports per capita, manufactured export growth rate per annum and technology-intensive exports as a percentage of total merchandise exports*. The construction of MECI follows a similar approach to the Human Development Index (HDI) provided by United Nations Development Programme (see equation 2.9 and 2.10 below). The sample minimum and maximum have been fixed across the main components (sub-indices), a logarithmic transformation has been taken to account for the high values of the manufactured export per capita measure, whereas equal weights of 0.3 have been assigned to the first two components of the index (i.e. manufactured exports per capita and manufactured export growth). Given its potential higher relevance to competitiveness, a higher weight (i.e. 0.4) has been assigned to the third component of the index, i.e. the technology-intensive exports.

$$\text{Sub - index} = \frac{\text{Actual Value - Minimum Value}}{\text{Maximum Value - Minimum Value}} \tag{2.9}$$

Where the *Actual Value* represents the value of a specific country, *Minimum* and *maximum Values* denote the sample minimum and maximum, respectively.

$$\text{MECI} = [\text{Sub-index}_1\text{*weight}] + [\text{Sub-index}_2\text{*weight}] + [\text{Sub-index}_3\text{*weight}] \quad (2.10)$$

MECI covers the current position of a country in export markets, which is measured by the manufactured export value per capita; the long-term export growth that led to this position, measured by the average manufactured export growth per annum; and the extent to which a country's exports are technology-intensive, measured by technology-intensive manufactures exports as a percentage of total merchandise exports. Accelerated manufactured export growth, in combination with technological upgrading and diversification are regarded as the key features of a competitive economy. The index takes values between 0 and 1 with higher values indicating greater levels of competitiveness at the macro level (Wignaraja and Taylor, 2003). It important to note that the aim of this index was to provide a framework of assessment in the context of developing economies, given the increasing internationalisation and the lack of comprehensive coverage of these countries in previous analyses.

Alternative measures of competitiveness primarily associated with performance indicators such as cost, profitability and productivity have been proposed by the strategic management school (Latruffe, 2010). The domestic resource cost (DRC) ratio compares the opportunity costs of domestic production, i.e. the cost of using domestic resources (land, labour and capital) non-traded inputs to the value added it generates, i.e. value of output minus tradable input costs per unit of output (Tsakok, 1990, Gorton et al., 2001). A DRC ratio less than 1, but greater than 0 indicates an efficient and internationally competitive production; while a DRC greater than 1 shows that the production is not internationally competitive. A DRC ratio lower than 0 (i.e. negative) indicates an unprofitable, loss-making activity. When used to compare countries, a lower positive DRC indicates a more competitive country. However, it is pertinent to note that this measure is sensitive to the choice of domestic prices for non-tradable inputs and changes in international prices (Gorton et al., 2001).

The DRC for the production of output *i* can therefore be defined as:

$$DRC_i = \frac{\sum_{j=k+1}^{n} a_{ij} P_j^D}{P_i^B - \sum_{j=1}^{k} a_{ij} P_j^B} \tag{2.11}$$

Where a_{ij}, $j = 1$ *to* k represents the quantity of traded input *j*, a_{ij}, $j = k+1$ *to* n denotes the quantity of non-traded input, used to produce one unit of output *i*, $P^D{}_j$ is the domestic (shadow) price of input *j*, $P^B{}_i$ is the border/reference price[15] of output *i*, while $P^B{}_j$ represents the border/reference price of traded input *j*. This indicator has been frequently used in the agricultural competitiveness literature for CEECs as well as at the farm level (Latruffe, 2010). Note that there are additional cost-related measures that are used in the literature to assess competitiveness at different levels of investigation, e.g. social cost-benefit (SCB) ratio, unit labour cost and costs of production.

A more composite measure of competitiveness, capturing not only the cost dimension but also the revenue is profitability. Profitability is frequently used at the firm and product level, but rarely at the country or industry level due to measurement complexities. There are two distinguishable approaches to measuring profitability, the accounting approach and the economic approach. While, the former reflects differences between revenues and costs, the latter tends to also evaluate the opportunity costs of the engaged resources. Considering that opportunity costs are not easily quantifiable, the accounting approach is more frequently used in the research work and it is frequently regarded to be a key measure of the competitive success (Schornberg and Fischer, 2007). Commonly used measures in the profitability literature are: return on assets, return on sales and value added. However, it worth noting that a few complications tend to arise when firms of different sizes are compared and assessed. For instance, some firms may decide to sacrifice short-run profits for long-run ones, which, in the short term would make them look uncompetitive, even though they are improving their competitive advantages in existing markets (Buckley et al., 1988). Another limitation stems from the complexity of measuring profitability, e.g. the value added measure contains labour costs, which tend to differ considerably across countries, thus making the actual measure imprecise (Schornberg and Fischer, 2007). However,

[15] The reference (border) price is: “the world price at fob (free on board) for exports, or at cif (cost, insurance and freight) for imports, converted into domestic currency at the official exchange rate” (Ellis, 1992, p. 75).

in spite of the highlighted limitations, profitability continues to be regarded an important component of competitiveness.

Of the wide range of competitiveness indicators, according to Porter (1990) productivity represents the only meaningful concept of competitiveness at the national level, since the standard of living of a country depends primarily on the productivity of its economy. The latter is measured by the value of goods and services produced per unit of the country's labour and capital. Countries with high levels of productivity, in turn, are able to support high wages, a strong currency and high returns to capital and, thus, assure a higher standard of living for their citizens (Porter, 2002). Similarly, Krugman (1994, p.11) claims that competitiveness is just another way of saying productivity. He also argues that, "Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker" (Krugman, 1994, p.11). A firm, an industry, or a country with high levels of productivity tends to be more competitive than its counterparts (McKee and Sessions-Robinson, 1989). However, it is pertinent to note that, despite the extensive promotion of productivity, it has been rarely utilised or associated with the concept of competitiveness in empirical studies (Latruffe, 2010). Productivity is commonly measured by: labour productivity, capital productivity and total factor productivity proxies. The former measure shows how productively labour is used to generate a unit of output and it is commonly represented by two main categories: a gross output, effectively measuring ULC and a value-added proxy (OECD, 2001a). According to Ark (1996), at a country level the value added approach is more valid, while, at an industry level, gross output is more appropriate. At more aggregated levels, the value added approach avoids double counting of intermediate inputs and is easily compared to the domestic product published in national accounts, thus allowing an integration of both primary and secondary source data. The gross output treats equally all engaged inputs, i.e. intermediate inputs, capital and labour; hence, it is to be preferred at the industry level, where the purchases of intermediate inputs from other industries are more dominant than at the country level.

Labour productivity is defined as follows:

$$\frac{Quantity\ index\ of\ gross\ output\ or\ Quantity\ index\ of\ value\ added}{Quantity\ index\ of\ labour\ input} \quad (2.12)$$

Labour inputs are commonly approximated by: *hours worked, number of full-time equivalent employed persons and numbers employed. Hours worked* tends to be the most preferred proxy of the labour input, but also the most difficult in terms of data availability and comparability. Countries may differ in their practices of computing these particular measures, and as a consequence their comparison will be inherently more difficult. It is important to note that, labour productivity does not refer only to the skills of employees or the intensity of their effort, but, it also depends on a wide range of other inputs, e.g. changes in capital, intermediate inputs, technical, organizational and efficiency changes, and economies of scale. Hence, it is considered as a partial productivity measure (OECD, 2001a). The measure of capital productivity is computed following the same approach as labour productivity, and it depict how productively capital is used to generate gross-output or value-added. Commonly used measures of capital input are capital services and gross/net stocks of capital.

$$\frac{Quantity\ index\ of\ gross\ output\ or\ Quantity\ index\ of\ value\ added}{Quantity\ index\ of\ capital\ input} \quad (2.13)$$

A more comprehensive productivity measure is the total factor productivity, also called the multifactor productivity. It describes how productively a combination of inputs (labour, capital, energy, services) is used to generate gross output. However, an inherent drawback of this particular measure relates to the difficulty of computing it since it requires a large amount of data that are generally not readily available (OECD, 2001a).

$$\frac{Quantity\ index\ of\ gross\ output}{Quantity\ index\ of\ combined\ inputs\ (KLEMS)} \quad (2.14)$$

As already postulated, no one indicator is sufficient to assess the broad concept of competitiveness (Henricsson et al., 2004, Latruffe, 2010), hence a joint analysis of its various components is frequently preferred. Supporting this approach, Fischer and Schornberg (2007) constructed a composite measure, called the Industrial Competitiveness Index (ICI) based on profitability, productivity, and output growth. Profitability was defined as the share of gross operating surplus in turnover, whereas productivity and output growth are measured as the value added per employee and the annual change in the value of production, respectively. They aggregated the three different components of competitiveness into one index by using the same methodology used by United Nations to construct the Human Development Index. The above outlined components were initially transformed into individual indices by using a standardization procedure that transforms absolute measure values into a scale from 0 to 100. The minimum value recorded across countries (i) and industries (j) in a period of time (t) has a zero score for a particular measure (k), while the maximum value will have a score of 100.

$$\mathrm{I}_{\mathrm{k}}^{\mathrm{tij}} = \left(\frac{\mathrm{M}_{\mathrm{k}}^{\mathrm{tij}} - \mathrm{M}_{\mathrm{k}}^{\mathrm{min}}}{\mathrm{M}_{\mathrm{k}}^{\mathrm{max}} - \mathrm{M}_{\mathrm{k}}^{\mathrm{min}}} \right) * 100 \tag{2.15}$$

Where I_k^{tij} represents the individual index values, $\mathrm{M}_{\mathrm{k}}^{\mathrm{max}}$ denotes the maximum values, $\mathrm{M}_{\mathrm{k}}^{\mathrm{min}}$ iss the minimum values, while, *i*–countries; *j*–industries; *t*–years; *k*–measures. The composite index (ICI) is constructed by combining simple means of individual indices. This assures that all indices have equal weights, thus reflecting the multidimensional definition of competitiveness (Fischer and Schornberg, 2007). Similarly, Wijnands et al. (2008) assessed competitiveness through the use of five individual indicators, i.e. growth in the real value added of a specific industry in the total food industry, growth of Balassa index (RCA), growth of the export share on the world market, growth of the real labour productivity and growth of real value added. The theory of international economics seems to have laid the foundation for this framework, though, no explicit rationale has been provided for the choice of these sub-indices. The authors, however, make reference to O'Mahoney and Van Ark (2003), and several EU studies, regarding the set of indicators adopted. All these (sub) indicators are standardized so they could have the same mean and the same variance. Standardized indicators can be presented as one single index and their mean can be used to assess the overall competitiveness of a nation. The authors used equal weights for each indicator. Note that a key limitation of this index is the strong dependency on the sample size, i.e. the number of countries and levels of indicators. If any of these features is likely to change, the position of a country will consequently change.

In the same vein, to assess the overall competitiveness of a country, the World Economic Forum (WEF) and the International Institute of Management Development (IMD) have produced composite indices based on a large set of independent measures. The World Economic Forum has introduced a Global Competitiveness Index (GCI), to assess the microeconomic and macroeconomic foundations of a country's competitiveness. The GCI comprises of a weighted average of several different components, each measuring a different aspect of competitiveness. These components are grouped into 12 pillars of competitiveness: *Institutions, Infrastructure, Macroeconomic environment, Health and primary education, Higher education and training, Goods market efficiency, Labour market efficiency, Financial market development, Technological readiness, Market size, Business sophistication, and Innovation.* The GCI is computed based on aggregations of scores from the indicator level to the overall GCI score. Individual variables are aggregated within a category through an arithmetic mean (WEF, 2012). Similarly, IMD provides the World Competitiveness Yearbook that focuses on the competitiveness of economic environment in which firms operate and compete. The report categorizes 249 measures into eight input factors: *domestic economy; internationalisation; government; finance; infrastructure; management; science and technology; and people*. Data are standardized and equally weighted in order to compute indices of competitiveness environment for countries analysed (Martin, 2004). The yearbook ranks countries according to their performance in each of these measures. It identifies 47 macro and micro factors, sub-divided by 8 input factors, which are considered as the most important for a competitive environment. Although the report provides a comprehensive representation of various measures, the quantity of variables and the lack of relative weights for the more important ones tends to reduce its analytical value (Martin, 2004).

Having provided an overview of a wide range of concepts and measures, this section highlights the complexity of fully capturing the notion of international competitiveness. In spite of the many indicators developed and/or adopted in the literature, their intended use is not yet clearly determined. Namely, there are studies that have used indicators such as productivity and profitability as measures or components of competiveness, with others treat them as potential determinants. However, in spite of this inconsistency, it is important to note that the international dimension of competitiveness puts emphasis on competition with other countries, whilst many of the outlined indicators (e.g. productivity, profitability and related measures) do not seem to be tied strictly to this notion (i.e. its international element). While, the actual proxies might be regarded as important indicators of a country's well being and economic success, they do not reflect its relative competitive position in the global economy.

2.4 Empirical evidence on international competitiveness: micro and macro perspectives

The complexity of defining and measuring the ambiguous and multifaceted concept of international competitiveness at different levels of aggregation has been reflected in the empirical research carried out in this field. Given the variety of theoretical and measurement approaches used and country and time-specific factors, differing results have been presented in studies. Taking these into consideration, two broad categories of empirical studies can be identified. The first category is concentrated on the assessment of international competitiveness per se with particular focus on ranking analysis. The second category, on the other hand, is focused on the investigation of the determinants of international competitiveness through the use of survey analysis, regression analysis and/or simple correlation analysis. The aim of this section is to provide a comprehensive review of the research work from both strands of literature. Studies dealing with the assessment of international competitiveness for the purpose of ranking and comparing the relative competitive positions of firms, industries or countries will be initially presented, followed by a overview of the empirical literature on the main driving factors of competitiveness (see Table 2.1). Distinguishing between two broad strands of this literature, the function of Table 2.1 is to summarize the key features of each empirical research reviewed in this section. Details on the authors of the study, followed by the research time span, methodology adopted, level of aggregation, sample size, measures of international competitiveness and their potential determinants (when available) are presented in this overview table. Furthermore, important notes regarding the potential impact of the choice of competitiveness measures on the final results of these studies have also been added.

This section will start with a review of studies employing mainly trade based indicators, to be followed by a consideration of studies following the strand of research adopting alternative proxies of international competitiveness (e.g. cost and composite measures). Banterle and

Carraresi (2007) used Balassa's revealed comparative advantage index, Vollrath's indices, net export index and the Grubel-Lloyd index[16] to assess the competitiveness of the EU countries in the prepared swine meat sector for the period 1990-2003. With few exceptions, all these indices seem to reveal a similar competitive performance for countries under analysis. In a later study, the same authors examined the international competitiveness of food and agricultural sectors of 15 European countries through the use of several trade based indicators (i.e. RCA, RXA, RMA, EMS, NEI) for the period 1991 – 2006. In addition, they used cluster analysis to classify countries into categories based on their competitiveness performance. Again, similar results were obtained, highlighting the validity and consistency of the employed measurement approaches (Carraresi and Banterle, 2008). Another similar research study assessing the international competitiveness of nations is conducted by Qineti et al. (2009). To analyse the dynamics of the agro-food trade of the Slovak Republic and the EU-27 with Russia and Ukraine, the authors employed a trade dataset made available from the EUROSTAT, for the period 1999 – 2006. Initially, Balassa's index was used to examine the export comparative advantage of these countries. Second, a regression analysis was carried out to check the stability of the index over time. The results indicated comparative advantage only for some commodities while differences across markets were identified. The evidence extracted from the regression analysis revealed declining comparative advantage for both the Slovak Republic and the EU 27, though a few exceptions were marked. An assessment of the competitive position of the agricultural sector in Czech Republic and Bulgaria was carried out by Gorton et al. (2000). The analysis adopted the revealed comparative advantage index (RCA) and the domestic resource cost (DRC) to proxy the competitiveness of these countries relative to EU and other international markets. The overall results of the RCA analysis revealed an uncompetitive position in the agricultural production in both countries, whereas when the domestic resource costs was used as a proxy measure, the cereal producers appeared to be competitive at international market prices as well as at the EU prices. This inconsistency of the results seems to be due to trade restrictions. As the authors explain, limited preferential access to the EU agricultural markets has been given to the selected countries, thus resulting in a low RCA.

[16]The Grubel-Lloyd index reveals the structure of an industry trade flows. When the index equals to 0, it indicates inter industry trade flows, while, when it equals to 1, it shows pure intra industry trade flows (Grubel and Lloyd, 1975).

Havrila and Gunawardana (2003), on the other hand, investigated the competitiveness of Australian's textile and clothing sector based on Balassa's and Vollrath's indices using Standard International Trade Classification (SITC) two and three digit level trade data. According to the findings obtained in the actual analysis, Australia appears to exert a comparative disadvantage in textiles and clothing, in all commodities at the aggregate level, though some exceptions were identified. Following the same approach, Fertö and Hubbard (2003) examined the competitiveness of Hungary in agriculture and food processing in relation to the EU, using both, Balassa's and Vollrath's indices of revealed comparative advantage, for the period 1992 - 1998. The empirical findings of the latter investigation reveal a comparative advantage of Hungary in a broad range of agro-food commodities, and furthermore show a stable trend during the course of the transition. Note that the results of the above outlined studies seem to further reinforce the consistency of the comparative advantage based indices. The competitive position of Turkey in the tomato, olive oil, and fruit juice industries in relation to the EU market was investigated by Serin and Civan (2008). The research was carried out for the period 1995-2005 and made use of the revealed comparative advantage (RCA) and the comparative export performance (CEP) indices. It is pertinent to note that the both sets of indicators produced similar evidence in terms of the comparative advantages/disadvantages of Turkey in specific industries. Drescher and Maurer (1999) conducted a similar analysis to determine the competitive position of the German dairy products relative to the corresponding products of other EU countries during the period 1983-1993. In addition to the traditional proxy measures of international competitiveness (i.e. export shares and Revealed Comparative Advantage), the analysis has also adopted a Revealed Comparative Advantage Export Indicator (XRCA) and a Revealed Comparative Advantage Net Export Indicator (NXRCA). The final results obtained from the analysis do not seem to draw clear conclusions about the competitiveness of Germany in these particular products. That is to say, while the XRCA showed a competitive disadvantage in certain products, but these findings were not supported by the NXRCA based analysis. Note that when the period under analysis was divided into two sub-periods, both indicators seem to tell a consistent story (i.e. a revealed competitive disadvantage). Another study focusing its research on trade indicators to evaluate international competiveness is provided by Bojnec and Fertö (2009). The competiveness of the agro-food industry in eight Central European and Balkan countries relative to the EU-15, for the period 1995 to 2007 was assessed using Balassa's and Vollrath's comparative advantage indices.

The ultimate findings of this investigation revealed substantial differences across commodity groups as well as across countries. Superior export specialization in more competitive and niche commodities was suggested by the revealed comparative export advantages (RXA) index, whereas, a relative trade disadvantage in all commodity groups was indicated by the RTA index. In the same vein, the RMA index revealed an import specialization disadvantage in the majority of commodities and countries. The mixed results are attributed to some extent to differences in factor endowments, agricultural structures, barriers to trade, and other potential influencing factors.

The review of studies outlined above shows how the assessment of international competitiveness is commonly carried out through the use of trade-based indicators. However, studies adopting other indicators, mainly of multidimensional nature, are also present in the literature. Fischer and Schornberg (2007) in their research study, constructed a composite indicator to assess the international competitiveness of food and drink manufacturing sector in 13 EU countries for the period 1995-2002. The 'industrial competitiveness index' covering profitability, productivity and output growth enabled competitiveness comparisons across industries and countries over time. Overall, the empirical results show a slight competitiveness enhancement compared to the EU average of the period 1995–1998. Following a similar approach, the competitiveness of the food and beverage manufacturing sector in 18 European countries for the period 2002 – 2007 was examined by Notta and Vlachvei (2011). According to this study, the beverage manufacturing sector appears to be the most competitive sector in Europe. In the same vein, Wijnands et al. (2008) assessed the competitiveness of the EU food industry in relation to Australia, Brazil, Canada, and the United States for the period 1996-2004. The authors constructed a composite index based on five individual indicators, i.e. growth in the real value added of a specific industry in the total food industry, growth of Balassa's index (RCA), growth of the export share on the world market, growth of the real labour productivity and growth of real value added. The findings of this research revealed a weak competitive position of the European food industry vis-à-vis the United States and Canada, and a comparable degree of competitiveness with Australia and Brazil.

A review of empirical studies adopting the domestic resource cost (DRC) methodology to assess the international competitiveness of agricultural production of Central and East European Countries (CEECs) was provided by Gorton and Davidova (2001). Based on their assessment, the crop production of this group of countries is revealed to be generally more competitive than livestock farming, some variations being identified across countries. However, the authors warn that these results should be treated with particular caution given the acknowledged limitations of DRC ratios (see the discussion presented in section 2.2). Similarly, Bojnec (2003) evaluated the international competitiveness of livestock production in Central and East European countries (CEECs) based on an overview of three concepts of competitiveness: Porter's diamond of competitive advantage, measures based on accountancy data using the Policy Analysis Matrix (PAM) approach[17], and trade-based competitiveness measures. An overall decline in the size of the livestock production in the former socialist countries of CEE was recorded during the course of transition. Whilst international competitiveness in this sector seemed to have improved over time, the results of this investigation revealed mixed evidence, with few sub-sectors being more competitive than others. Kovacic (2008), on the other hand, examined the competitive position of CEECs in relation to other EU countries by using the WEF of IMD competitiveness indices. Assessed from the Growth Competitiveness Index perspective, Slovenia was ranked on top of the group, while the Czech Republic appeared to be the best performing country in the field of technology. Estonia seemed to have been ranked very high when assessed in the context of marketing and technology-driven industries, whilst the lowest gap with respect to EU, in the white-collar high-skilled occupations, was recorded by Hungary. Additional specific rankings based on the above outlined indices were provided in this study.

The main purpose of this review was to show how research studies have been primarily concerned with the measurement of international competitiveness, through the development of new measures or adoption of existing ones. Considering the multidimensional nature of the concept, there was a tendency to use as many indicators as possible, so, that more supposedly reliable results could be provided. Regarding the theoretical background, most of the reviewed studies were grounded in the traditional neoclassical theories. When the comparative advantage

[17] It compares revenues, costs of traded and non-traded intermediary inputs, primary domestic resources, and profitability at private (domestic) and economic (social) prices (Bojnec, 2003).

principle was used to explain and assess international competitiveness, Heckscher – Ohlin theory was predominantly followed, with only few studies adopting Porter's diamond approach. The international competitiveness research work presented in this section was mostly conducted at a country or sector level, using either trade based or composite indices. The main purpose of those studies was to compare the performance and trends of sectors and/or countries in the global market. In spite of their limitations and valid criticisms, the revealed comparative advantage indices developed by Balassa and Vollrath were among the most widely used in the competitiveness literature. Note that these indicators have been criticized for being based on assumptions that do not always apply to industries or countries. The ignored role of domestic demand, domestic market size, and important developments within the market has also been highlighted as a potential drawback of the index (Drescher and Maurer, 1999). Furthermore, an economy's trade patterns are likely to be distorted by government interventions and policies, thus, leading to potentially false comparative advantageous positions (Fertö and Hubbard, 2003). However, given the complexity of fully defining and measuring comparative advantage, Balassa argued that relying on the trade performance of an economy is a sensible indication ofits comparative advantage as it reflects the relative costs and differences in non-price factors. By taking this into consideration, the author claims that it is not strictly necessary to account for other potential components of comparative advantage (Balassa, 1965).With respect to the composite indices recently used in the literature, the coverage of many dimensions of competitiveness appears to be their key advantage. However, core shortcomings stem from the difficulty of comparing their findings with those of other empirical studies, and the lack of a solid theoretical basis and aggregation methods (Fischer and Schornberg, 2007, Siggel, 2007). As previously discussed, the focus of this strand of literature was placed on developing or adopting international competitiveness measures with the purpose of ranking and comparing trends across sectors or countries. However, this reveals nothing about the sources and potential determinants of international competitiveness, as well as changes required to enhance the competitiveness of an entity. To account for these, the remainder of this section will present a review of the empirical studies on the potential drivers of international competitiveness conducted at different levels of aggregation. The discussion will be initiated with an overview of country level studies, followed by sector and firm level research analyses.

Fagerberg (1988) was one of the first scholars to investigate the determinants of international competitiveness at a country level. He developed a model to assess the impact of the ability to compete in technology, the ability to compete in price and the ability to compete in delivery on growth in market shares for exports and imports. The model was tested on pooled cross-country and time-series data for 15 industrial countries for the period 1960-1983. The level of technological development was captured by a weighted average of an R&D index (%of GDP) and patent index (i.e. adjusted external patent applications per capita). Growth rates for technological development were also utilized in the regression analysis. The ability to compete in delivery has been represented by investment-based factors, such as gross fixed investment (as a % of GDP), whereas the growth of relative unit labour costs (RULC) was introduced to proxy the price or cost dimension of competitiveness. The evidence obtained from this study highlighted the importance of the technological competitiveness and the ability to compete on delivery as key influencing factors on differences in the growth of markets shares across countries. Alternatively, Guerrieri and Meliciani (2003) examined the determinants of international competitiveness and international specialisation in selected groups of producer services in eleven OECD countries for a period of eight years. Specialisation was measured by the share of exports in a given sector over the total exports of that country, while competitiveness was measured by the share of exports of a given country in a given sector over the total exports of the 11 OECD countries in the same sector. The former reflects comparative advantage, while the latter is perceived to capture the absolute advantage of the country. In addition to the traditional cost factors, the impact of intermediate demand and the impact of national technology advantage were also quantified and assessed in the present study. The share of labour costs in total production costs was introduced to represent the cost dimension, whereas the technological advantage was captured by the information and communication expenditure on GDP. The impact of intermediate demand, on the other hand, was proxied by computing specialisation in manufacturing weighted by the use of services by manufacturing industries. Supporting evidence was found for the positive role of the domestic demand from the manufacturing sector and Information and Communication Technology (ICT) expenditures on international specialisation and international competitiveness. The results appear to be consistent with the theoretical considerations and highlight the key importance of technology on trade patterns and competitiveness (Posner, 1961; Krugman, 1985).

Marconi and Rolli (2007) assessed the relationship between the revealed comparative advantages and competitiveness structure of the domestic manufacturing sector of sixteen developing countries over the period 1985-2000. The former was measured by a modified version of the Lafay index, while, the latter was captured by a set of industry and country factors, i.e. costs, the accumulation of physical capital, the availability of skilled human capital, the acquisition of foreign technology via imports of capital goods, and other potential driving factors. Note that, the model specification was derived from the traditional trade theories and the "new economic geography"[18] approach. The main findings of this study show that low unit labour costs in both, low-tech and medium/high-tech sectors seem to affect positively the revealed comparative advantages (RCA), while the accumulation of physical capital affects positively the RCA in medium-or-high tech sectors only. In line with expectations, human capital endowments appeared to exert a strong and positive impact on the international advantages of countries in the technology-intensive sectors. No supporting evidence, on the other hand, was found for the economic geography approach, since the impact of the latter characteristics on revealed comparative advantage of the manufacturing sector turned out insignificant.

The research paper by Chor (2010) provided a quantitative assessment of the importance of various sources of comparative advantage for the pattern of trade at an industry level. For a sample of 83 countries and 20 manufacturing industries, a model that expresses comparative advantage as function of country and industry characteristics was developed. By applying two estimation methods, OLS and simulated method of moments (SMM), the author examined the impact of distance, Ricardian productivity, factor endowments, and institutional conditions on bilateral trade flows. The Ricardian and Hesckshер-Ohlin theories were incorporated in this empirical investigation, using an extended version of the Eaton and Kortum (2002) empirical model. The estimated results of this study highlight the importance of all the assessed potential determinants for a country's trade pattern, thus confirming the usefulness of the adopted modelling framework in explaining bilateral trade flows. In the same vein, Van der Marel (2012) examined the determinants of comparative advantage in the services sector for a group of 23

[18] This theory suggests that location characteristics have an important impact on a country's economic performance (Venables, 2006).

OECD countries. To assess the comparative advantage of the sector, this author also adopted the extended version of Eaton and Kortum's (2002) model of comparative advantage developed by Chor (2010). The actual model specification relied on geographical, Heckscher-Ohlin, institutional and regulatory based variables. Moreover, potential variations in the sources of comparative advantage between goods and services were assessed. The empirical findings of the research study suggested that the determinants of competitive advantage for services tend to differ from those of goods. In the former sector, the main sources of comparative advantages were found to be a high skilled labour force, the level of trust enjoyed by importers, and the quality of regulatory governance practiced when liberalizing services sectors. The same factors are also likely to influence the comparative advantage of the goods sector, though, to a lesser extent. No significant differential effects were found for sharing a common border, a similar jurisdiction, decreasing entry barrier and lowering FDI restrictions.

Following the same approach, Kowalski (2011) assessed the role of several sources of comparative advantages on bilateral trade flows, covering a sample of 55 OECD and emerging economies and 44 manufacturing sectors for the period 1990-2009. Physical capital accumulation, human capital accumulation, financial development, energy supply, the business climate, a number of aspects of functioning of labour markets and import tariff policy were regarded as key determinants of comparative advantage this paper. Supporting evidence was found for the positive role of the majority of the assessed determinants (i.e. physical and human capital accumulation, financial development, the business climate, and a number of aspects of labour market institutions). In addition, the obtained results suggested growing differences between OECD and non-OECD countries in terms of physical capital, availability of credit or regulatory quality and more heterogeneity within the non-OECD countries, implying thus high and increasing potential for North-South and South-South trade. It is pertinent to note that the estimated results are consistent with the traditional comparative advantage theoretical framework. Another research analysis assessing the potential sources of comparative advantages, with particular focus on factor endowments, was conducted by Stone et al. (2011). To carry out such an analysis, the authors constructed a measure for the factor content of trade based on the Heckscher-Ohlin-Vanek (HOV) model. Consistent with the neoclassical trade theory, the evidence acquired from the analysis supported the importance of the relative factor endowment in explaining the pattern of trade. That is to say, countries that possess larger stocks of capital and skilled labour tend to trade more goods and services requiring intensive use of these factors (e.g. OECD countries). While for developing countries that are typically endowed with relatively larger stocks of unskilled labour, the intensive use of these resources in their trade was more common. However, it is worth noting that some contradicting results in the case of the United States and Japan were identified. For instance, a surplus in the unskilled labour trade was recorded in Japan, while a deficit in the capital-intensive trade existed in the United States. When the actual analysis was extended by also including the intermediate trade component, some of the seemingly counterintuitive results reversed. The changing nature of trade is perceived to be a potential explanation for these findings, i.e. trade depending not only on domestic based factors but also on internationally mobile ones. Additional empirical evidence of a positive relationship between a country's factor endowments and its trade pattern is provided by Debaere (2003), Romalis (2004) amongst others.

Olmeda and Varela (2012) in their research study tried to identify the factors that determine the level of competitiveness of the pharmaceutical industry using data provided by the Global Competitiveness Report of the World Economic Forum (WEF). Following Porter's competitiveness diamond approach, through a discriminant analysis, the authors examined the impact of 5 sets of factors, i.e. factor conditions, related and supporting industries, demand conditions, firm structure, strategy and rivalry, government on the competitiveness level of the pharmaceutical industry. Note that each factor category consisted of 6 to 16 independent variables. The empirical findings emerging from this investigation suggested that a country's factor conditions are major drivers of competitiveness. Conversely, government-related determinants, such as property rights, intellectual property protection, burden of government regulation, inflation, and prevalence of trade barriers were not found to exert a significant impact on the level of competitiveness of a country. Also following Porter's diamond model, Shafaei (2009) employed the same assessment framework to measure and explain the competitive performance of four major Iranian, synthetic fibre-manufacturing firms. The determinants of Porter's diamond model used in the analysis comprise of two to six elements, with each element consisting of several independent variables. Questionnaires and interviews were utilised to collect firm data for the above outlined elements. The Analytical Hierarchy Process (AHP)[19] was employed to assess the competitive performance of firms, an approach commonly adopted when following Porter's competitive advantage diamond. The results emerging from the analysis suggested a low competitive position of the firms under investigation. Factor conditions, such as raw materials, human resources, specialized factors, capital, physical and information infrastructure, administrative and logistical infrastructure, and technology, were found to contribute highly to the competitive performance of these firms. Whereas, the demand conditions (i.e. local market, quality of demand, market share export, related industries, and supporting industries) turned out to exert an insignificant impact on the latter. Note that the actual findings are consistent with those of the export value and RCA analyses for the same industry in Iran and other countries, hence supporting the validity of the utilised approach. Nevertheless, it is also important to note that this approach is regarded as being more useful when identifying potential driving factors, rather than assessing their quantitative effect on competitiveness (Shafaei, 2009).

Schiefer and Hartmann (2008) assessed the determinants of competitiveness in the German food processing industry through a nonparametric correlation, and regression analysis. Data used to carry such an analysis were gathered in an online survey. The competitive performance was measured by profitability indicators, such as the relative return on assets and sales (ROA, ROS), relative change in sales (CIS) and a combination of the three. The first two indicators are commonly used to measure the current profitability of a firm, while the relative change in sales was introduced to overcome some of the limitations of current profitability, i.e. not capturing the dynamics of a firm's performance. Moreover, in order to cover the various dimensions of performance, the authors constructed a composite measure, integrating the three indicators together. Technology and production-related variables turned out to exert a stronger impact on firm's competitive performance, whereas the influence of staff qualification was significant only at the management level. Overall, a consistent picture was revealed; few variations in terms of the level of significance were identified across the performance indicators. In line with the ''resource-based view'' (RBV), firm-specific factors were found to explain a large share of the variation in a firm's competitive performance. Note that the latter theoretical approach highlights the key contribution of a firm's resources to its comparative advantage. However, given that the

[19]This approach structures multiple-choice criteria into a hierarchy, evaluates the relative importance of these criteria, compares alternatives and determines an overall ranking of these alternatives.

survey response was not satisfactory; the estimated results from this investigation should be interpreted with caution.

The international competitiveness of the 103 Peruvian SMEs was examined by Peña Vinces and Róldan (2012) using Partial Least Squares Structural Equation Modelling (PLS-SEM). Global strategy[20], human resources background[21], firm size, firm age, collaboration of industrial sector, the environment of the home country and the environment of the host country were quantified and their potential impact on the competitive performance of firms was assessed. The investigation was based on questionnaires completed by international operations managers, with five to seven point scales being used to evaluate the variables of interest. The competitiveness dimension was represented by the percentage of local profits over total profits and the percentage of foreign profits over total profits. The results showed that one of the most influential factors on international competitiveness was the use of a global strategy, with human resources background playing a crucial role in utilizing this strategy. In conclusion, all the empirical findings of this study appear to be consistent with the resource based view (RBV) and the industrial economics approach. Arbache and De Negri (2005) looked into the determinants of the competitive advantage of Brazilian exporting firms by employing data on employees and firm characteristics. A probabilistic binomial model was used to examine the impact of education, technology and scale of production on a firm's probability of exporting. Significant differences between exporting and non-exporting firms in terms of their labour force, size, capital ownership and other specific characteristics were revealed by the actual analysis. Economies of scale and technology appeared to play a key role in determining a firm's probability of being an exporter. The quality and efficiency gains from human capital (i.e., schooling, tenure, experience) appear to be valued higher in exporting firms as compared to their counterparts[22],while, the impact of firm characteristics on competitive performance turned out to be stronger than those of the industry. The results of the study are consistent with the traditional and new trade theories,

[20] "The set of activities, actions, plans, policies that a firm makes in order to plan its future in local and international markets, with the unique aim of improving its international performance"(p. 6).
[21] The set of employee characteristics that helps firms improve their competitive position in international markets (e.g. age, education, fluency in foreign languages, and knowledge and experience of international markets).
[22]A more detailed discussion on the link between human capital and international competitiveness, accompanied by a review of empirical studies will be presented in Chapter 4.

suggesting that factor endowments, technology and economies of scale are key influencing factors on trade and firm's probability of exporting.

A study by Dosi et al. (2013) investigated the determinants of international competitiveness of Italian firms with respect to a subset of OECD countries for the period 1989-2006. The focus of the study was on the impact of costs and technology on a firm's decision to enter foreign markets, as well as on the level of export market shares and its growth rate. Supporting evidence was found for the positive role of investment and patents on the probability of being an exporter as well as on the capacity to gain and increase market share. Wage expenditure, (i.e. the average labour cost per employee and the firm's wage over the weighted average of wages across countries) turned out positive and significant in the majority of sectors. In the growth (market share) model specification, the relative unit labour cost was used to capture the cost dimension and it exerted a statistically significant impact only in some sectors. Note that, unit labour cost is regarded as a more appropriate proxy measure than simple wage measures, since it covers the full set of labour costs, not just wages and salaries and furthermore, it potentially accounts for productivity. The present study was also augmented by an analysis focusing on the potential link between cost-technology and export market share at a macro level, for a sample of 15 OECD countries. Technology appeared to be a significant determinant of the pattern of international competitiveness, while costs seemed to matter in specific sectors only. The current empirical evidence is consistent with the theoretical considerations highlighting the key importance of technology on comparative advantages.

Table 2.1 International competitiveness: overview of empirical studies

Studies assessing international competitiveness for ranking and comparative purposes							
Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**Competitiveness measure (Dependent variable)**	**Independent variables**	**Comments/Notes**
Drescher and Maurer (1999)	1983-1993	NA	Sector	Germany	Export shares, Balassa's index, XRCA, & NXRCA	NA	The use of alternative competitiveness measures yielded mixed results
Gorton et al. (2000)	1994-1996, 1997	NA	Sector	Bulgaria and Czech Republic	Balassa's index & Domestic resource cost (DRC)	NA	The use of alternative competitiveness measures yielded different results
Gorton and Davidova (2001)	1992-1998	NA	Sector	CEECs	Domestic resource cost (DRC)	NA	

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Havrila and Gunawardana (2003)	1965-1996	NA	Sector	Australia	Balassa's index,Vollrath's indices & Grubel-Loyd index	NA	The use of alternative competitiveness measures yielded similar results
Fertö and Hubbard (2003)	1992-1998	NA	Sector	Hungary	Balassa's index & Vollrath's indices	NA	The use of alternative competitiveness measures yielded similar results
Bojnec (2003)	1989-1998	NA	Sector	CEECs	Porter's diamond, accounting based measures and Policy Analysis Matrix (PAM) approach, & trade-based measures	NA	
Banterle and Carraresi (2007)	1990-2003	NA	Sector	EU countries	Balassa's index, Vollrath's indices, Net export index, & Grubel-Lloyd index	NA	The use of alternative competitiveness measures yielded similar results

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Fischer and Schornberg (2007)	1995-2002	NA	Sector	13 EU countries	Industrial competitiveness index	NA	
Carraresi and Banterle (2008)	1991-2006	NA	Sector	15 EU countries	Balassa's index, Vollrath's indices, Export market share, & Net export index	NA	The use of alternative competitiveness measures yielded similar results
Serin and Civan (2008)	1995-2005	NA	Sector	Turkey	Balassa's index & Comparative export performance (CEP)	NA	The use of alternative competitiveness measures yielded similar results
Wijnands et al. (2008)	1996-2004	NA	Sector	EU countries	Composite competitiveness index	NA	
Kovacic (2008)	2000, 2004-2005	NA	Country	CEECs	WEF of IMD competitiveness indices	NA	

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Qineti et al. (2009)	1999-2006	NA	Sector	Slovak Republic and the EU 27	Balassa's index	NA	
Bojnec and Fertö (2009)	1995-2007	NA	Sector	8 Central European and Balkan countries	Balassa's index & Vollrath's indices	NA	The use of alternative competitiveness measures yielded different results
Notta and Vlachvei (2011)	2002-2007	NA	Sector	18 EU countries	Industrial competitiveness index	NA	
Studies assessing the potential determinants of international competitiveness							
Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**Competitiveness measure (Dependent variable)**	**Independent variables**	**Comments/Notes**

Fagerberg (1988)	1960-1983	2SLS	Country	15 OECD countries	Growth (export and import) market share	The ability to compete in technology, the ability to compete in price and the ability to compete in delivery	
Guerrieri and Meliciani (2003)	1992-1999	GLS	Sector	11 OECD countries	Export market share	Traditional cost variables, intermediate demand, and national technology advantage	The use of alternative competitiveness measures yielded similar results.
Arbache and De Negri (2005)	1996-1998	Logit	Firm	Brazil	Firm's probability of exporting	Education, technology and scale of production	
Marconi and Rolli (2007)	1985-2000	Cross-country panel	Sector	16 developing countries	Lafay index	Costs, physical capital accumulation, skilled human capital availability, and foreign technology acquisition via imports of capital goods	

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Schiefer and Hartmann (2008)	2006	Nonparametric correlation and OLS	Firm	Germany	Relative return on assets and sales, relative change in sales, and a composite measure combining the three variables	Technology, production-related variables, and staff qualification	The use of alternative competitiveness measures yielded similar results.
Shafaei (2009)	2001-2005	Analytical Hierarchy Process (AHP)	Firm	Iran	Competitive performance index	Factor conditions, related and supporting industries, demand conditions, firm structure, strategy and rivalry, and government	
Chor (2010)	1990	OLS and SMM	Sector	83 countries	Bilateral trade flows	Distance, Ricardian productivity, factor endowments, and institutional conditions	

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Kowalski (2011)	1990-2009	Conditional Poisson Fixed Effects	Sector	55 OECD and emerging economies	Bilateral trade flows	Physical and human capital accumulation, financial development, energy supply, business climate, labour markets aspects and import tariff policy	
Stone et al. (2011)	1997, 2001, 2004	NA	Country	41 OECD and emerging economies	Factor content of trade	NA	
Peña Vinces and Róldan (2012)	2006-2009	PLS-SEM	Firm	Peru	Percentage of local profits over total profits and the percentage of foreign profits over total profits	Global strategy, human resources background, firm size, firm age, collaboration of industrial sector, and the environment of the home country and host country	The use of alternative competitiveness measures yielded similar results.

Authors	Period	Methodology	Level of aggregation	Sample	Competitiveness measure (Dependent variable)	Independent variables	Comments/Notes
Olmeda and Varela (2012)	2001, 2004, 2007	Discriminant analysis	Sector	36 countries	Competitiveness level	Factor conditions, related and supporting industries, demand conditions, firm structure, strategy and rivalry, and government	
Van der Marel (2012)	1999-2005	OLS and PPML	Sector	23 OECD countries	Services and Goods trade	Geographical, Heckscher-Ohlin, institutional and regulatory related variables	
Dosi et al. (2013)	1989-2006	Pooled OLS	Country and Firm	15 OECD countries/Italy	Probability of exporting, level and growth of export shares	Costs and technology related variables	The use of alternative competitiveness measures yielded similar results, with a few exceptions.

The overview of papers presented above has shown how the majority of analyses have been carried out at sector and firm level, while lesser attention being given to the country level of aggregation. The ambiguity of the concept of competitiveness at a more aggregated level might be a potential explanation for this. It is pertinent to note that the majority of the reviewed studies in this section do explicitly refer to the concept of international competitiveness and its assessment. There is, on the other hand, a wide range of studies that have tested empirically various potential proxies of international competitiveness (e.g. productivity, profitability, trade patterns) without referring to the concept per se. An important implication of this review is that the measurement approaches adopted in the literature seem to depend highly on the purpose of the undertaken investigation, i.e. whether it aims to assess the competitiveness of an entity or to investigate its hypothesized determinants. While the strand of research dealing with the former tends to provide a thorough discussion of the complexity of defining and measuring competitiveness, as well as its various measures developed/adopted in the literature, studies dealing with the potential determinants of competitiveness in general provide a narrower discussion of the concept. They appear to be mainly focused on the selection of the potential driving factors, without giving much attention to the measurement of competitiveness itself. In this strand of literature, the concept of international competitiveness is commonly tied to the comparative advantage framework and trade patterns. Depending on the theoretical framework adopted as well as the level of aggregation, the impact of different sets of factors on international competitiveness has been assessed. The traditional theories of Ricardo and Heckscher-Ohlin have frequently formed the basis for the underlying analysis, followed by the new trade theory, Porter's diamond of competitive advantage, and the new economic geography approach. In spite of the criticisms outlined above, the findings obtained in the majority of studies provided sufficient evidence to support the validity of the corresponding theories. Though empirical results from studies adopting the new economic geography approach, in general, were inconsistent with the hypothesized role of geographical factors in explaining comparative advantages. Porter's diamond model, on the other hand, due to its qualitative nature, was unable to provide a quantitative assessment of the potential determinants of competitiveness (Shafaei, 2007). In conclusion, considering the variety of traditional and new theories developed in the literature, the strengths and limitations of each, an integrated theoretical framework, i.e. an eclectic approach, is recommended for a more reliable investigation.

The literature review presented in this chapter has emphasized the strengths and limitations of each commonly used measure of international competitiveness, while at the same time acknowledging that there is no single perfect measure. Common shortcomings acknowledged in the literature relate to the lack of appropriate data, specification problems and the lack of a solid theoretical basis. However, in spite of the highlighted limitations and the variety of potential alternative measures, trade based indicators are so far the most widely employed in assessing international competitiveness. The key rationale for relying on this approach stems primarily from its intrinsic connection with the concept per se, well established theoretical grounds and the availability of the required data. The hypothesized link between human capital and international competitiveness, accompanied by a thorough review of studies dealing with the latter nexus will be presented in the next chapter (i.e. Chapter 3).

2.5 Conclusions

The purpose of this chapter was to provide a review of the research undertaken in the international competitiveness literature with particular emphasis on its meaning and measurement. A comprehensive discussion of its various definitions accompanied by corresponding measurement approaches has been placed at the centre of the chapter. Given the diverse conceptualisation, the term 'international competitiveness' appears to be inherently ambiguous and complex, particularly, when being assessed from a macro level perspective. In spite of the extensive use of the notion in previous research, various scholars have raised doubts about its relevance and importance at the country level, the most prominent opponent being Krugman. The latter author contested the underlying concept of international competitiveness on several grounds. In order to capture the arguably unclear concept of competitiveness, two broad measurement approaches have been distinguished in the literature. The first approach focuses primarily on the international trade dimension, whereas, the structure and strategy of firms seems to have laid the basis for the second approach. The former approach builds off several conventional trade theories and new trade theory models and it has been commonly proxied by the real exchange rate, comparative advantage indices, and export or import indicators. Cost superiority, profitability, and productivity are listed among the key measures of international competitiveness from the strategic management perspective. A set of multidimensional indicators has also been introduced to the current debate, though; their theoretical basis and aggregation approaches remain questionable.

The diversity of measures has also contributed to a wide range of empirical studies prevailing in the competitiveness literature. Depending on the aim of the undertaken investigation, two broad sets of empirical studies have been identified and presented in this chapter. The first category of research has been mainly concerned with the measurement of competitiveness, where a large number of indicators were developed, modified and/or adopted. Conventional trade theories were used as the theoretical framework, with very few studies relying on alternative frameworks, e.g. Porter's diamond approach. The vast majority of studies from this strand of literature were undertaken at more aggregated levels of investigation, mainly adopting the trade based measurement approach, Balassa's and Vollrath's revealed comparative advantage indices being the most prominent. Ranking and comparative assessments across sectors and countries were at the focus of this body of literature. The second category of research studies reviewed in this chapter placed a key emphasis on the assessment of the potential determinants of international competitiveness. A core feature of the latter set of studies is their prime focus on the choice of potential drivers of competitiveness rather than on its measurement per se. The majority of these studies were conducted at the firm and sector levels, relying mainly on the comparative advantage framework. In general, the evidence generated by these studies was consistent with the hypothesised theoretical underpinnings, with few exceptions regarding some of the newer theoretical approaches.

The overall literature review presented in this chapter has emphasised the lack of agreement on a single measure of international competitiveness, while at the same time recognising the advantages and disadvantages of the most commonly used measurement approaches. Among the main shortcomings surrounding these measures are the lack of solid theoretical basis, specification problems and the lack of appropriate data. The comprehensive and critical assessment presented in this chapter will help us understand the broad concept of international competitiveness, identify and justify the potential proxy measures for our own empirical investigation presented in the later chapters. The theoretical background behind the potential link between human capital endowments and international competitiveness, followed by a contextualised review of empirical literature will be presented in Chapter 3. Particular emphasis will be placed on a critical review of the main approaches to defining and measuring human capital.

CHAPTER 3

HUMAN CAPITAL AND INTERNATIONAL COMPETITIVENESS: THEORY, MEASUREMENT AND EVIDENCE

Contents

3.1 Introduction

In light of the preceding discussions on the link between international competitiveness and the process of transition, its broad range of definitions and measures, this chapter focuses on human capital theory, the key measurement approaches and the underlying mechanisms through which human capital endowments influence international competitiveness. An empirical assessment of the aforementioned link will be carried out using macro and micro level data in the subsequent chapters. Section 3.2 of this chapter provides a review of the key contributions to human capital theory with particular reference to Becker (1964) and Schultz (1961). The central role of human capital for the economic performance of nations is discussed in the light of different schools of thought, followed by a critical assessment of the theoretical mechanisms through which human capital influences innovation, productivity and international competitiveness. The hypothesised causal channels are explained and their relevance for transition economies is assessed. The remainder of this chapter provides an overview of empirical research undertaken on the relationships between human capital, productivity, growth and international competitiveness. The evidence on the human capital and international competitiveness nexus is reviewed from a macro and micro perspective. Following the rationale established in the previous chapter, studies focusing on the export dimension of competitiveness have received a greater attention in the literature review presented in section 3.3. In particular, the choice of human capital measures employed in these studies, the estimation approaches utilised, their key limitations and their relevance to this research investigation are highlighted in this section. Section 3.4 looks at the main approaches to defining and measuring human capital, with special reference to education as one of the most important sources of human capital accumulation. Finally, section 3.5 summarises the main findings of the chapter and concludes.

3.2 Theoretical framework

3.2.1 Human capital and economic growth

The central role of human capital in determining the economic performance of nations has been recognized since the early work of Petty (1690) and Smith (1776). However, with economies becoming increasingly based on knowledge, it has started to receive even greater attention in recent decades. Although, the importance of human capital accumulation for productivity and economic growth has been investigated extensively in the literature, different schools of thought have offered different theoretical explanations for the mechanism through which human capital influences growth. While, traditional-neoclassical theories of growth stress the importance of physical capital accumulation, and treat human capital as just another factor input in production (Mankiw et al., 1992), the new endogenous growth theory consider the role of knowledge and human capital investment as crucial for the economic performance of nations (Lucas, 1988, Romer 1990). According to Romer (1990), skilled individuals are more likely to innovate, adopt, and adapt to more sophisticated technologies, thus leading to higher productivity and economic growth. Similarly, Nelson and Phelps (1966) argue that better educated individuals make better innovators and are more likely to successfully adopt new technologies, hence accelerate technological diffusion. Moreover, these authors postulate that the introduction of education, a proxy measure for human capital, as another factor of production, as suggested by the neoclassical theories, may comprise a serious misspecification of its hypothesised relationship with growth. According to Nelson and Phelps's theoretical viewpoint, education is perceived to influence growth through the technology diffusion mechanism, rather than to be treated as just a simple input in production. This may have been one reason why many empirical studies seem to have found inconclusive results on the human capital-growth relationship. This view has been supported by Benhabib and Spiegel (1994), who, following Lucas's (1990) suggestion that poor endowments of human capital might be an explanation for the lack of physical capital flows to less developed countries, argue that human capital may also encourage physical capital accumulation. From all the outlined theoretical perspectives, innovation and technology diffusion emerge as the key channels through which human capital increases productivity and generates growth, thus, making human capital a necessary precondition for these activities to take place (Nelson and Phelps, 1966, Romer, 1990, Aghion and Howitt, 1992).

The potential link between human capital and labour productivity, with particular focus on the main sources of human capital accumulation has been assessed by various schools of thought, one of the most prominent being orthodox human capital theory. Becker as one of its main contributors considers education and on-the-job-training as the key components of human capital development, suggesting that investment in the latter activities increases an individual's labour productivity and earnings (Becker, 1964). In line with these views, Rosenzweig (1995, 1996) postulates that education develops learning abilities of individuals which in turn, tends to translate into higher labour productivity. The author emphasises two channels through which education may boost labour productivity: "by improving access to information sources such as newspapers or instruction materials, or by improving the ability to decipher new information, whether from external sources or from own experience" (Rosenzweig, 1995, p.153). Through better access to information, educated individuals will know better how to use new technologies and at the same time benefit from their use (Nelson and Phelps, 1966). Furthermore, they will be able to learn and interpret information more quickly and efficiently. Hence, when engaged in the production process they are expected to generate a relatively larger output compared to their less educated counterparts.

In the same vein, Welch (1970) distinguished two key underlying effects of education on labour productivity: the 'worker effect' and the 'allocative effect'. According to the latter, higher levels of education allow workers to perform better with resources at hand, increasing, thus, their final output. Moreover, increased education will improve a worker's ability to select and distribute efficiently inputs between different uses. An extension of the 'allocative effect' was proposed by Ram (1980), who claims that education decreases the marginal costs of gaining useful information for production and increases the marginal benefits of using the current information. The cost decline might come as a result of more educated individuals having better communications skills and superior 'contacts'. Whereas, a rise in marginal benefits tend to come as a result of more educated individuals being more capable of utilizing the acquired information. Hence, education is perceived to raise the level of relevant information acquired by individuals, which, in turn enhances their allocative and productive abilities. A simple implication of this view is that information is an important intermediary between education and allocative competences. Furthermore, the relevance of information and education tends to be more valuable in 'dynamic' rather than 'static' production settings (Schultz, 1964, Welch, 1970, Ram, 1980). Referring to the agricultural sector, Welch (1970) postulates that in a static environment of production, the productive characteristics will be easily understood, and information will flow from one generation to another, leaving, thus, no place for a role of education. A dynamic environment, on the other hand, entails much more diverse production characteristics, primarily related to the changing technology: hence requiring more educated individuals. The transition process in the former socialist countries of CEE and former Soviet Union[23] has been accompanied by several reforms and structural changes in their production settings, thus, highlighting the need for a more educated labour force.

An important implication of Rosenzweig's studies discussed above is that education is likely to have a greater impact on productivity when more learning is required to perform complex tasks, whereas, the effect will be relatively smaller when simpler tasks are to be performed. The latter was supported empirically by Acemoglu and Autor (2012) who suggest that the effect of human capital on growth is subject to the set of tasks in use. Since different types of skills are needed to perform different tasks, workers with a specific set of skills will have comparative advantage in performing skill-specific tasks. Other studies have also supported this view by arguing that the effect of human capital on productivity is determined by the effectiveness of its use. That is to say, if the knowledge and skills acquired throughout education and other human capital enhancing activities do not match with the specific job undertaken, the underlying relationship between the two tends to be insignificant (Australian Workforce and Productivity Agency, 2013). Furthermore, Thurow (1975) argues that productivity is more related to the characteristics of the job rather than to an employee's background. Like Nelson and Phelps (1966) and Romer (1990), Thurow argues that employers hire workers with higher levels of education, because they tend to adapt more quickly to required changes, and can be trained at a lower cost than those with lower levels of education. According to Arrow (1973), Spence (1973) and Stiglitz (1975), education acts as a signalling or screening mechanism for a worker's individual abilities rather than as a direct enhancer of labour productivity.

On the relationship between human capital and technological knowledge, Rosenzweig (1995, 1996) postulates that specific types of skills are mostly useful when combined with specific technologies. Hence, consequently the demand for high skill workers will be in line with the changes in technology. This appears to confirm the complementary link between formal and informal education and technological change. The importance of education for skill development was also supported by Curtin et al. (2011), who argue that more educated individuals are more able to understand, engage and contribute to the production process. Schultz (1975), on the other

[23] This group of countries will be empirically assessed in Chapter 6 adopting a micro level perspective.

hand, claims that education improves the ability of individuals to cope with economic disequilibria. Moreover, in an earlier study, the same author introduced two other categories of activities that are likely to affect the size and distribution of human capital: health and migration. Even though the latter has been rarely elaborated in the literature, it is considered as an investment in human capital since it captures workers' mobility to exploit superior job opportunities (Schultz, 1961).

Another important component of human capital expected to influence positively labour productivity is informal education. Following Hanushek and Woessmann (2007), knowledge and skills embedded in an individual's human capital can be developed not only through formal education, but also through the informal dimension of education, on and off-the job training programmes, experience, family, peers, and other human capital accumulation sources. According to Stanwick (2011), vocational education and training enhances the ability of individuals to learn, solve problems and adapt quickly to changing economic conditions, and it is also likely to produce spillover effects. That is to say, highly productive workers, as a result of their superior competencies and skills, are likely to boost the productivity level of other workers as well (Boarini et al., 2012). According to Becker (1962), workers raise their labour productivity by learning new skills and upgrading their existing ones while performing different tasks on the job. The author categorizes the knowledge and skills acquired through training programmes into: general and specific. General characteristics are usually provided by education institutions, while investment on specific knowledge and skills is usually provided by firms on the job. The key difference between these two types lies on the transferability of a worker's human capital across different firms. Knowledge acquired on the job at a specific firm increase a worker's productivity in performing only firm-specific tasks; while general characteristics can be utilized in a broader range of firms.

3.2.2 Human capital and international competitiveness

Following the discussion of the key role of human capital and its main sources of accumulation presented above, this section elaborates the main approaches to modelling empirically the hypothesised relationship between human capital and international competitiveness, by focusing on the links between knowledge and skills, technological diffusion and catch-up and labour productivity. The importance of human capital accumulation for competitiveness and export performance is generally derived from its intrinsic relation with technological progress, innovation and labour productivity. According to Wakelin (1998a), there are two theoretical approaches that explain the link between innovation and exports. The “neo-endowment” approach, which initially focused on the factor endowments, of labour and capital, has been augmented by including human capital and knowledge as determinants of trade, i.e. the Heckscher-Ohlin theory. The second approach, on the other hand, refers to the technological differences as the principal sources of trade, i.e. the technology gap theory (Posner, 1961) and the product cycle approach (Vernon, 1966). Notwithstanding these differences, most empirical studies referring to either approach treat human capital and technology as crucial drivers of international competitiveness. Accordingly, an increasing level of human capital is expected to play an important role in inducing innovative activities, which, in turn, will impact international competitiveness and export market share by improving the quality of the existing products and supporting the creation of new products that are of superior quality to those of competitors (Grossman and Helpman, 1991, Agénor, 1995). It was Stokey (1991), who argued that an increase in the stock of human capital in less developed countries raises the proportion of high quality goods produced and reduces the share of low quality goods. According to Toner (2011), the skills set required to induce and promote innovation activities tends to depend considerably on the nature of innovation. There are two types of innovation identified in the literature: ‘radical’ and ‘incremental’. The former type involves ‘elite scientific, engineering and design occupations, and original management skills’ since it deals with major technological modifications, whereas the latter refers to minor changes to existing products, therefore lower level and more generic set of skills are required.

The importance of knowledge and skills for international competitiveness is also supported by the established link between productivity and knowledge-based activities. According to Porter (1990), human capital, as a key determining factor of productivity, is regarded as an important source of the competitive advantage of countries. There is an increasing body of literature that supports the positive link between productivity and export performance. As Melitz (2003) points out, the level of productivity of firms is a key determinant of their export propensity. Only the most productive firms can overcome the additional export-related costs and thus engage in exporting activities. Similarly, Bernard and Jensen (1999), Wagner (2007), Bernard et al. (2007)

have argued that more productive firms are more likely to participate in international markets via exporting. According to a research undertaken by Cassiman et al. (2010) for a sample Spanish firms, it is the product innovation that enhances a firm's productivity, leading, thus to self selection firms into international markets. Similarly, studies assessing the explicit link between innovation and exports have suggested that innovative firms are more globally oriented than their non-innovative counterparts, implying that the innovation level of a firm is positively associated with its export engagement. Besides, not only do these firms export more, they also likely to export to more destinations. Damijan and Kostevc (2008) investigated the relationship between innovation and exporting for Slovenian firms. The results of a bivariate Probit regression suggested a positive relationship between the two, even though the causation direction was not clearly established. Overall, engagement in innovation activities appears to be a major underlying force to exporting, outweighing, thus, the explanatory power of country specific and traditional driving factors such as price-cost (Wakelin, 1998b, Roper and Love, 2002, European Commission, 2008).

However, it is pertinent to note that, in the context of transition economies, a different pattern might prevail given their degree of innovation engagement and level of technological development. For this set of countries, human capital is more likely to facilitate technological catch-up rather than stimulate pure innovation. In accordance with Nelson and Phelps' (1966) model, Benhabib and Spiegel (1994) and Griffith et al. (2004) suggest that countries that are far from the technological frontier but are well endowed with human capital tend to catch up faster with the world leaders. According to Acemoglu et al. (2002) and Vandenbussche et al. (2006), technological adoption is regarded as a potential source of productivity growth in countries that are far from the technological frontier, while, innovation activities tend to be closely linked to productivity in countries closer to the frontier. Similarly, Madsen (2010) suggests that the interaction between educational attainment and distance to the technological frontier is a key determining factor of productivity growth. Distinguishing between skilled and unskilled human capital, Vandenbussche et al. (2006) suggest that a highly skilled labour force is better suited to innovation activities, with less skilled workers being only able to assist with imitation or technical adoption. This implies a relatively greater advantage of the former category in specializing in innovation activities. Similarly, following Toner's (2011) assessment of the skills-innovation link, we would expect that the current skill formation of transition economies is more likely to induce ‘incremental’ innovation, i.e. minor changes to the existing products, rather than ‘radical’ innovation. It should, however, be emphasised that some of the transition economies who are already members of the European Union have started to engage increasingly in innovation activities. Based on their innovation performance, the Innovation Union Scoreboard 2015 ranks Slovenia as among the ‘innovator followers’[24], while, Croatia, the Czech Republic, Estonia, Slovakia, Hungary, Poland, and Lithuania are classified as ‘moderate innovators’.[25] The innovation performance of Bulgaria, Latvia and Romania appears to be well below that of the EU average, hence are treated as ‘modest innovators’. No transition economies have been listed in the top performing category, i.e. ‘innovation leaders’.[26]

In spite of the improvements, R&D activities in the transition region remain low compared to those of developed economies. In contrast to the latter set of countries, the R&D expenditure accounted by firms in transition countries is relatively low compared with that of governments (EBRD, 2014a). The same applies to the percentage of patents held by firms, the quality of the latter also differing across countries. According to the Transition Report 2014 which draws from the latest round of BEEPS data, innovation activities, in many transition economies involve mainly the adoption of existing products, processes and technologies from advanced countries and their adaption to the local environment. This implies that there is a tendency among firms in these countries to ‘buy’ rather than ‘make’ knowledge (EBRD, 2014a). Of the total number of firms covered in BEEPS, only 12 percent appear to have introduced a new product in the last three years. Note that the actual percentage dropped significantly when products new to the market were assessed. A third of firms having introduced new products have also engaged in new process innovation activities. The share of surveyed firms introducing new processes but not new products is around 9 percent. The organizational and marketing innovation statistics show that around 28 percent of firms surveyed by BEEPS have adopted new organisational or marketing practices over the previous three years (EBRD, 2014a). All in all, the discussion presented above suggests that, while, for a subset of transition economies, the human capital–

[24]This group refers to countries with a performance above to that of the EU average.
[25]This group refers to countries with a performance below to that of the EU average.
[26]This group refers to countries with a performancewell above to that of the EU average.

innovation link might be valid, for the remaining majority of the countries, a more relevant theoretical explanation seems that of human capital–technological catch-up.

3.3 Human capital, productivity, and growth: empirical evidence

In spite of the vast literature assessing the relationship between human capital, productivity and growth, empirical studies do not fully agree on the nature and strength of this relationship. Education based measures appear to have been most frequently used to proxy human capital in cross-country growth models. Early studies, such as Benhabib and Spiegel (1994), and Barro and Sala-i-Martin (1995) found a positive and significant impact of the level of schooling on growth, though; the same was not replicated when changes in schooling were assessed. The lack of robust evidence has been attributed to some extent to the measurement and misspecification errors related to education per se (De la Fuente and Doménech, 2000, Woessmann, 2000, Krueger and Lindahl, 2001). Barro (1991), on the other hand, has found supporting evidence for the hypothesised positive role of school enrolment rates at the primary and secondary levels on the growth rate of real GDP per capita, though, no discussion about potential endogeneity in the latter relationship was provided in the study. In later research studies undertaken by the same author, a positive relationship between the growth rate and years of school attainment of males at the secondary and higher levels was established, while the role of the educational background of females turned out to be statistically insignificant (Barro, 1996, 2001, 2013).

Since neglecting the quality dimension of education is likely to cause a serious specification error (Woessmann, 2000), Barro (2013) in his panel analysis introduced students' performance in international tests as an indicator of the quality of education. In accordance with Hanushek and Kimko's (2000) and Hanushek and Woessmann's (2007) research studies, the impact of the quality of education on growth turned out to be positive and stronger than that of the quantity of education. Other macro level studies that have found a positive relationship between education based measures and growth are: Levin and Renelt (1992), Mankiw et al (1992), Hanushek and Kimko (1995), Gemmel, (1996), Krueger and Lindahl (1999, 2001), De la Fuente and Domenech (2006), Cohen and Soto (2001), Bassanini and Scarpetta (2001), Sianesi and Van Reenen (2003).

The relationship between education based indicators and productivity has also been gaining increased attention in the empirical literature. According to Lynch and Black's (1995) empirical analysis, everything else constant, firms with a better-educated workforce tend to have relatively higher levels of labour productivity. In the same vein, Black and Lynch (2001) found that an increase in the average education level of production employees increases a firm's labour productivity significantly. A positive link between education attainment and labour productivity was also found in Canton (2007). The latter study has also highlighted the importance of human capital stock on improving a country's capacity to absorb new technologies. An empirical investigation carried out by Jones (1999) supported the higher relative productivity of individuals with completed tertiary education as compared to their secondary educated counterparts. The latter, on the other hand, in line with expectations, turned out more productive than individuals with just primary education. However, note that when the development level of countries was accounted for, differences across countries in the final results were identified. According to Gemmell (1996) and Sianesi and Van Reenan (2003), tertiary education is more likely to impact growth in more developed countries, whereas, lower levels of education tend to be more important for growth in developing economies.

In addition to formal schooling, a variety of other factors are perceived to influence human capital development and consequently, boost labour productivity and economic growth. According to Mason et al. (2012), in addition to the hypothesised positive impact of educational attainment, on-the-job training and experience are additional key drivers of labour productivity growth. On-the-job training is an important component of human capital, though; it has not been extensively investigated in this literature, potentially due to restricted availability of adequate data. Given the latter issue, the research literature seems to have been mainly directed towards individual and firm level assessments as compared to the country level of aggregation (Bishop, 1994, Bartel, 1994, Conti, 2005, Deardern et al. 2006, Columbo and Stanca 2008, Bernier et al. 2010, Sala and Silva, 2011). Early studies such as Bartel (1994, 1995) highlighted the positive role of formal training on firm's productivity, particularly in firms with low initial productivity. However, it is important to note that these studies seem to have suffered from estimation bias due to inability to control for unobserved heterogeneity and the potential prevalence of endogeneity. Note that attempts have been made to account for the latter. For instance, utilizing longitudinal data, Conti (2005) found supporting evidence for the positive hypothesised link between training and productivity. A similar investigation was carried out by Dearden et al. (2000, 2005). A positive and significant association between the proportion of workers trained in an industry and the value added per worker was established in the latter study. According to Zwick (2006) and Columbo and Stanca (2008), training intensity exerts a positive impact on the valued added per worker. Similarly, Sala and Silva (2011) suggested that an extra hour of training per worker is positively associated with productivity growth, and that access to training helps workers benefit from technology development and consequently raises their labour productivity.[27] It is also worth highlighting that training data being restricted only to specific countries has made cross-country assessments more difficult. The lack of comprehensive information on the types and quality of training is another shortcoming evident in the literature. Although, the majority of empirical studies on the impact of human capital flows on productivity growth have relied on neoclassical growth models, there are increasing numbers of studies investigating the relationship between human capital stock and productivity through the underlying mechanism of innovation. The latter approach, in accordance with the endogenous growth view, postulates that high skilled individuals are more likely to adopt and develop new practices and processes than their less skilled counterparts (Australian Workforce and Productivity Agency, 2013).

Reviewing the literature on the human capital-competitiveness nexus is challenging, primarily due to the multidimensional nature of the latter concept. As already discussed in Chapter 2, a variety of measures of international competitiveness have been proposed with no general agreement on the superiority of any given one. Given the large and diverse pool of developed measures, this chapter will provide a review of two broad strands of literature. The first category of empirical research consists of studies that have used performance indicators, such as profitability and productivity to proxy competitiveness while, the second body of literature covers studies that have employed trade based indicators (i.e. comparative advantage indices and other export indicators). It is worth noting that, not all the studies reviewed here have explicitly focused on international competitiveness in their investigation. Even though, the concept has

[27]For an extensive review of training studies see the Australian Workforce and Productivity Agency review paper (2013).

attracted widespread interest in the literature, it has been more frequently used for ranking analyses and comparative assessments of the relative competitive positions of entities rather than examining its potential determinants. Hence, the review presented below aims to focus primarily on studies that have assessed the potential impact of human capital endowments on comparative advantage and export performance, at different levels of aggregation. Note that, studies adopting other measurement approaches, i.e. profitability and productivity are also briefly covered in the sub-sections below. The first sub-section provides a review of studies examining the human capital-international competitiveness nexus from a macro level perspective, to be followed by an overview of micro level empirical studies presented in the second sub-section. The overview of studies is also presented in a tabular format. Table 3.1 summarises the key features of these studies by providing details about their authors, time span, methodology, level of aggregation, sample size, measures of international competitiveness and human capital. In addition, it presents any potential human capital related factor assessed in these studies, e.g. technology and innovation based, and relevant notes and comments about their key findings.

3.3.1 Human capital and international competitiveness: a review of the macro evidence

Focusing on labour productivity as a measure of competitiveness, Cörvers (1996) examined the potential impact of the share of intermediate and highly-skilled workers on the level and growth of labour productivity in manufacturing sectors in seven EU countries. The empirical results of this study revealed that highly-skilled workers are more likely to increase the productivity level, whereas, the intermediate workers tend to exert a stronger impact on productivity growth. Marconi and Rolli (2007), on the other hand, investigated the link between revealed comparative advantage and human capital for 16 developing countries, for the period 1985-2000. The results of their cross country panel analysis supported the positive impact of the average years of schooling, a proxy for human capital, on the Lafay Index of international trade specialization(for further details on this index see section 2.3). Similarly, Van der Marel (2012) assessed the importance of human capital for the comparative advantage in the services sector. The relative factor endowments for both high-skilled and mid-skilled turned out to exert a positive impact on the export of services, implying that countries with higher levels of skilled workers are more likely to exploit comparative advantages in skill-intensive services. A similar study was conducted by Chor (2010) for a sample of 83 countries. The latter author examined the potential impact of factor endowments on bilateral exports at the industry level. The empirical findings supported the key importance of human capital per worker, proxied by average educational attainment, for the comparative advantage of a country. Kowalski (2011) assessed the impact of human capital, distinguishing between secondary, tertiary education attainment and average years of schooling on bilateral trade flows. A novelty of this study was the introduction of interaction terms between industry and country characteristics, e.g. human capital stock variables being interacted with labour skill intensities. The results of this investigation revealed a positive relationship between human capital endowments and trade, with the interaction terms exerting a strong and robust influence. Similarly, Cörvers and Grip (1997) analysed the impact of human capital endowments on the trade performance of 14 industrialized countries. Human capital endowments were proxied by the share of low-skilled[28], intermediate-skilled[29] and highly-skilled[30] labour and the proportion of R & D workers in a country's labour force, whereas, the revealed comparative advantage in specific sectors[31] was employed to measure the trade performance of a country. The empirical results, in general, suggested that a highly-skilled labour force and high levels of technological knowledge are likely to have a positive impact on the revealed comparative advantage of technology intensive sectors and a negative impact on the revealed comparative advantage of labour-intensive sectors. The labour force with low and intermediate skills, on the other hand, exerted an insignificant impact on either of the sectors. Note that the latter outcome is in accordance with the Heckscher-Ohlin-Vanek (HOV) model, supporting its usefulness in explaining trade flows between developed countries.

Using a cointegration and error correction technique, Chuang (2000) assessed the causal relationship between human capital accumulation and exports for Taiwan during the period 1952-1995. The Granger causality test carried out in this research revealed bidirectional causality

[28] The low skilled workers correspond to workers who completed less than ISCED level 3 or level A in the OECD classification

[29] The intermediate skilled workers correspond to workers who completed an initial education beyond lower secondary education (ISCED level 2), but without achieving level D or E.

[30] The highly-skilled workers correspond to either level D (higher non-university education) or level E (university education) in the OECD classification.

[31] Labour-intensive, capital-intensive and technology-intensive sectors.

between exports and higher education attainment. The empirical results suggested that a more skilled labour force is likely to improve the comparative advantage of countries in exporting more superior-skilled intensive products, while, at the same time, expanding trade tends to promote the accumulation of human capital, which in turn impacts a country's long-run growth. Carlin et al. (2001) examined the association between the average years of schooling and export market share in 14 OECD countries during the period 1970-1990. In line with a priori expectations, the results of the investigation revealed a positive and significant impact of the average years of schooling on the export market share of countries under analysis. The evidence appears to be in accordance with theoretical considerations, highlighting the key importance of education in boosting labour productivity and in turn increasing a country's export share in international markets. Gråsjö (2005) examined the impact of human capital endowments on export performance of Swedish municipalities during the period 1993-1999. The author proxied human capital by the number of people with at least three years of university studies, whereas exports were proxied by the value of exports and the number of export products with export price above 1000 SEK per kg. In addition, access to university R&D and company R&D and its impact on exports was empirically tested. Human capital and company R&D were shown to have a significant positive impact on export performance, with the former measure exerting a stronger impact compared to the latter. However, it is worth noting that due to multicollinearity problems the separate effects of these factors were not easily determined. Subsequently, Fraga and Bacha (2011) investigated the impact of the average level of schooling of the employed workforce on export performance of Brazilian states during 1995-2006. The results of their empirical analysis suggested a non-linear relationship between human capital and exports. An increase in the level of schooling was shown to increase exports to certain point, and after that its effect becomes negative. This implies that increases in lower level of human capital have a stronger effect on export performance. A possible explanation for this might be that the group of commodities investigated in this study was not intensive in high skills, e.g. farming, agro-industrial and mineral commodities. A non-linear relationship was also revealed in Contractor and Mudambi's (2008) study. In an assessment of a set of developed and developing countries, the impact of human capital investment appeared to be stronger for the exports of goods and services in the latter subset of countries.

An important aspect that has started to increasingly attract the interest of researchers is the potential impact of human capital on the quality of exports of a country. According to Cavallaro and Mulino (2009), a country's ability to absorb foreign technological knowledge is translated into higher quality exports and greater competitiveness. This view has also been supported by an earlier research conducted by the authors, i.e. Cavallaro and Mulino (2008). The empirical results of the latter study revealed an improved quality content of the exports of 5 CEECs[32] over time, potentially as a result of the technological catching-up following their integration in the European Union. This quality upgrading and its potential positive impact on export competitiveness and market share growth of CEECs has also been discussed in Cavallaro et al. (2012). Skilled human capital, according to the latter study, is considered a key source of higher quality and technological catch-up with more advanced economies. In their assessment of export diversification and sophistication, Cabral and Veiga (2010) found supporting evidence for the positive role of the educational level of the workforce on both export dimensions, the impact being relatively stronger on the latter. This view was also supported by Parketa and Tamberi (2008), who argued that a higher quality human capital is expected to ease the diversification process and the diffusion of innovative activities. However, this analysis failed to determine the underlying link empirically. Expenditure on R&D turned out to be statistically significant and with the expected sign. To capture the "quality" or "sophistication" of a country's export basket, Hausmann et al. (2007) developed an export sophistication index. The authors postulate that countries that specialise in more sophisticated (higher level productivity) export portfolios tend to have better economic performances. While human capital turned out to be positively correlated with export sophistication, the causality direction was not well established. According to Anand et al. (2012), the educational level of the workforce is a key precondition to producing and exporting higher quality/sophisticated goods and services. The results of their research revealed a positive association between the years of schooling in tertiary education, total years of schooling and export sophistication. Similarly, Zhu et al. (2009) found supporting evidence for the positive impact of human capital on export sophistication. The gross tertiary enrolment rate turned out significant for low-income countries, whereas, the R&D based measure appeared to exert a positive and significant impact for high-income economies only. The positive empirical

[32]The Czech Republic, Hungary, Poland, Slovakia, and Slovenia.

association between human capital stock and export sophistication has also been supported by Jarreau and Poncet (2009), Weldemicael (2010) and other research studies.

The share of medium and high technology intensive exports is an alternative, more conventional measure, used frequently to capture the quality/sophistication level of exports. Srholec (2007) examined the impact of technological capabilities on export specialization in electronics products for a group of 111 developing countries. The empirical analysis undertaken in this study revealed supporting evidence for the positive impact of the ICT patents per capita, computers per capita, and gross tertiary enrolment on a country's specialization in high-tech products. A positive association between the stock of human capital, R&D expenditure and export specialization in ICT products was also found in a study conducted by Vogiatzoglou (2009). Similarly, Ferragina and Pastore (2007) investigated the impact of human capital on the high technology exports of 84 countries for the period 1994-2003. According to their empirical assessment, human capital proxied by secondary school enrolments exerted a positive impact on the share of high-tech exports. Furthermore, the hypothesised role of R&D expenditure on technology intensive exports was also revealed, confirming the complementary link between the two. It is important to note, however, that enrolment rate is a proxy of flows rather than the stock of human capital, limiting thus, the inference drawn from the analysis. Tebaldi (2011) in his panel analysis suggested a positive effect of the average years of schooling on measures of high-tech exports (i.e. high-tech exports per worker and high-tech exports as a percentage of manufactured exports). The positive role of human capital on the high-tech exports of 15 EU countries during 1995-2010 was also established through a cointegration analysis conducted by Gökmen and Turen (2013). In contrast to the above outlined studies, Sara et al. (2012) found an insignificant relationship between the quality of education and training of a country's labour force and the percentage of high-technology products as share of manufactured exports. This counterintuitive evidence might be possibly due to the proxy of human capital by a composite index (i.e. Global Competitiveness Report, 2008-2009). Note that such indices tend to be subject to many limitations, one of the main being the lack of solid theoretical grounds. Though Sara et al. (2012) did find evidence on the importance of a country's innovative capabilities for their high-tech export performance.

3.3.2 Human capital and international competitiveness: a review of the micro evidence

As previously highlighted, the empirical literature on international competitiveness is quite broad and diverse and this is primarily due to the wide range of indicators adopted. It is pertinent to note, however, that when reviewing the research on the potential driving factors of competitiveness, the tendency to employ export-based indicators was more prevalent. Taking this into consideration, the section below provides an overview of studies examining the impact of human capital on export behaviour undertaken at the micro level of aggregation. Schiefer and Hartmann (2008) assessed the impact of the qualification of staff at the executive and non-executive levels on international competitiveness, the latter being proxied by profitability measures such as returns on assets and sales, and relative change in sales. The empirical results revealed supporting evidence for the positive role of the former, while, the latter level of qualification (i.e. of non-executive staff) turned out to exert a less significant impact. It is important to note, however, that due to low survey participation rates, the evidence should be interpreted with great caution. In a similar study, Peña Vinces and Róldan (2012) investigated the impact of employee education, fluency in foreign languages, knowledge and experience in foreign markets and similar human capital characteristics (e.g. experience of other countries and cultures and proficiency in English) on the local and foreign profits of Peruvian SMEs. No evidence was found to support the hypothesized relationships, a potential explanation for their counterintuitive results, according the authors, was the employees' lack of adequate work-related competencies and skills, potentially due to the poor quality of education in Latin American developing countries. However, it is interesting to note that with the exception of the employee education, the other measures are skills-based hence the given explanation does not seem appropriate. Following Porter's diamond model, Shafaei (2009) assessed the competitive performance of four major Iranian firms using the Analytical Hierarchy Process.[33] Factor conditions[34] were revealed to be the main contributors to the performance of firms, i.e. quality of education, on-the-job training, labour productivity, presence of R&D, cooperation of universities with industry and level of applied research, and the presence of national research funds. Note

[33] "It involves structuring multiple-choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each and determining an overall ranking of the alternatives" (Shafaei, 2009, p. 24).

[34] The interviewees evaluated the importance of each variable by scoring them as highly related, very related, related, less related and not related to the competitiveness of a firm.

that the reliability of the results is subject to the underlying limitations of the methodology adopted, The Analytical Hierarchy Process faces various shortcomings, e.g. the weights assigned to the main components for each index being based on 'expert's' perceptions. Furthermore, the Porter's framework per se, has not been strongly supported in the empirical research.

Van Dijk (2001) investigated the potential impact of the share of skilled employees[35], the share of training expenditure in output and R&D expenditure to output ratio on the export propensity of Indonesian firms. The assessment was conducted separately for 28 industries at three digit level and it revealed mixed empirical evidence. Employees' skills turned out to exert a positive and significant impact on the exports of supplier dominated[36] firms and a negative impact on scale intensive[37] firms. The impact of the training dimension was relatively small, whereas, the results on R&D expenditure and export propensity differed significantly across industries. A similar relationship was examined empirically by Arbache and De Negri (2005). The authors found a positive association between the average years of schooling, experience and tenure of employees and the probability of exporting in Brazilian firms. Günther and Norbert (1999) examined the impact of employees' human capital on the probability of German firms exporting. The former dimension was proxied by the share of employees with university or college degree, the share of skilled employees without university or college degree and the level of average wages. Out of the three measures employed in this study, only the level of average wages turned out to have a positive and significant impact on export probability. The authors argue that knowledge and skills needed to engage in exporting are mostly acquired through on-the-job training and other activities, thus explaining the lack of significance of the formal education proxies. A positive relationship between the average wage per employee and export propensity and intensity is also found in a study undertaken by Barrios et al. (2001) for a sample of Spanish firms. Moreover, the human capital dimension was augmented by additional potential measures of human capital, i.e. the proportion of non-production and technical employee to total employees, respectively. Overall, the evidence for the latter set of measures turned out positive and significant when export intensity was assessed, though this result was not replicated when

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[35]It is defined as the sum of four education levels, i.e. college, bachelor, master, and PhD in total employees.

[36]"In supplier dominated firms, new technology is mainly introduced by suppliers of machinery or other capital goods. Process innovation is relatively more important than product innovation and firms are typically small. Supplier dominated sectors are mature industries such as the textile and food industry" (Van Dijk, 2001, p.7)

[37] "Scale intensive firms produce mainly bulk materials such as cement or steel" (Van Dijk, 2001, p.7).

the export propensity of firms was examined. In line with expectations, R&D engagement appeared to play an important role in driving a firm's export behaviour. The impact of average wages, as a proxy for the human capital of the workforce, has also been assessed in studies conducted by Bernard and Jensen (2001) and Wagner (2012). The latter authors found supporting evidence for the positive impact of average wages on the export propensity and intensity of U.S and German firms, respectively. In addition, a positive association between the share of white collar, medium[38] and highly qualified[39] employees and export propensity and intensity was established in both research studies. In line with expectations, the share of highly qualified employees turned out to have a stronger impact on export performance as compared to their less qualified counterparts (i.e. employees with a medium qualification). Another wage based assessment, focusing on the impact of wage expenditure per employee and relative unit labour costs on export propensity, export market share and its growth rate was conducted by Dosi et al. (2013). A firm's decision to engage internationally was positively influenced by wage expenditure, whereas the (negative) impact of relative unit labour costs was significant only in some sectors (i.e. food, textile and chemicals). Overall, supporting evidence was found for the positive role of technology in the export performance of firms.

This review of empirical literature has identified a large set of studies relying primarily on labour cost measures when controlling for the potential impact of human capital endowments on firms' export behaviour.Controlling for potential simultaneity, Arnold and Hussinger (2005) investigated the causal relationship between productivity and the engagement of a sample of manufacturing German firms in international markets via exporting. Given the hypothesised positive correlation between the quality of the labour force and wages, the authors decided to rely on average wages as a proxy measure for the human capital dimension. Employing a Probit estimation approach, two model specifications were analysed. Initially, the entire sample of firms was assessed, to be followed by a separate estimation of a subsample of persistently exporting firms only. In line with the recent firm-level theoretical underpinnings, the results of the analysis found supporting evidence for the causal impact of productivity on exporting rather than vice versa. The human capital dimension, as proxied by average wages, was found to exert an

[38] The share of employees with either the high-school diploma or with vocational training.
[39]The share of employees with a polytechnic or university degree.

insignificant impact on the export decision of firms in the former model specification. It is, however, pertinent to note that the latter model seems to only assess the export probability of firms, a specific reference to the results for persistent exporters is made. Since the latter assessment does not seem to be explained the obtained empirical evidences in not reported and commented in this review. A positive and significant impact was identified for the R&D intensity on export behaviour, in both specifications, whereas the share of newly introduced products appeared significant only in the specification for persistent exporters. However, it is important to note that, in spite of the potential positive correlation between wages and human capital, the lack of more direct information about the latter dimension reduces the explanatory power of the model and the inference drawn from the latter. With a particular focus on export spillovers from MNE’s, Sousa et al. (2000) also explored the potential link between the labour force skills and the export decision and propensity for a sample of UK firms. The skill composition of firms was proxied by the average wage, while the innovation dimension was measured by the domestic and foreign R&D activities, respectively. The latter refers to the R&D expenditure performed in UK by foreign firms. Adopting a Heckman selection model, the study revealed supporting evidence for the hypothesised positive role of skills on both the decision to export and the share of exports over turnover. The effect of foreign R&D activities turned out positive and robust across the two specifications, while the expenditure on R&D performed by domestic firms appeared to exert a significant impact only in the former model.

The determinants of the export behaviour of firms were also investigated by Eickelpasch and Vogel (2009). Using cross-sectional and pooled fractional Probit models, the export behaviour of a sample of German firms in the services sector was empirically assessed. Following many previous studies, the human capital dimension was captured by average wages. It is worth noting that no additional measures potentially related to human capital, such as the technology level or innovation, were adopted in this research analysis. The impact of human capital appeared positive and significant when the cross sectional analysis was undertaken, however its underlying effect disappeared when accounting for the fixed effects (e.g. unobserved heterogeneity). The latter revealed the potential link between the human capital and unobserved characteristics. However, it should be noted that, the prime reliance on wages and the lack of more adequate measures of human capital might have driven the final results. Wages were also used by Cassiman and Martínez-Ros (2007) and Ruane and Sutherland (2004) to proxy the skill level of the workforce when modelling the export decision and intensity of firms. However, the hypothesised positive link between the two was not empirically established, i.e. overall insignificant or counterintuitive results were found. As previously argued, this might, to some extent, be attributed to remuneration not being an accurate measure of human capital.The potential link between qualification of the workforce and export intensity was empirically tested in an earlier study conducted by Wagner (2001). Overall, supporting evidence was found for the hypothesised role of the percentage of jobs demanding a university or polytechnic degree on the export intensity of German-based firms. Other variables potentially correlated with human capital intensity, such as R&D, patents and product innovation appeared to exert a positive and significant impact on export performance as well. It is worth noting that when an industry classification is introduced to the assessment, mixed evidence was revealed. Another empirical analysis focusing on the human capital-export performance nexus is conducted at the firm level by Alvarez (2007). A novelty of this investigation is the differentiation between non-exporters, sporadic exporters, and permanent exporters for a sample of Chilean manufacturing firms. The human capital dimension was proxied by the share of white and blue collar wages, whereas, the technological innovation level of firms was captured by the expenditure on foreign technical licenses. The results, in general, supported the hypothesised positive influence of human capital endowments on a firm's exports, however the same measures fail to explain the performance differences between permanent and sporadic exporters. Similar research was carried out by Johansson and Pettersson (2010) for Swedish food processing firms for the period 1997-2004. According to their empirical results, the share of employees with at least three years of university education has a positive and stronger impact on the probability of being a permanent exporter relative to the probability of exporting occasionally or not exporting at all.

In the same vein, Kagochi and Jolly (2010) assessed the impact of human capital and R&D expenditure on the export volume of US, Canada, Australia and Brazil's agricultural commodities. Overall, contrary to expectations, human capital proxied by the secondary school enrolment rate turned out to be negative. The arguably inaccurate measurement approach adopted in the current study might be a potential explanation for the counterintuitive result. School enrolment rates are regarded as weaker proxies of the current human capital stock;

therefore, their use might have distorted the findings of the study. In line with expectations, supporting empirical evidence is found for the positive role of domestic R&D expenditure on the exports of agricultural commodities. Employing a multinomial logit approach, Hollenstein (2005) assessed the determinants of a Swiss firm being engaged in international markets via exporting (without direct presence abroad), participating in foreign locations with other activities (in addition to exporting) or serving domestic markets only. This study followed Dunning's 'OLI paradigm' to explain the engagement of firms in international markets, i.e. 'O' representing a firm's ownership specific factors, 'L' denoting location specific characteristics and 'I' representing the internalising advantages. Amongst the three sets of potential determinants, the O-advantages, captured by a firm's key characteristics, such as the share of personnel holding a university degree or similar, R&D activities, the share of firms with high expenditure for product development and the share of firms with product innovations were found to be the key drivers of a firm's level of internationalisation. The impact of the underlying factors appeared to be the strongest for firms engaged in other foreign activities in addition to exports.

Using the Business Environment and Enterprise Performance Survey (BEEPS) undertaken by the World Bank and EBRD, Gashi et al. (2014) assessed the potential impact of human capital and technology-related factors on the export behaviour of SMEs in transition economies. The authors employed both cross section and panel data for the years 2002, 2005 and 2008/2009. The share of employees with higher education was found to exert a positive and significant impact on the export intensity of firms. The empirical evidence on the importance of on-the-job training, the share of skilled workforce and the education of the top managers was generally weak. The hypothethised role of on-the-job training turned out insignificant, whereas top manager's education was statistically significant in only one of the model specifications (the imputed sample). The introduction or upgrading of (new) products and technologies, on the other hand, was revealed to influence positively the export behaviour of firms. To address the issue of missing data, alternative model specifications were estimated using a multiple imputation technique. Overall, consistent empirical evidence was found across the specifications. The export behaviour of firms, with particular focus on the computer services industry was also examined by Falk and Hagsten (2015). A micro perspective was employed to assess the determinants of the export engagement of Swedish SMEs. The results indicated that a higher share of workers with tertiary education tends to increase the probability of a firm exporting. However, its size and significance appears to decrease considerably when the output to employment (a measure of labour productivity) ratio is added to the explanatory variable list. This might be due to potentially high correlation between the two. To account for potential endogeneity in the estimations, the majority of explanatory variables were lagged one year. Again, it is worth noting that no information about additional sources of human capital accumulation (e.g. on-the-job training) was included in the analysis, neither did it control for related influencing factors, i.e. innovation activities.

Table 3.1 Human capital and international competitiveness: overview of empirical studies

Macro level empirical evidence								
Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**International Competitiveness measure**	**Human Capital measure (result)**	**Human Capital - related measures**	**Comments/Notes**
Cörvers (1996)	1988-1991	OLS	Sector	7 EU Countries	Competitiveness indicator: Labour productivity (level and growth rate)	The share of intermediate workers (+, productivity growth) The share of highly-skilled workers (+ , productivity level)	NA	
Cörvers and Grip (1997)	1985	OLS	Country	14 industrialized countries	RCA	The share of low-skilled labour in a country's labour force (insig.) The share of intermediate-skilled labour in a country's labour force (insig.) The share of highly-skilled labour in a country's labour force (mixed)	The proportion of R & D workers in a country's labour force (mixed)	
Chuang (2000)	1952-1995	Cointegration and error correction modelling	Country	Taiwan	Exports	Higher education attainment ratio (+)	NA	

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Carlin et al. (2001)	1970-1990	OLS	Sector	14 OECD countries	Export market shares	Average years of schooling (+)	R&D expenditure to GDP (insig.) Patent applications (insig.) R&D scientists and engineers per worker (insig.)	
Ferragina and Pastore (2004)	1994-2003	Panel FE and RE	Country	84 countries	High-technology exports (% of manufactured exports)	Human capital (% secondary school enrolment) (+)	Research and development expenditure (% of GDP) (+)	
Gråsjö (2005)	1997-1999	Quantile regression	Municipalities	Sweden	Export value Number of high valued export products	Average of the number of people with at least three years of university studies (+)	University R&D (insig.) Company R&D (+)	Due to multicollinearity problems the impact of each measure is not easily determined, when investigated together.
Marconi and Rolli (2007)	1985-2000	Cross-country panel	Sector	16 developing countries	Lafay index	Average years of schooling (+)		
Haussman et al. (2007)	1992-2003	OLS	Country	48-133 countries	Export sophistication index - EXPY	Human capital (+)	NA	The causal direction has not been tested empirically in this analysis

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Srholec (2007)	2003	OLS and 2SLS	Country	111 Developing countries	Export specialization,(exports/(exports + imports))	Technological capabilities (composite index): ICT patents per capita, computers per capita, and gross tertiary enrolment (+)	NA	
Contractor and Mudambi (2008)	1989-2003	Hierarchical OLS	Country	25 developed and developing countries	Exports of goods and services	Average years of schooling (+, non-lin)	NA	The impact of human capital investment appeared stronger for the exports of goods and services in the subset of developing countries.
Parteka and Tambieri (2008)	1985-2004	Pooled OLS and FE	Country	60 countries	Export specialization/diversification: The relative Theil entrophy index (Cowell, 1995) The relative Gini index (Amiti, 1999)	Enrolment in secondary and tertiary education as % of population (insignificant) Illiteracy rate (% population aged 15-24) (insignificant)	Spending on R&D as % of GDP (-) Number of researchers per mln citizens (insig.)	Despite having the expected sign, almost all human capital variables turned out insignificant.
Zhu et al (2009)	1992-2006	GLS and GMM	Country	171 countries	Export sophistication index - EXPY	Gross tertiary enrolment rate (+)	The proportion of R&D expenditure in GDP (+)	In order to deal with potential endogeneity, system GMM and IV were used

Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**International Competitiveness measure**	**Human Capital measure (result)**	**Human Capital - related measures**	**Comments/Notes**
Jarreau and Poncet (2009)	1997-2007	FE Panel	Country	China	Export sophistication index - EXPY The share of medium and high-tech products in exports	Stock of university graduates over population 15+ (+) Secondary education stock (mixed)	NA	
Vogiatzoglou (2009)	2000-2005	FE Panel	Country	mixed group of countries	ICT Export specialization: Balassa Index	Human capital stock: Researchers in R&D per million people (+)	Research & development expenditure as a % of GDP (+)	
Chor (2010)	1990	Simulated method of moments (OLS and SMM)	Sector	83 countries	Bilateral exports	Factor endowments: Human capital per worker: average educational attainment (+)	NA	
Kagochi and Jolly (2010)	1971-2006	Dynamic ordinary least squares (DOLS)	Commodity	US, Canada, Australia and Brazil	Export volume	The fraction of secondary school graduates to the agricultural labour force (-)	R&D expenditure (+)	

Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**International Competitiveness measure**	**Human Capital measure (result)**	**Human Capital - related measures**	**Comments/Notes**
Cabral and Veiga (2010)	1960 to 2005	Pooled OLS and FE	Country	Sub-Saharan Africa	Export diversification (ED) - Number equivalent and Theil index Export sophistication (ES) - EXPY and PRODY	Labour force with primary, secondary and tertiary level of education (+) The share of GDP spent in education (+, ED, Insignificant, ES)	NA	Tertiary education plays a more important role in explaining ES, whereas, primary education is a more important factor in explaining ED.
Weldemicael (2010)	1980-2000	OLS, 2SLS and GMM	Country	mixed group of countries	Export sophistication index - EXPY	Average years of schooling (+)		
Kowalski (2011)	1995, 2005	Conditional Poisson Fixed Effects	Sector	55 OECD and emerging economies	Value of exports	Secondary schooling*skilled-labour intensity (+) Tertiary schooling*skilled-labour intensity (+) Years of schooling*skilled-labour intensity (+)	NA	The results suggest that differences in secondary schooling had a stronger influence on trade patterns

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Fraga and Bacha (2011)	1995-2006	FE	Country	Brazil	Total value of exports	Average years of schooling of the workforce (non-lin.)	NA	The findings suggest that human capital has a non-linear effect on exports
Tebaldi (2011)	1980-2008	Panel FE	Country	95 countries	High-technology exports per worker; High-technology exports (% of manufactured exports)	Average years of schooling (+)	NA	
Van der Marel (2012)	1999-2005	Poission Pseudo-Maxi mum Likelihood technique (OLS and PPML)	Sector	23 OECD countries	Export of services	The stock of high-skilled labour (+) The stock of mid-skilled labour (+)	NA	
Anand et al. (2012)	1990–2008	Fully Modified Ordinary Least Squares (FMOLS)	Country	100 countries	Sophistication of goods and services exports (EXPY)	Total years of schooling, and years of schooling in tertiary education (+)	NA	

Authors	**Period**	**Methodology**	**Level of aggregation**	**Sample**	**International Competitiveness measure**	**Human Capital measure (result)**	**Human Capital - related measures**	**Comments/Notes**
Sara et al. (2012)	2008	NA	Country	120 countries	High-technology exports (% of manufactured exports)	An index of the quality of training and education of a country's labour force (Insig.)	An index of innovative capability of a country (+) An index of the quality of existing technologies in a country (insig.)	
Gökmen and Turen (2013)	1995-2010	Panel unit root test; Cointegration test; FMOLS panel long-run estimators; Panel Granger causality test	Country	EU-15	High technology export volume	Human Development Index Scores (+)	NA	
Dosi et al. (2013)	1989-2006	Pooled OLS	Country and Firm	15 OECD countries/ Italy	Probability of exporting Level of export shares Growth of export shares	Wage Expenditure (+) Relative Unit labour costs (mixed)	Investment intensity (+) Propensity to patent (+)	

Micro level empirical evidence

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Günther and Norbert (1999)	1997	Simple and Simultaneous Probit	Firm	Germany	Export probability	Employees with univ. or college degree/number of employees (Insig.) Skilled employees without univ. or college degree/ number of employees (Insig.) Total labour costs/number of employees (+)	innovation expenditures/sales (+)	Allowing for simultaneity, the results do not support the potential effect of export activities on innovation.
Sousa et al. (2000)	1992-1996	Heckman selection model	Firm	United Kingdom	Export decision and propensity	Average wages (+)	Domestic R&D expenditure (insig., +) Foreign R&D expenditure (+)	The main focus of the paper was on the links between MNEs and the export performance of domestic firms.
Bernard and Jensen (2001)	1984-1992	Linear probability and Probit	Firm	U.S.	Export propensity	Workforce quality: Lagged average wages (+) Ratio of white collar to total employees (+)	NA	

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Wagner (2001)	1994-1995	OLS, Tobit, BETA and PW	Firm	Germany	Export/sales ratio	Percentage of jobs demanding a university or polytech degree (+)	R&D/sales ratio (+) Patents (+) Product innovation (+)	When firms by industry were investigated separately, mixed results were found.
Van Dijk (2001)	1995	Tobit and Papke and Woolridge models (PW)	Firm	Indonesia	Export propensity	Share of skilled employees (educational level) (mixed) Share of training expenditures in output (mixed)	R&D expenditures to output ratio (mixed)	The impact of skilled labour varies between sectors
Barrios et al. (2001)	1990-1998	Probit and Tobit	Firm	Spain	Export propensity Exports/sales ratio	Average wage per employee (+) Ratio of non-production to total employees (mixed) Percentage of technical employees (mixed)	R&D expenditure / sales (+) R&D expenditure by domestic firms in sector j / sales by domestic firms in j; (mixed) R&D expenditure by MNEs in sector j / sales by MNEs in j (mixed)	
Ruane and Sutherland (2004)	1991-1998	Heckman selection model	Firm	Ireland	Export decision and intensity	Average wages	R&D expenditure per employee (+)	

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Arbache and De Negri (2005)	1998	Logit	Firm	Brazil	The probability of exporting	Average years of schooling of the workforce (+)	Average experience of workers in the firms (+) Average tenure in the firm (+)	The probability of exporting grows until some point of schooling, and after that it decreases.
Arnold and Hussinger (2005)	1992-2000	Probit	Firm	Germany	Export probability	Average wages (mixed)	R&D intensity (+) The introduction of new products (mixed)	The estimated results appear to suggest that the direction of causality runs from productivity to exporting, and not vice versa.
Hollenstein (2005)	1998	Multinomial Logit	Firm	Switzerlan d	The probability to export, engage in other foreign activities or serve the domestic market.	The share of personnel holding university or similar degrees (+)	R&D performing Share (%) of firms with high outlays for product development (+) Share (%) of firms with product innovations (+)	Overall, the estimates of the study are in line with the "OLI paradigm", a theoretical framework proposed by Dunning.
Cassiman and Martínez-Ros (2007)	1990-1999	Pooled Probit & Random effects Probit	Firm	Spain	Export decision	Wage intensity (-)	Product innovation (+) Process innovation (insig.)	

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Alvarez (2007)	1990-1996	Multinomial Logit	Firm	Chile	Permanent exporters Sporadic exporters Non-exporters	Labour skills: White-collar wages (mixed) Blue-collar wages (mixed)	R&D - the expenditure on foreign technical licenses normalized by value-added (mixed)	Labour skills and technological innovation are positively correlated with exporting, but these factors cannot explain why some firms export permanently.
Schiefer and Hartmann (2008)	2006	Nonparametric correlation and OLS	Firm	Germany	Relative return on assets and sales, relative change in sales, and a combination of these variables	Staff qualification at the executive level (+) Staff qualification at the non-executive level (insig.)	Product innovation: Share of innovative products in the product range (+) Level of innovation (insig.) Process innovation (+)	
Shafaei (2009)	2001-2005	Analytical Hierarchy Process (AHP)	Firm	Iran	Competitive performance index - An index based on Porter's diamond of competitive advantage.	Quality of education (+) On-the-job training (+) Human resource productivity (+)	Presence of R & D (+) Cooperation of universities with industry and level of applied research (+) Presence of national research and funds (+)	The CP index reflects how each component (diamond) influences the competitiveness of a firm/country

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Eickelpasch and Vogel (2009)	2003-2005	Cross-sectional Probit and pooled Fractional Probit	Firm	Germany	Export probability and intensity	Average wage (mixed)	NA	This study adopted a newly introduced approach to estimating the export behaviour, i.e. the so called Fractional Probit.
Johansson and Pettersson (2010)	1997 – 2004	Multinomial Logit	Firm	Sweden	Permanent exporters Occasional exporters Non-exporters	The share of employees that have at least three years of university education (mixed)	NA	Human capital increases the probability of being a permanent exporter relative to the probability of exporting occasionally or not exporting
Kagochi and Jolly (2010)	1971-2006	Dynamic ordinary least squares (DOLS)	Commodity	US, Canada, Australia and Brazil	Export volume	The fraction of secondary school graduates to the agricultural labour force (-)	R&D expenditure (+)	

Authors	Period	Methodology	Level of aggregation	Sample	International Competitiveness measure	Human Capital measure (result)	Human Capital - related measures	Comments/Notes
Peña Vinces and Róldan (2012)	2006-2009	Partial Least Squares Structural Equation Modelling (PLS-SEM)	Firm	Peru	Percentage of local profits over total profits and the percentage of foreign profits over total profits	Employees age and education Fluency in foreign languages, Experience in foreign markets, Knowledge of foreign markets, Experience in other countries Cultures and English as a means to work in the firm (insig.)	NA	
Wagner (2012)	2006	OLS, Probit, Fractional logit	Firm	Germany	Export propensity Exports/total turnover	The shares of medium qualified employees (+) The shares of highly qualified employees (+) The average wage in a firm (+)	R&D intensity (+)	The study suggests that average wage is a useful proxy for human capital stock of a firm.
Gashi et al. (2014)	2002, 2005 & 2008/2009	Generalised Tobit	Firm	Transition countries	Export intensity	The share of the workforce with some university or higher education (+) On-the job training (insig.) The share of skilled workers (insig.)	Changes in organizational structures (insig.) Spending in R&D (insig.) The introduction of new products (technologies)/ upgrading of	To handle the issue of missing data, alternative model specifications were estimated using a multiple imputation technique. Overall, consistent empirical evidence was found across the specifications.

						The education of the top manager (insig.)	existing products (+) The relative technological level (insig.)	
Falk and Hagsten (2015)	2002-2010	Fixed effects conditional Logit	Firm	Sweden	Export probability	The share of workers with a tertiary education (+) Output to employment ratio (+)	NA	

As previously argued, international competitiveness has been mainly approximated by trade/export based indicators; hence this review has covered mainly studies examining the determinants of the latter, even when no direct reference to the concept has been made. The determinants of export behaviour (propensity and intensity) of firms have been most frequently assessed, with most of the studies also controlling for the impact of human capital endowments. At the country/sector level, studies have mainly relied on export measures, i.e. revealed comparative advantage indices or export market share indicators. The level of education attainment, years of schooling, enrolment rates and/or average wages have been amongst the most commonly employed measures of human capital, with very few studies also controlling for other specific human capital components (e.g. training incidence). An increasing strand of literature appears to be focusing on the determinants of the quality of exports and the hypothesised positive impact of human capital endowments. Quality or the sophistication of exports has been assessed mainly at the country/sector level and it has been proxied by the relative size of technology intensive exports and/or a newly introduced export sophistication index. It is pertinent to note that one of the main shortcomings of the vast majority of studies reviewed here is the lack of a critical debate regarding potential sources of endogeneity and ways to account for it. In many cases, potential reverse causation between human capital and international competitiveness was not discussed and/or no robustness checks were undertaken to determine the direction of causality. It is well established in the literature that estimating models in the presence of endogeneity yields biased and inconsistent estimates and invalid causal inherence. Hence, an important element of our own investigation will be assessing and addressing, where necessary, potential endogeneity. Another limitation of most of these studies relates to appropriately capturing the broad dimension of human capital. While, various measures related to the quantity of education have been employed, the quality of education as a key dimension of human capital was rarely quantified and tested in any of the above outlined analyses. Given its hypothesised key relevance, particularly when conducting cross-country analyses (i.e. differing qualities of schooling), we will account for this dimension in our research analysis to the greatest possible extent. On-and off-the job training are two other important dimension of human capital accumulation not frequently assessed in the empirical literature.

3.4 Human capital: definition and measurement

The aim of this section is to provide a discussion of the main approaches to defining human capital and its measurement, with special reference to education as an important source of human capital accumulation. There is a widespread acceptance that an individual's human capital is based on knowledge and skills obtained by various learning activities. In spite of many definitions of human capital proposed, the one provided by the OECD is currently the most comprehensive and is frequently cited in the literature. It defines human capital as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD, 2001b, p18). According to Laroche (1999, p. 89), human capital consists of two main components: the innate abilities and the knowledge and skills acquired over an individual's lifetime. Innate abilities are defined as "physical, intellectual and psychological capacities that individuals possess at the time of birth" whereas, the latter component refers to competencies, knowledge and skills that are generally built up throughout education, on-the job training, work experience, and other similar activities. While human capital might seem simple to define, it is inherently more difficult to measure due to its multidimensional nature.

Three key approaches to measuring the stock of human capital have been identified in the literature: the cost-based approach, income-based approach and education-based approach. The first method measures the stock of human capital by looking at the total costs incurred to produce an individual's human capital. This approach was first introduced by Engel (1883) and later augmented by Kendrick (1976) and Eisner (1995). According to Kendrick, human capital costs can be divided into tangible and intangible dimensions. The tangible component refers to the costs needed to produce and rear an individual until a certain age, while the intangible costs are expected to improve the productivity of labour. The latter component refers to costs on health, safety, mobility, education and training, and also the opportunity cost of attending school and training (Oxley et al., 2008). Given the availability of data on public and private costs, the approach appears easily applicable; though it has also been criticized for unjustifiably assuming a positive relationship between investment and the quantity and quality of output produced. The value of human capital does not necessarily depend just on the cost of production, it is more likely to depend on demand and supply for that human capital (Le et al., 2003, Oxley et al., 2008). This measure tends to become even more problematic under certain circumstances: specific individuals require additional rearing costs (e.g. such as with children with disabilities and health issues), leading to an over-estimated human capital (Oxley et al., 2008, Boarini et al., 2012). Another limitation of this approach stems from the difficulty of precisely distinguishing between investment and consumption costs in the production of human capital. For instance, the expenditure incurred for a student's food and clothes can be considered both consumption and investment expenditure (Boarini et al., 2012). Frequently, an arbitrary division is proposed, making sensitive assumptions, which if not valid, can lead to over or under-estimation of the real value of human capital. An additional drawback relates to the use of different depreciation methods by researchers. Furthermore, this approach appears to completely neglect the potential appreciation of human capital (Oxley et al., 2008).

An alternative measurement method which places greater emphasis on the future rather than past and output as opposed to input, is the income-based approach. The latter focuses on the sum of the discounted values of future income flows that a person expects to earn throughout her/his lifetime. This approach, initially introduced by Petty (1690), was later adopted and extended versions by various researchers. According to Oxley et al. (2008), among the key pioneer contributors to measuring the value of human capital are: Farr (1853), Wittstein (1867), Nicholson (1891), De Foville (1905), and Dublin and Lotka (1930). Later, Jorgenson and Fraumeni (1989) provided an augmented method by simplifying the discounting procedure. Note that relying on this approach as opposed to the historical costs seems more sensible, when the future productivity of an economy is assessed (Oxley et al., 2008). Human capital is valued at market prices, depreciation is implicitly captured, life tables are available and earnings by age and education level can be acquired from various surveys. However, the approach is also subject to various limitations. Initially, the assumption that the wage rate captures productivity capacities does not necessarily hold, since there are other factors highly likely to impact the wages differences, e.g. minimum wage provisions, market conditions, bargaining power, etc. Besides, a subjective judgment has to be made about the discount rate, retirement age, and future income growth rate, which, if not correctly specified, might lead to biased results (Oxley et al., 2008). It is, however, important to note that, a common limitation of the two measurement approaches outlined above is the undervaluation of human capital that comes mainly as a result of neglecting completely the non-market benefits of human capital investment e.g. improved health, greater civic awareness and participation, and improved social inclusion (Boarini et al., 2012).

The final measurement approach, the most commonly used in the economic literature, rests primarily on education-based indicators. As hypothesised by the conventional human capital theory, education is regarded as a key source of human capital development. Widespread accepted theoretical grounds and general availability of data on education participation and attainment constitute the main rationale behind their frequent use. It is pertinent to note that the choice of which human capital measurement approach to be adopted should depend primarily on the purpose of the investigation. Hence, given that education-based indicators are generally perceived to reflect the knowledge, skills and competences of the potential labour force, employing this approach seems more sensible when assessing the human capital-international competiveness nexus. Besides, not being prone to problems associated with the alternative measures (i.e. valuation, costs) tends to further favour the adoption of this approach. That is to say, the mechanism through which human capital influences international competitiveness relies primarily on productivity, the latter being determined by the knowledge and skills of the individuals/workforce. It important to highlight that, in spite of the widespread use and its intrinsic relevance to our own empirical investigation, this measurement approach is also subject to limitations that will be discussed in more details below. As the human capital theory somewhat reluctantly acknowledges, there are other components of human capital that are of similar importance to productivity and competitiveness and should be taken into account in order to obtain reliable results., e.g. informal education, on-the-job training and experience.

The education-based approach typically estimates human capital generally based on output indicators such as adult literacy rates, and education attainment. One of the commonly used proxies of education is school enrolment rates. Both, gross and net enrolment rates have been proposed in the literature, with the former being more frequently used given the general availability of such data for developing countries. The gross enrolment ratio is defined as "the ratio of all persons enrolled at a given level of schooling to the population of the age group that national regulation or custom dictates should be enrolled at that level". The net enrolment ratio, on the other hand, is defined as "the ratio of students at a given level of schooling in the designated age group to the total population of that age group" (Barro and Lee, 2001, p.7). These ratios represent today's investment in human capital that will be reflected in the accumulated human capital sometime in the future. However, school enrolment rates are considered to be weaker proxies of the current human capital stock. As a measure of current flows, these rates represent the future level of schooling rather than that of present labour force (Oxley et al., 2008). Another drawback stems from the fact that current level of schooling might not be added to the future human capital stock, if graduates do not participate in the labour force, e.g. due to emigration, unemployment, health conditions and/or if there are significant numbers of grade repetition and dropouts in the current enrolment. While, changes in the stock of human capital over time are a reflection of the differences between the human capital of those who enter the labour market and those who retire, the latter component is not captured by enrolment rates at all (Woessmann, 2003, Oxley et al., 2008). Furthermore, data on enrolment rates sometimes tend to be of poor quality, particularly for developing countries, due to false reporting or inaccurate data. For instance, in some countries schools or municipalities deliberately report exaggerated figures in order to acquire additional resources for their educational institutions (Chapman and Boothroyd, 1988). Besides, this ratio refers only to the registered number of students at the beginning of the year, thus ignoring that the number of students attending school during the years might be significantly lower (Barro and Lee, 1993). It also tends to ignore the differences in the length of both compulsory and actual schooling. Overall, the above outlined limitations question the adequacy of this approach in representing accurately either the current or future flows of human capital.

As opposed to the education flows discussed above, the adult literacy rate is a measurement method that captures the stock of human capital for the adult population. According to UNESCO (1993, p.24), the adult literacy rate is defined as "the percentage of population aged 15 years and over who can both read and write with understanding a short simple statement on his/her everyday life". Although it represents a relevant component of the human capital stock, it focuses only on basic literacy, while neglecting other important fundamentals such as: numeracy, logical and analytical reasoning and scientific and technological knowledge acquisitions. It is worth noting that this measure is not as commonly employed in the research work as enrolment rates, mainly due to censuses and surveys of the adult population being carried out less frequently and the lack of variation of the literacy rates across time or countries (Barro and Lee, 1993). More importantly, reliance on this proxy assumes that advanced levels of education are irrelevant for the productivity of the labour force. The inappropriateness of this proxy to capture the human capital stock has also been highlighted by Judson (2002). The latter argues that only in countries with little education beyond the first level is this proxy valid, it is inadequate when assessing countries with relatively high levels of education. To overcome some of these shortcomings, newly designed international comparable literacy tests covering more advanced dimensions have been introduced and will be discussed later in this section.

Education attainment is another proxy measure of human capital frequently used, particularly when trying to assess the hypothesised role of the knowledge, skills and competences of the population/potential labour force. As opposed to the previous measures, this proxy captures the total amount of formal education acquired by the potential labour force of an economy, rather than the stock of future labour force (Woessmann, 2003). Education attainment is typically defined as the percentage of population who have successfully completed different levels of education; with average years of schooling being one the most commonly used specification in the research literature (Woessmann, 2003). According to the OECD (1998), education attainment proxies have been found to be positively correlated with direct skills indicators and earnings.

The lack of readily available data on years of education has led several researchers to construct their own estimates. Depending on the estimation methodology used, three sets of studies can be identified, i.e. studies that used census/survey based method, the projection method, and the perpetual inventory method (Oxley et al., 2008). The survey/census estimation method, which focuses on the levels of educational attainment extracted from surveys and censuses, was proposed by Psacharopoulos and Arriagada (1986). Although, the authors collected data on the educational attainment of the labour force for six different levels of education the limited coverage in terms of the time span and countries seems to be one of the main drawbacks of their dataset. In order to overcome some of these limitations, a projection method was developed by Kyriacou (1991). Years of schooling as provided by Psacharopoulos and Arriagada were regressed on lagged gross enrolment ratios obtained from UNESCO databases, to predict average years of schooling in the labour force for additional countries and years. However, in spite of the improvements, the dataset remained associated with significant measurement errors. This method rests on assumption that lagged enrolment ratios and years of schooling have a stable relationship over time and across countries, which might not be applicable in many cases (Oxley et al., 2008). Alternatively, Lau et al. (1991) proposed the perpetual inventory method that measures the stock of education by computing the sum of enrolment rates at specific grade levels at a specific time and the probability of survival. A shortcoming related to this approach stems from the measurement errors related to enrolment and mortality data, given that earlier periods figures were not available and thus had to be extrapolated. Furthermore, this approach did not take into account dropouts, grade repetition and migration rates when performing the calculations. To address the latter limitation, Nehru et al. (1995) offered a modified version, albeit by keeping the dropouts and repetition rates constant over time and across grade levels. Moreover, the ability to collect data for earlier periods reduced to a large extent the previous issues associated with backwards extrapolation. Yet, the authors decided not to use census data on attainment levels, arguing that the actual data are not necessarily better than those computed using the perpetual inventory method. This, was, however, strongly criticized by De la Fuente and Domenech (2006), who argue that the decision to ignore direct information provided by censuses is irrational.

A composite measurement approach was introduced by Barro and Lee (1993, 1996, 2001, and 2013), who integrated the three methods outlined above to produce education attainment stock data. Using UNESCO, Eurostat, and national sources survey and census data, they constructed measures of educational attainment for a large number of countries at 5-year intervals for the period 1950 to 2010. The dataset presents the distribution of educational attainment of the adult population aged 15 and 25 over across six different categories of education. The dataset was also augmented by additional measures of average years of schooling. Since there was a large number of missing observations on education attainment levels, forward and backward extrapolation were used to fill the gaps. Data on adult illiteracy rates were used to fill the missing values of the no–schooling category, considering the high correlation between the two proxies. Initially, to fill the missing observations for the main categories of education the authors applied a perpetual inventory method, using the census/survey data on the educational attainment of the adult population over age 15 or 25 as benchmark stocks. School enrolment rates and population age structures were used to estimate changes from the benchmarks. However, given the criticism raised against this approach, a new methodology was later adopted by the authors. In their new dataset, Barro and Lee (2013) used observations in 5-year intervals for the previous or following 5-year periods, thus reducing the measurement error considerably. New estimates, such as survival/mortality rates by age and education, and completion ratios by educational attainment and age were also constructed. The updated estimates appear to have overcome to a large extent the previously acknowledged limitations (Barro and Lee, 2013).

Despite its widespread use and popularity, education attainment proxies have been criticized for reflecting only the formal education output. As postulated by the human capital theory, training represents an important component of human capital accumulation that should be taken into account when quantifying the stock of the human capital. However, in spite of the hypothesised added value, its role has been researched relatively less compared to that of formal schooling. A possible reason behind this might be the complexity of measuring investments in training and the limited availability of data, particularly at more aggregated levels of investigation. Eurostat has started to address the latter issue by carrying out a survey on the continuing vocational training (CVTS). This survey is conducted every five years and up to now there are three waves of data available: 1999, 2005, and 2010. Firm level data on the incidence of on-the job training in the transition region is also provided by BEEPS survey, a joint initiative of EBRD and the World Bank.

Another drawback relates to each additional year of schooling being typically perceived to increase the stock of human capital by an equal amount, regardless of being a person's first or tenth year of schooling. This measurement approach also ignores the quality of the education system, by implicitly assuming that it does not have any significant impact on the human capital stock (Woessmann, 2003). That is to say, by considering the quality of education the same across countries, one year of schooling in a Brazilian Amazon village is perceived to make the same contribution to the stock of human capital as one year of schooling in Belgium. Given that the latter perception is highly likely to be false a cross-country analysis relying only on the quantity of education tends to produce biased and inconsistent results (Hanushek and Woessmann, 2007). By further supporting this view, Hanushek and Woessmann (2009), argue that focusing primarily on cognitive skills as opposed to years of schooling is inherently advantageous, since it reflects the differences in knowledge that the schooling system aims to produce. In this way, it is likely to capture skills and competencies acquired from various sources, beyond those related to formal schooling. In order to capture latter dimension, Barro and Lee (1996, 2001) introduced the real public educational spending per student, teacher-pupil ratios, estimated real salaries of teachers, length of the school year, as well as repeaters and dropout rates, as input proxies for the quality of education. In spite of the attempts, the existing evidence seems to suggest that the majority of these proxies are weak measures of the quality of education (Hanushek, 1996).

Alternatively, the quality dimension of education across countries has been represented by students' achievements on internationally comparable tests. In this context, international tests in the field of mathematics, science and reading (PISA, TIMSS, PIRLS) have been carried out by the Organisation for Economic Co-operation and Development (OECD), the International Assessment of Educational Progress (IAEP), and the International Association for the Evaluation of Educational Achievement (IEA). By making use of such information Hanushek and Kimko (2000) constructed a single quality index based on primary or secondary students' cognitive achievements on six international tests in mathematics and science for 39 countries. The inability to directly account for the educational capital of the current workforce represents a key limitation of this approach. Furthermore, due to data limitations for the latter dimension, it is difficult to provide an assessment that integrates both the quality and quantity of education. Woessmann (2003) tried to integrate the above mentioned quality measure into the stock of human capital, the latter being proxied by the average years of schooling (extracted by Barro and Lee)and average rates of return to education (Psacharopoulos, 1994). However, given the restricted availability of the data for the quality and rates of return to education this turned out not to be very useful. Furthermore, the weighting procedure for the quality measures was determined in an ad-hoc manner (Woessmann, 2003). In attempt to extend this approach further, Hanushek and Woessmann (2009) included new international tests, additional countries, and other time and country specific elements. The latter cognitive skills measure was constructed by integrating and standardizing mathematics and science test scores for 50 countries, for the period 1964–2003.

Unlike the quality measures discussed so far, the International Adult Literacy surveys were introduced to capture the human capital of the adult labour force. The adult literacy test scores are comparable across countries and reflect specific skills of the adult population, beyond the education related skills (Barro and Lee, 2001). Three main adult literacy surveys have been designed and made available: the International Adult Literacy Survey (IALS), the Adult Literacy and Lifeskills Survey (ALL), and the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) (Thorn, 2009). Statistics Canada in cooperation with OECD and other institutions introduced the International Adult Literacy Survey (IALS). Data were collected for three waves (1994, 1996, 1998) for 22 countries, where three domains of literacy were assessed, prose literacy, document literacy and quantitative literacy. The Adult Literacy and Lifeskills Survey (ALL) was introduced to measure a wider range of adult population skills, though, the country coverage remains quite limited. In the first round (2002-2003), seven countries were covered, while the assessment carried out in 2006introducedanother five countries. This test focused on prose literacy, document literacy, numeracy, and problem solving. Other domains, such as teamwork, practical cognition and working with information technology were initially projected to be part of the survey, but it turned out not to be possible to construct corresponding reliable measures for the latter (Thorn, 2009). To provide an assessment of an advanced range of skills the OECD introduced a programme for the International Assessment of Adult Competencies. The latter survey assessed the skill level of the adult population aged 16 and over, in literacy (combined prose and document), numeracy and problem solving in technology rich environments in 24 countries. Moreover, information on activities related to reading and numeracy, the use of information technology, and other basic skills were also collected. Respondents were also asked if their skills and credentials matched their job requirements (OECD, 2013a). However, despite the advantage of measuring directly labour force skills, these datasets remain very limited in terms of the time span and country coverage. It is pertinent to highlight that, in addition to the skills discussed above; there is another important set of skills that is likely to influence the performance of individuals. It refers to the "set of attitudes, behaviours, and strategies that are thought to underpin success in school and at work, such as motivation, perseverance, and self-control" (Gutman and Schoon, 2013, p.2). These skills are commonly termed as "non-cognitive skills" or "soft skills" and have been less extensively researched in the literature. Despite the hypothesized positive link between non-cognitive skills and an individual's personal and professional success, the causal empirical evidence is still weak. An important implication is that, in order to obtain more reliable results, non-cognitive skills should be assessed in combination with each other rather than separately (Gutman and Schoon, 2013).

The discussion presented above indicates that the measurement of human capital is very challenging and that there are no flawless measures currently available. Data restrictions and incorrect measurement specifications may be potential reasons why inconsistent results, particularly on the relationship between human capital and economic growth, have prevailed in the empirical literature. However, given their established theoretical grounds, popularity, the general availability of data, and the relationship to be investigated in this research project, the macro level analyses conducted in Chapters 4 and 5 will be based on an integrated approach, using both estimates of the educational attainment developed by Barro and Lee (2013) and the cognitive skills measure proposed by Hanushek and Woessmann (2009). In the micro level analysis conducted in Chapter 6, the human capital dimension will be proxied by the education attainment of a firm's labour force. This analysis will also take into account the training dimension as an important source of human capital accumulation. The latter will be captured by a dichotomous measure, i.e. whether a firm has offered formal training programmes for its permanent, full-time employees or not. In addition, the potential impact of the percentage of skilled workers and the level of education and years of experience of the top manager will be also assessed in this research analysis. Note that, the choice of human capital measures to be employed in this firm-level analysis is ultimately determined by the specificity of data made availability by BEEPS.

3.5 Conclusions

In this chapter, the importance of human capital endowments for productivity and economic growth has been elaborated in the light of different schools of thought. It was endogenous growth theory that emphasised the crucial importance of human capital investment for the economic performance of nations. Proponents of this view argue that skilled individuals are more likely to innovate and/or adopt new sophisticated technologies, which consequently increases productivity and generates growth. According to the conventional human capital theory, education and on-the job training are the main sources of human capital development. Both activities are expected to develop and enhance learning abilities of individuals, which in turn tend to translate into higher labour productivity. Regarding the transmission mechanism, the influence of skills and knowledge on productivity seems to depend on the set of tasks to be performed. The role of informal sources such as on-and off-the job training, and the importance of the quality dimension of education have been also reviewed and critically assessed. Furthermore, the chapter provided a discussion on the main approaches to modelling empirically the relationship between human capital and international competitiveness. Similar to the human capital – growth mechanisms, the importance of human capital accumulation for competitiveness and export performance was generally derived from its relation with technological diffusion and catch up, innovation and labour productivity. The importance of knowledge and skills for international competitiveness was supported by the established link between productivity and knowledge and skill based activities. Human capital, as a key determinant of productivity, is considered an important source of competitiveness. The research reviewed suggests that more productive firms are more likely to participate and remain in international markets as compared to their less productive counterparts. An increasing level of human capital is also expected to play a key role in inducing innovative activities, which, in turn, is likely to enhance international competitiveness. It is pertinent to note that the validity of the above outlined link tends to be also subject to the level of development of countries under analysis. For instance, for many transition economies, given their current degree of innovation engagement and level of technological development, human capital is more likely to facilitate technological catch-up and incremental innovation, rather than stimulate radical innovation. As hypothesised, the skill set required to induce innovation is subject to the nature of innovation. More advanced skills are needed to promote major changes in technology and production processes, whilst, more basic skills may be sufficient to deal with minor process modifications.

In spite of the extensive number of studies having assessed empirically the relationship between human capital, productivity and growth, the results remain inconclusive. To a large extent, the lack of conclusive results has been attributed to measurement and misspecification errors surrounding human capital. Among the three key measurement approaches reviewed in this chapter, the education-based method has been most commonly employed in the economic literature. Its widespread accepted theoretical basis and the availability of data are the main reasons behind its frequent use. Furthermore, in the absence of direct information, education attainment, both formal and informal, is perceived to reflect the knowledge, skills and competences of individuals more adequately than the alternative proxy measures.

To the complexity of measuring precisely human capital is also added the difficulty of quantifying the multidimensional concept of international competitiveness. Regarding the latter, a variety of measures have been proposed in the literature with no agreement on the superiority of any given one, though, a tendency towards trade/export based measures has been identified. Taking these into consideration, a review of empirical studies assessing the potential link between human capital and international competitiveness, the latter being mostly proxied by export based indicators has been presented in this chapter. Overall, the review of micro and macro evidence has revealed that, relative human capital endowment tend to have a positive impact on the international competitiveness of entities. To shed new light on the hypothesised link between human capital endowments and international competitiveness, with special reference to transition economies, a country-industry level analysis using longitudinal data for the period 1995-2010 will be conducted in the following chapter.

CHAPTER 4

HUMAN CAPITAL AND INTERNATIONAL COMPETITIVENESS: COUNTRY AND INDUSTRY LEVEL EVIDENCE

Contents

4.1 Introduction

The aim of this chapter is to investigate the impact of human capital endowments on the international competitiveness of a group of European countries, with special reference to transition economies. This investigation is based on country and industry level estimations using longitudinal data for the period 1995-2010. The choice of the model specification is derived from the discussion on the theoretical mechanisms through which human capital influences international competitiveness presented in Chapter 3. As argued in the previous chapter, the stock of human capital is likely to impact international competitiveness through the following underlying channels: technological diffusion, innovation and labour productivity. The new endogenous growth theory postulates that more educated and higher skilled individuals are more likely to innovate and/or adopt new sophisticated technologies, which consequently tends to boost labour productivity. In turn, more productive firms and countries are more likely to maintain and/or enhance their international competitiveness. In this investigation, following the discussions in the previous two chapters, international competitiveness is represented by the export market share and a measure of relative export advantage, whereas, human capital is proxied by education attainment, quality of education, and participation in vocational training. In line with the human capital theoretical underpinnings, the education and training are considered crucial to developing the knowledge, skills and competences of individuals. The remaining parts of this chapter are organized as follows: section 4.2 discusses variable specification, their functional transformations, data sources, and presents key descriptive statistics. The following section (4.3) provides discussions of the main estimation methodologies employed for panel data analysis, their key advantages and disadvantages, the issue of omitted time invariant variables and ways to handle it. Section 4.4 and 4.5 present and interpret the country and industry level empirical findings obtained from the preferred baseline estimation method as well as the alternative estimators. The issue of endogeneity bias is assessed and accounted for in all the specified models following an instrumental variable (IV) approach, using lagged values of the potentially endogenous variables as instruments. Finally, section 4.6 summaries the main findings and concludes.

4.2 Data and variable specification

As elaborated in Chapter 2, international competitiveness is regarded as a complex and ambiguous notion, and this is reflected in the many measurement approaches proposed in the literature. That Chapter provided a comprehensive assessment of its main definitions and proxy measures, accompanied by a review of empirical research; that analysis established the basis for the specification of international competitiveness in the empirical investigation presented in this and the following chapters. In spite of the variety of measures being developed/adopted in the economic literature, there was a distinct tendency among researchers to rely on trade/export based indicators. Hence, given the widely accepted theoretical basis and data availability, international competitiveness in this empirical analysis is initially represented by export market share *(emsh)*. This variable is defined as the ratio of each country's exports of goods to the total exports of goods of EU-28. As constructed, it is expected to reflect the degree of competitiveness of each country relative to this set of countries. Data are taken from UNCTAD's database: Goods and services trade openness indicators, annual, 1980-2011. It is important to note that, alternative specification of this measure has also been considered to proxy international competitiveness, i.e. exports of goods of country *i* over the total imports of goods of EU-28.[40] Even though, the latter might be regarded a sensible measure of the export share of a country in a particular market, in this investigation, we are more interested in measuring the competitiveness of a country by comparing its exports with the exports of specific group of countries (e.g. potential competitors). As previously argued, the rationale for using this particular specification of export market share is to be able to capture the degree of importance/competitiveness of a country within the total exports of a region (EU-28). That is to say, if exports of a country increase at a higher rate than the total exports of EU-28, it can be argued that the relative position of that country has improved compared to EU-28, and vice-versa.

In addition to assessing the export market share of these countries, a modified version of Balassa's (1965) revealed comparative advantage index (RCA) has been introduced to capture the degree of international competitiveness at the industry level. Indices are calculated for ten manufacturing industries (grouped), using export data from the OECD's *STAN Bilateral Trade*

[40]For comparison purposes, an alternative regression analysis employing this measure has been conducted in this chapter and the use of the two alternative measures has yielded very similar empirical evidence.

Database by Industry and End-use Category, edition 2012 (OECD, 2013b). As discussed in Chapter 2, the revealed comparative advantage index (RCA) has been introduced to measure the comparative advantage of a country in a specific industry or product. Despite its widespread use in the literature, it has been subject to various criticisms, i.e. the inability to fully capture the theoretical concept of comparative advantage, as well as its questionable statistical features. The revealed comparative advantage was initially introduced by Balassa (1965) (see equation 4.1) and it has since been modified by numerous scholars with the purpose of overcoming some of its limitations, e.g. inconsistency when compared with alternative comparative advantage measures, asymmetric[41] distribution, and instability across time and countries.

$$RCA_{ij} = (X_{ij} / X_{it}) / (X_{nj} / X_{nt}) \qquad (4.1)$$

Where *X* represents exports, *i* denotes countries, *j* denotes industries *t* represents a set industries and *n* denotes a set of countries. If the value of the index is greater than 1, a given country has a revealed comparative advantage in the export of that specific product or industry. Conversely, if the value is less than 1, there is a lack of a comparative advantage in the export of that specific product or industry. Vollrath (1991) developed a modified specification of the original index, in order to correct for the industry and country double counting and the asymmetry problem, the relative export advantage (RXA). This index, henceforth referred as RXA is defined as the ratio of country *i* exports of industry/product *j* relative to its total exports and to the corresponding exports of EU-28, expressed in logarithmic terms. In contrast to Balassa's RCA index, *t* denotes all products or industries other than *j*; *n* denotes all countries other than *i*. The industry classification used to construct these indices is presented in Table 4.1 below.

Table 4.1 Manufacturing industries according to ISIC rev. 3

No.	**Manufacturing industries**	**ISIC code**	**Technology intensity**
1	Food products, beverages and tobacco (FBT)	15-16	Low
2	Textiles, textile products, leather and footwear (TLF)	17-19	Low
3	Wood and products of wood and cork (PWC)	20	Low

[41] The RCA is asymmetric through the origin, i.e. not comparable on both sides of unity. The index ranges from zero to one, if a country does not have a comparative advantage, while it ranges from one to infinity, if a country has a comparative advantage in a specific industry/product.

4	Pulp, paper, paper products, printing and publishing (PPP)	21-22	Low
5	Chemical, rubber, plastics and fuel products (CRPF)	23-25	M. low/ M. high/ High
6	Other non-metallic mineral products (NMM)	26	M. low
7	Basic metals and fabricated metal products (BMF)	27-28	M. low
8	Machinery and equipment (ME)	29-33	M. high/high
9	Transport equipment (TE)	34-35	M. low/M. high/high
10	Manufacturing n.e.c. and recycling (MR)	36-37	Low

Source: STAN Bilateral Trade Database by Industry and End-use category. Ed. 2012 ISIC Revision 3

Human capital as the primary variable of interest in this investigation is proxied by the education attainment indicators provided by Barro and Lee (2014), and a cognitive skills measure developed by Hanushek and Woessmann (2009). The choice of these measures is derived from the human capital measurement discussion provided in the previous chapter. As previously argued, in the absence of more direct information on the skills and competences of the potential labour force, we have to primarily rely on the attainment of formal education. The formal education based indicators used in this investigation are: the percentage of population aged 15 and over who have attained secondary education, the percentage of population aged 15 and over who have attained tertiary education and the average number of years of schooling for the population aged 15 and over. The first two variables refer not only to the total stock of population who have completed the entire cycle of studies, but also to those who have completed some secondary/tertiary education. That is to say, the first measure reflects the share of population who have completed secondary education as their highest level attained as well as those who have attained part of secondary education, whereas, the share of population who have continued to higher education are reflected in the (total) tertiary education measure. Henceforth, these variables will be referred as the share of population 15 and over who have attained secondary/tertiary education as their highest level.[42] Since these indicators are constructed at 5-year intervals, the gaps for the periods in between need to be filled in order to make use of the highest possible number of observations. According to Rizvanolli (2012), interpolation is preferred to multiple imputation since the missing values are more likely to be linked to the existing data values rather than to other variables. By assuming that the education stock changes slowly over time with a possible increasing trend, the author has used linear interpolation based

[42] The share of population with no schooling and the share of population who have attained primary education are omitted from the estimations as the total shares would add up to one and the model would suffer from multicollinearity (see Wooldridge (2009) for further explanations).

on the time variable. The same approach has been adopted in several other studies (Chen, 2004; Apergis, 2009; Shirotori et al., 2010, Seck, 2012) and it will be also employed in this empirical assessment.

As already discussed in the previous chapter, in order to overcome some of the drawbacks of focusing entirely on the quantity of education, a proxy for the quality dimension of education has also been introduced to this investigation. To the best of our knowledge, no study so far has assessed the impact of the quality of education on international competitiveness. Given the lack of more direct information on the quality of education, this investigation has been restricted to using students' achievements on internationally comparable tests. Hanushek and Woessmann (2009) proposed a single indicator which is constructed by integrating and standardizing students' test scores for the period 1964–2003. The cognitive skills measure (*cskills*) is defined as the average test score in mathematics and science, primary through end of secondary school, all years (scaled to the PISA scale divided by 100). According to the authors, the key rationale for averaging the data over a period of 40 years is to try to capture the education quality of the labour force rather than that of students. However, its constant nature seems to rely on the assumption of no or slow changes in the quality of education. To ensure that this assumption holds, students' scores of the main tests included in the calculation of the indicator were assessed and compared. A review of PISA and TIMSS test scores in mathematics and science for the sample of countries covered in this study did not suggest any significant changes in the quality of education over the time period covered. Taking this into account, we decided to make use of the cognitive skills measure beyond its original time span, i.e. until 2010. Note that data on this index are originally averaged until 2003.

Vocational training is another important component of human capital development expected to influence international competitiveness through the productivity mechanism, technology and innovation channels. However, given the data restrictions, this aspect will only be partially assessed in this investigation. Eurostat conducts a survey on continuing vocational training (CVTS) at 5-year intervals and up to now there are only three waves of data available: 1999, 2005, and 2010. Using these datasets, one of the models will be assessing the role of the percentage of employees participating in CVT courses *(emplcvt)* and training enterprises as a percentage of all enterprises *(trngent)* on the country's export market share. In order to be able to make use of the highest possible number of observations, the same approach as with education attainment data, i.e. linear interpolation to fill the gaps in between was adopted. We are aware of the restrictions that this imposes on the analysis and thus we will be very cautious when making inference about the magnitude and significance of these parameters. Given the theoretical rationale for assessing the role of human capital endowments, this component is expected to exert a significant impact on the international competitiveness of countries under investigation.

A related dimension, of special interest to this assessment, given the highlighted theoretical considerations is the innovation engagement. As argued by many researchers, innovation and technology diffusion are among the major underlying forces of international competitiveness (Wakelin, 1998b, Roper and Love, 2002, European Commission, 2008). In line with this, numerous empirical studies have found a positive correlation between innovation activities and export share, though the causation direction has not been clearly established (Damijan et al., 2008, Cassiman et al., 2010). Three potential innovation measures have been considered for this empirical analysis: research and development expenditure (% GDP), patent grants, and patent applications. The former two have been excluded from the estimations due to the large proportion of missing values. Data on patent applications (*patappr*) are provided by World Bank's World Development Indicators (WDI) database, and refer to the number of patent filings by residents. Consistent with the current empirical evidence, a positive and significant coefficient is expected to be found for this variable.

Subsequently, the current investigation aims to control for other variables that are also likely to explain the export market share/relative export advantage of countries. The choice of control variables is derived from the theoretical framework and literature review presented in the previous two chapters. The foreign direct investment *(FDI)* stock is expected to influence the export performance of host countries through different channels. According to UNCTAD (2002), transnational corporations (TNCs) play an important role in promoting the export share of host countries by providing extra capital, technology and managerial practices, better access to their home markets as well as to other new international markets. Numerous studies have found supporting evidence for the positive and significant impact of inward FDI on the export performance of different countries (for example: Zhang and Song, 2000, Jensen, 2002, Wang et al., 2007, Kutan and Vukšic, 2007). Taking this into consideration, the potential impact of FDI stock on export market share will be assessed in our own sample of countries. Foreign direct investment (*fdi*) is represented by the inward foreign direct investment stock (% GDP) and it is expected to exert a positive and significant impact. Data used for this variable are taken from UNCTAD.

The level of real GDP per capita (*gdpc*) is another control variable to be included in the model specification. This indicator is introduced to capture the level of development of countries, while their sizes have been proxied by their total population (*pop*). The values of real GDP per capita are expressed in US Dollars at constant 2005 prices and are derived from the World Bank's World Development Indicators (WDI) database. The population figures come from the Penn World Table 7.1 (Heston et al., 2012). Following the theoretical argumentations behind these relationships, both variables are expected to exert positive effects on export market share/relative export advantage. In accordance with Ricardo's theory of comparative advantage (1817), production cost (e.g. labour cost/unit labour cost) is another potential influential determinant of exporting. Although, the discussion in Chapter 2 revealed that some researchers have used the cost dimension as a measure of competitiveness rather than a determinant, this does not seem to be easily justified as a comprehensive measure. Therefore, given that in this investigation, the degree of international competitiveness is captured by the engagement of countries in international markets, the unit labour cost is likely to have a significant impact. This variable, in our estimations, is proxied by a real unit labour cost index (*rulc*) and is derived from Eurostat's database. In line with previous research, Amable and Verspagen (1995), Carlin et al. (2001), Laursen and Meliciani (2010) and other empirical studies, labour cost is expected to exert a negative effect on export market share.

The hypothesised importance of the geographical characteristics of a country for its international competitiveness dates back to Adam Smith's "Wealth of Nations", and is has been further supported by the economic geography approach (Krugman, 1991, Krugman and Venables, 1990, Venables and Limão, 2002). Distance is highly likely to influence transportation costs and consequently impact on the international competitiveness of countries. A greater distance to the exporting market implies higher shipping costs and longer transporting procedures (Radelet And Sachs, 1998, Limao and Venables, 2001, Behar and Venables, 2010). This measure is commonly used in gravity models since data on the bilateral distance between the country of origin and destination are needed. In this analysis, however, given the nature of data the distance from each country's capital city to Brussels will be used, the latter being a proxy for ease of access to the main EU markets. The calculations for this measure are done by CEPII (2014) using the great circle formula and, we expect to find a negative and significant coefficient for the latter. It is important to note that, numerous studies have already found supporting empirical evidence on the negative impact of distance on export performance (e.g. Chor, 2010, Kowalski, 2011, Van der Marel, 2012). Transportation infrastructure and landlocked-ness are additional geographical features that are likely to impact a country's international competitiveness. The extent of rail lines (total route-km) and roads (total network-km) are potential proxies for transport infrastructure but have not been included in the estimations due to lack of adequate data. Landlocked countries are also likely to export less due to higher transportation costs (Limao and Venables, 2001, Clarke et al., 2004, Behar and Venables, 2010). This variable was initially included in the estimations; however, given its low variation, i.e. the majority of countries not being landlocked, it did not seem to make a significant contribution to the analysis. The EU-28 being an important exporting destination for our sample of countries, i.e. around 67 %, on average (1990-2010) (UNCTAD, 2014b) represents another potential reason for not assessing the latter measure.

Since the competitiveness level of transition economies is of primary interest to this investigation, a transition indicator and a transition dummy have been also included in the estimations. The former is defined as an average measure of a set of indicators (large scale privatisation, small scale privatisation, governance and enterprise restructuring, price liberalisation, trade and foreign exchange system, and competition policy) provided by the EBRD (2014b). It represents a country's progress in transition, and it is scaled from 1 to 4.3. Following Hall and Jones (1999) and Eicher and Schreiber (2007), this averaged indicator is normalized to a range from zero to one. Zero denotes the "complete absence of market based economic institutions", whereas one refers to "institutional standard similar to OECD economies" Eicher and Schreiber (2007, p. 4). Note that, since the corresponding data for the

Czech Republic are missing from 2006, due to completion of the transition process, the maximum value, 4.3, which was later normalized to 1.0 has been imputed for the remaining years. A range of governance indicators provided by World Bank – *Control of Corruption, Government Effectiveness*, *Political Stability and Absence of Violence/Terrorism, Regulatory Quality, Rule of Law, Voice and Accountability* – were initially included in the analysis, but due to the large share of missing values, their potential impact could not be quantified. The transition dummy, on the other hand, represents a dummy variable which equals to 1 if a country has gone through the transition process and 0 otherwise. It is important to note that, although, the transition process has been declared to be completed by the World Bank (2008) for all the Central Eastern European countries analysed in our sample, these are still refered as transition economies in order to differentiate between countries that have gone through the transformation process and those that have not.

The potential link between the level of economic freedom of a country and its export market share and relative export advantage will be also assessed in this investigation. The Heritage Foundation has constructed an economic freedom index based on a set of 10 different factors (including property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labour freedom, and monetary freedom). This is an average measure with equal weights being given to each factor or category. In line with the existing evidence, this indicator is expected to exert a positive impact on international competitiveness.

Another important aspect to be accounted for in this investigation is the phenomenon of labour market mismatch. The initial aim was to introduce a specific measure that captures the degree of mismatch between the knowledge and skills of employees and market needs. This would have allowed us to assess the hypothesis that in the presence of a high degree of skill mismatch the contribution of more educated employees to productivity enhancement and competitiveness would be have been less significant. However, since the degree of skills mismatch is not easily measurable due to the lack of appropriate data, a broader mismatch proxy, i.e., the long term unemployment rate (% of total unemployment) is employed in this investigation. Data for this variable are made available by the World Development Indicators (WDI) - World Bank, and we expect this indicator to exert a negative effect on competitiveness.

Finally, in order to assess the potential impact of the size of the non-tradable sector on the exports share of a country, services, etc., [43] value added as a % of GDP is used, though we are aware that this is not an ideal proxy. This measure represents the value added in wholesale and retail trade, transport, and government, financial, professional, and personal services such as education, health care, and real estate services (% of GDP). It also covers the imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. However, given the recent changes in the information and communication technology, services are becoming increasingly tradable, though since distinguishing between tradable and non-tradable goods is quite difficult; using the share of services is the only option readily available. Data for this measure are taken from World Bank's World Development Indicators (WDI) database. A higher share of services in a country, holding other factors constant, is likely to reduce its propensity to export; hence, we expect to find a negative coefficient for this variable.

Variable descriptions, labels, the expected signs and data sources are also summarized in Table 4.2 below.[44]

Table 4.2 Variable descriptions

[43] This is the World Bank's definition of this indicator and it consists of the above listed categories.
[44] A domestic investment measure and a price measure (REER) were initially included in the analysis as control variables but were later excluded since they did not seem to add much value to the explanatory power of models.

Variable name	Description	Expected sign	Data source
emsh	Exports of goods of country *i* over total exports of goods of EU-28 (level)	Dep. variable	Own calculations based on UNCTAD database (2013)
rxa	The ratio of country *i* exports of industry *j* relative to its total exports and to the corresponding exports of EU-28	Dep. variable	Own calculations based on OECD STAN database (2012)
sedut	The percentage of population aged 15 and over who have attained secondary education	+	Own calculations based on Barro and Lee's (2014) database (version 2.0)
tedut	The percentage of population aged 15 and over who have attained tertiary education	+	
avyrs	The average number of years of schooling of the population aged 15 and over	+	
cskills	Average test score in mathematics and science, primary through end of secondary school, all years (scaled to the PISA scale divided by 100)	+	Hanushek and Woessmann (2009)
emplcvt	Percentage of employees (all enterprises) participating in CVT courses	+	Eurostat (2014)
trngent	Training enterprises (as % of all enterprises)	+	Eurostat (2014)
patappr	Number of patent applications by residents	+	WDI – World Bank (2014)
fdi	Inward foreign direct investment stock (% GDP)	+	UNCTAD (2014)
gdpc	GDP per capita (constant 2005 US$)	+	WDI – World Bank (2014)
pop	Total population (in thousands)	+	Penn World Table 7.1 (Heston et al., 2012)
rulc	Real unit labour cost index (2005=100)	-	Eurostat (2014)
dist	Distance from capital city to Brussels (in km)	-	CEPII (2014)
transindN	Transition indicator (average of a set of single indicators - normalized from 0 to 1)	+	EBRD (2014)
transdummy	Transition dummy - going through transition (1-Yes, 0-No)	-	EBRD (2014)
ecofree	Index of Economic Freedom (overall score based on a set of 10 factors)	+	The Heritage Foundation (2014)
unem	Skills mismatch: Long-term unemployment	-	WDI – World Bank (2014)

	(% of total unemployment)		
serv	Services, etc. , value added (% of GDP)	-	WDI – World Bank (2014)

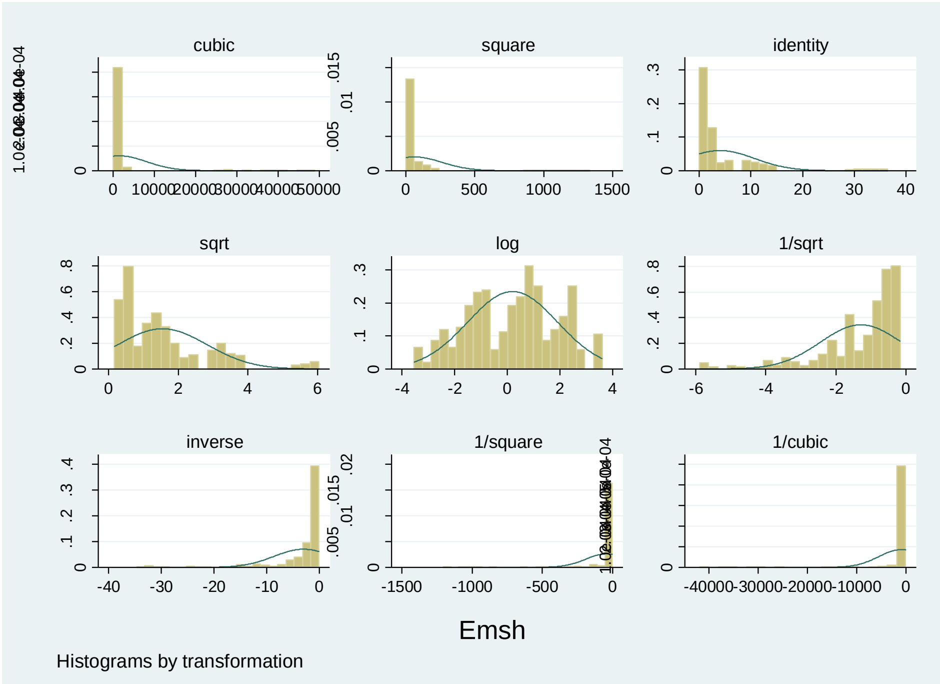
For the purpose of linearising and normalising the distribution of the variables, the approach of ladder of powers proposed by Tukey (1977) was followed. Its output, in general seems to support the logarithmic transformation of the dependent variable and a number of explanatory variables.[45] For the rest of the variables[46], no functional transformation is needed or is applicable. The ladder of powers has been computed in Stata by the *ladder* and *gladder* commands. The *ladder* option reports numeric results for several functional transformations, supporting the one with the lowest chi-squared value. Similarly, the *gladder* command produces nine histograms and it favours the transformation which makes the variable more normally distributed. The results presented in the table and figure below support the logarithmic transformation of the export market share variable. The functional transformations (histograms) of other variables are presented in Figures A4.4.1- A4.5.8, in the appendix section (A4).

Table 4.3 Export market share *(emsh)* functional transformation

Transformation	**formula**	**chi2(2)**	**P(chi2)**
cubic	emsh^3	.	0.000
square	emsh^2	.	0.000
identity	emsh	.	0.000
square root	sqrt(emsh)	.	0.000
log	log(emsh)	27.65	0.000
1/(square root)	1/sqrt(emsh)	.	0.000
inverse	1/emsh	.	0.000
1/square	1/(emsh^2)	.	0.000
1/cubic	1/(emsh^3)	.	0.000
. implies high chi-squared values			

[45] Although there is no functional transformation required for sedut and tedut, a logarithmic transformation has been taken in order to account for potential outlying observations. Furthermore, the use of logged variables seems to capture more closely the relationship(s) we are trying to investigate.
[46] Avyrs, cskills, transdummy/transind, unem, serv and dist.

Figure 4.1 Export market share *(emsh)* functional transformation



The summary statistics for variables expressed in levels show very large standard deviations for *patappr*, *fdi*, *gdpc*, *pop and dist*, implying that data for these variables are spread widely around the mean (see Table A4.3 in Appendix A4). Since we are dealing with countries of different sizes and economic development levels, this level of dispersion is expected. In addition, the means of these variables are larger than their medians, indicating a positively skewed distribution. The logarithmic transformation applied to these variables has made their distribution more symmetrical; thus suggesting that the log based descriptive statistics should be reported rather than their levels (see Table 4.4). The statistics from the table below also show that we are using an unbalanced panel due to missing data for some variables in some years. There is no indication of data missing for a specific reason rather than randomly, therefore this is not expected to influence the reliability of the results.

Table 4.4 Descriptive statistics

					Quantiles			
Variable	**n**	**Mean**	**S.D.**	**Min**	**.25**	**Mdn**	**.75**	**Max**
lnemsh	464	0.20	1.70	-3.55	-1.02	0.43	1.35	3.60
lnrxa	4570	-0.10	0.89	-5.52	-0.59	-0.09	0.41	3.92
lnsedut	464/4640*	4.05	0.24	3.21	3.89	4.09	4.19	4.49
lntedut	464/4640	2.81	0.36	1.95	2.52	2.87	3.11	3.69
avyrs	464/4640	10.34	1.18	6.69	9.54	10.38	11.22	12.82
Cskills**	432/4320	4.90	0.19	4.54	4.78	4.96	5.05	5.19
lnpatappr	442/4420	6.56	1.97	1.10	5.49	6.67	7.73	10.85
lnfdi	463/4630	3.23	1.75	-9.21	2.83	3.45	3.93	5.78
lngdpc	464/4640	9.83	0.83	7.76	9.19	9.99	10.48	11.38
lnpop	464/4640	8.94	1.38	5.93	8.23	9.01	9.71	11.32
unem	440/4400	39.22	15.35	0.00	27.00	42.35	51.10	73.10
lnecofree	453/4530	4.18	0.12	3.76	4.11	4.19	4.26	4.41
lnrulc	431/4310	4.62	0.04	4.52	4.60	4.61	4.64	4.86
serv	452/4520	66.71	7.47	35.83	62.03	66.66	72.01	86.55
dist	464/4640	1142.02	631.97	68.44	767.16	1129.98	1601.10	2904.98
transdummy	464/4640	0.38	0.49	0.00	0.00	0.00	1.00	1.00
transind	153[†]/1530	3.62	0.30	2.60	3.40	3.60	3.90	4.10
emplcvt	293[††]	31.95	12.86	8.00	19.20	33.00	41.00	61.00
trngent	299	60.92	20.43	11.00	44.00	68.00	76.00	96.00

Notes:
(*) The number of observations for the industry level analysis. Note that the descriptive statistics for the independent variables are the same across the two levels of aggregation.
(**) Data for Croatia and Malta are missing for all years; therefore both countries are excluded from the estimations.
(†) The number of observations refers to the sub-sample of transition economies since the transition indicator is applicable only for this group of countries.
(††) The number of observations refers to the training sub-analysis which covers the period 1999-2010. The same applies for the *trngent* variable.

The diagnostics presented in the Table 4.5 raise no major concerns regarding the collinearity of explanatory variables, with the exception of GDP per capita, population, transitional dummy and patent applications. Their variance inflation factors (VIFs) are 10 or greater than 10, thus indicating potential problems of multicollinearity. The correlations matrix is another tool that gives insights about the potential collinearity between explanatory variables. Its results indicate quite high degrees of correlation between population and patent application, GDP per capita and transitional indicator, and secondary education attainment and average years of schooling (see

Table A4.3.1 in Appendix A4). The share of population who attained secondary education and average years of schooling are by definition correlated with each other but since these are included in separate models, multicollinearity is not an issue. Dealing with multicollinearity usually involves either increasing the sample size or dropping the potentially problematic variables (Wooldridge, 2009). The former is not always applicable, whereas the latter can lead to omitted variable bias, if relevant variables are excluded. To investigate this further, models with and without the potentially problematic variables were estimated. Even though, some slight changes in the magnitude and significance of some of the estimated coefficients were noticed, the signs remained unchanged. Both, GDP per capita and population are considered of key importance to the model specification and their exclusion would distort the estimated results. Moreover, as Wooldridge (2009) points out, if the degree of correlation between any control variables does not affect, i.e. is not correlated with the variables of interest, the partial effects of the latter can be determined without any difficulties. Hence, taking this into account, the econometric models were estimated with the full set of explanatory variables.

Table 4.5 Collinearity diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared	Eigenval	Cond Index
lnsedut	8.07	2.84	0.1239	0.8761	5.0035	1.0000
lntedut	3.70	1.92	0.2704	0.7296	2.9259	1.3077
avyrs	9.19	3.03	0.1088	0.8912	2.0887	1.5477
cskills	2.66	1.63	0.3765	0.6235	1.1699	2.0680
lnpatappr	11.94	3.46	0.0837	0.9163	1.0741	2.1583
lnfdi	1.30	1.14	0.7683	0.2317	0.8591	2.4134
lngdpc	21.28	4.61	0.0470	0.9530	0.7325	2.6135
lnpop	13.37	3.66	0.0748	0.9252	0.6245	2.8306
unem	2.17	1.47	0.4603	0.5397	0.4985	3.1682
lnecofree	2.86	1.69	0.3492	0.6508	0.3252	3.9223
lnrulc	1.19	1.09	0.8412	0.1588	0.2398	4.5676
serv	2.72	1.65	0.3680	0.6320	0.1995	5.0081
dist	3.42	1.85	0.2928	0.7072	0.1326	6.1424
transdummy	22.96	4.79	0.0436	0.9564	0.0558	9.4660
trngent*	7.81	2.79	0.1280	0.8720	0.0513	9.8752
emplcvt	4.17	2.04	0.2395	0.7605	0.0190	16.2348
Mean VIF	7.43					
Condition Number						16.2348
Eigenvalues & Cond Index computed from deviation sscp (no intercept)						
Det(correlationmatrix)						**0.0000**

Notes: (*) Training variables, i.e. *trngent* and *emplcvt* are assessed separately therefore multicollinearity is not an issue.

4.3 Estimation methodology

Following the data and variable specification discussion presented in section 4.2, the baseline model specification for this empirical analysis is presented below.

$$Y_{i(k)t} = \beta X'_{it} + \alpha_i + \varepsilon_{it}, \qquad (4.2)$$

$i = 1, \ldots, 27, \; t = 1, \ldots, 16$

Where $Y_{i(k)t}$ represents the natural logarithm of export market share/ relative export advantage (RXA), X_{it} is a vector of explanatory variables, α_i is the unobserved country specific effect and ε_{it} is the error term, *i* denotes countries, *k* denotes industries, and *t* denotes time. All the models in this investigation have been augmented by including a set of time dummies. According to Roodman (2006, p.26), "it is almost always wise to include time dummies in order to remove universal time-related shocks from the errors". Two separate models have been estimated: Model 1 focuses on the impact of the share of population aged 15 and over who have attained secondary and tertiary education, while, Model 2 assesses the effect of the average years of schooling on the export market share/ relative export advantage.

In order to investigate the impact of human capital on international competitiveness, a sample of 27 European countries[47] (EU-27)[48] over the period 1995-2010 will be used. The key focus of this analysis is placed on transition economies.[49] Given the advantages of combining two dimensions of data, time series and cross-section, panel data modelling is widely adopted in the empirical research. The advantages of using panel data analysis are, "more information, more variability, less collinearity among the variables, more degrees of freedom and more efficiency" (Baltagi, 2005, p.5). Moreover, it accounts for heterogeneity across units, and it is better at analyzing the "dynamics of adjustment" (Baltagi, 2005, p.6). The most commonly used methods to estimate panel data are fixed effects (FE) and random effects (RE). One of the key features of the fixed

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[47] Countries included in our sample are members of the EU, excluding Malta and Croatia (i.e. Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Germany, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, and United Kingdom) and Norway.

[48] It is important not to confuse this with EU-28 which represents the reference group of countries in constructing *emsh* and *RXA.*

[49] Albania, Croatia, Bosnia and Herzegovina, Kosovo, Macedonia, Montenegro and Serbia are excluded from the investigation due to the lack of available data.

effects estimation is that it allows for correlation between the unobserved effect and explanatory variables in the model. A random effects estimator, on the other hand, is used when the unobserved individual effect is assumed to be uncorrelated with the included explanatory variables (Wooldridge, 2002, Greene, 2002, Baltagi, 2005). Choosing the appropriate estimator does primarily depend on the discussed link between the explanatory variables and unobserved unit effects. If the explanatory variables are correlated with the unobserved effect, the estimates of the RE (GLS[50]) would be inconsistent and biased. As Greene (2002) argues, the assumption of no correlation is hardly justifiable and it usually fails. In the same vein, Wooldridge (2009, p. 450) claims that "in many applications, the whole reason for using panel data is to allow the unobserved effect to be correlated with the explanatory variables". Hausman (1978) has contributed to the aforementioned debate by proposing a specification test that checks if there are systematic differences between the two estimators. A simple interpretation of the results is that the rejection of the null hypothesis suggests that the fixed effects estimator is needed, while a non-rejection favours the use of random effects (Wooldridge, 2002, Baltagi, 2005). This approach was adopted in order to make a decision on choosing the appropriate estimation method for our own empirical analysis. Despite the noted advantages, a main shortcoming of this model is the inability to estimate the coefficients of time-invariant variables. The fixed effects estimator uses a transformation to remove the unobserved specific effect and all the time invariant explanatory variables before estimation (Wooldridge, 2009). Hence, this restricts the investigation given that three of the explanatory variables are constant over time. The cognitive skills measure which is of primary interest to this analysis would be omitted if the standard FE approach is employed. The same applies to the other time invariant explanatory variables, distance and the transitional dummy. To overcome this problem, alternative estimation methods that share similar features with FE but allow for time constant variables have been developed.

Hausman and Taylor (1981) developed an instrumental variable method which is a mixture of fixed effects and random effects. In contrast to the FE and RE's strict assumptions of correlation and no correlation, respectively, this estimator allows for some explanatory variables to be correlated with unobserved specific effects while others not. Variables that are specified as exogenous, both time varying and time invariant, are used as instruments for the endogenous

[50] Generalized Least Square

variables. It is important to note that, all the explanatory variables are assumed to be uncorrelated with the error term (Baltagi, 2005, Cameron and Trivedi, 2005). Despite its widespread popularity among researchers, Cameron and Trivedi (2005) and Breusch et al. (2011) argue that identifying the endogeneity or exogeneity of every explanatory variable is not an easy task. Similarly, Plumper and Troeger (2007) claim that this method yields reliable estimates only if the instrumental variables are strongly correlated with the endogenous variables and uncorrelated with the unobserved specific effects and error term. Given the difficulty of specifying these links, the authors introduced an alternative estimation method.

The fixed effects vector decomposition, henceforth referred as FEVD, is a three step procedure that allows for time invariant and rarely changing variables in models estimated with unobserved specific effects. First, a standard fixed effects model is estimated, excluding time invariant variables. In stage two, the unit effects, which is extracted from the regression in the previous stage, is regressed on time invariant and rarely/slowly changing variables. This stage enables the decomposition of unit effects into the unexplained and explained part. The third stage involves a pooled OLS model of time varying, time invariant, rarely changing variables and the unexplained part extracted from step two. The rationale for extending the procedure to the third step, according to the authors, is to correct for the degrees of freedom and hence, adjust the standard errors of the estimated parameters. This procedure can be easily implemented in Stata using the *ado* file provided by the authors. By conducting a series of Monte Carlo simulations, the authors have suggested that their estimator outperforms pooled OLS, random effects and Hausman and Taylor in estimating models with time invariant and/or slowly changing variables. They argue that FEVD has got better finite sample properties and thus, produces more accurate estimates when both time invariant and time varying variables are assumed to be correlated with the unobserved effect. Moreover, they argue that FEVD is more efficient than FE as well, given that its estimates are based on within as well as between variance (Plumper and Troeger, 2007, 2011). Although, it has attracted the attention of many researchers and has been used in many empirical analyses, it has also been criticised by some econometricians. Greene (2011) argues that the new method is the same as the LSDV estimator and that there are no apparent efficiency gains. Moreover, he has strongly criticised step 3 of the procedure by arguing that it produces very small standard errors, and therefore, it should not be carried out. He further suggests that, subject to the validity of the orthogonality assumption, researchers should only rely on the estimates of step 1 and step 2 (with some additional calculations). If the above outlined condition is not met then the actual estimator, according to Greene (2011), is regarded as inconsistent with a potentially smaller variance compared to its alternative estimation approaches. However, the authors of FEVD claim to have addressed the issue of very small standard errors in their updated Stata *ado* file. According to Breusch et al. (2011), if there is an indication of potential endogeneity, i.e. time invariant variables being correlated with the unobserved effects, the FEVD estimator will be inconsistent. A similar procedure, to the first two steps of FEVD, is the two stage estimator proposed by Hsiao (2003). It assumes no correlation between the time invariant variables and the unobserved fixed effects. However, the consistency of this estimator seems to be subject to the sample size to be investigated. This procedure produces consistent estimates for time invariant variables only when N approaches infinity.

By assuming that there might be some persistence in countries' export market shares, the estimation was further extended by also accounting for the "dynamics of adjustment". As Bond (2002) argues, even when we are not primarily interested in its impact, allowing for dynamics might improve the consistency of the estimates of other coefficients included in the model. A favourable estimation approach that accounts for the past while at the same time allowing for time variant variables is the "system" GMM[51] developed by Arellano and Bover (1995)/Blundell and Bond (1998). A great advantage of estimating GMM models is that it allows for endogenous variables, heteroskedasticity and serial correlation within individuals (Roodman, 2006). "System" GMM, in particular, is more efficient since it uses more information and it performs better for variables that are close to a "random walk" (Bond, 2002, Roodman, 2006). The issue of endogeneity is addressed through the use of internal instruments. However, a main drawback of this estimation approach is the problem of "too many instruments". Although, it is not clearly specified how many instruments are "too many", the *xtabond2*[52] usually gives a warning when it exceeds the number of cross sections (Roodman, 2006). The same author has suggested limiting the number of instruments by restricting the lags or applying the "collapse[53]" option in xtabond2.

[51] Generalized method of moments
[52] Xtabond2 is a user written command for STATA that implements both difference and system GMM.
[53] "The collapse suboption of gmmstyle() specifies that xtabond2 should create one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance" (STATA - xtabond2 help).

As predicted, given the small number of cross sections (27) and fairly long time series (16), the problem of "too many instruments" arose in the estimations. Roodman's suggestions were applied to reduce the number of instruments to an "acceptable" figure, however, the specification tests for instrument validity turned out "too good" (p-value = 1.00). The latter implies that a high number of instruments tends to weaken the power of the test itself and its ability to detect the potential invalidity of the instruments (Roodman, 2009). Unless the number of regressors in the model is reduced, the problem seemed to persist. Excluding relevant explanatory variables is not an advisable solution, since this would lead to omitted variable bias. Therefore, given all the above outlined estimation issues, we decided not to proceed further with this particular estimator.

4.4 Country level empirical evidence

Following the discussion on the different estimation methodologies presented in the previous section, the empirical results and diagnostic tests from the preferred estimator (s) will be reported in this section. We have started the estimations using the fixed effects (FE) and random effects (RE) and their estimated results are presented in Tables A4.1 (A4.1.1), A4.2 (A4.2.1) in the appendix section (A4). To be able to compare the two estimators and consequently decide on the preferred approach, the Hausman test has been employed. The null hypothesis of no systematic differences between the estimators has been strongly rejected for all the models (p-value =0.000), suggesting that the FE estimator is a more appropriate approach (see Tables A4.1.2 and A4.2.2 or A4.2.2.1, in Appendix A4). Furthermore, given that we are not interested in making any inference outside the sample, i.e. we are already investigating the population of interest, using FE does not represent a drawback in this respect. It is important to note that when comparing these estimators, the default version of Hausman produces a negative chi-square test statistic. This is likely to happen due to different estimates of the error variance being used for the FE and RE. The *sigmamore* option is recommended to overcome this problem since it specifies that both covariance matrices are based on the estimated disturbance variance from the efficient estimator (Cameron and Trivedi, 2009).

Once the preferred estimation methodology is established, the next step involves checking the key diagnostics of the models. Heteroskedasticity is commonly present in panel data analysis when countries of different sizes and economic development levels are assessed. In the presence of heteroskedasticity estimates are still consistent but not efficient and their standard errors are biased. This can, however, be easily corrected by using robust standard errors (Baltagi, 2005). Serial correlation and non-normality are also highly likely to be present in panel data estimations. The results of several diagnostic statistics show evidence of groupwise heteroskedasticity, serial correlation and non-normality in the errors in all the econometric models (see Tables A4.1.3 and A4.2.3 or A4.2.3.1, in Appendix A4). To ensure that the statistical inference is valid, the aforementioned specification issues need to be addressed. *xtscc* is a user written command that accounts for heteroskedasticity, serial correlation and cross sectional dependence[54] by producing Driscoll and Kraay (1998) standard errors (Hoechle, 2007). Although, the presence of cross sectional dependence was not tested in this investigation, due to the unbalanced panel, as Hoechle (2007, p.281) argues, "erroneously ignoring possible correlation of regression disturbances over time and between subjects can lead to biased statistical inference".

Table 4.6 Estimated results with Driscoll-Kraay standard errors

VARIABLES	**Model 1** lnemsh	**Model 2** lnemsh
lnsedut	0.228**	
	(0.109)	
lntedut	0.592***	
	(0.117)	
avyrs		-1.081***
		(0.328)
sqravyrs		0.0495***
		(0.0148)
lnpatappr	0.0557**	0.0521**
	(0.0254)	(0.0218)
lnfdi	-0.00428	0.00525**
	(0.00469)	(0.00223)
lngdpc	1.224***	1.436***
	(0.122)	(0.177)
lnpop	-1.922***	-1.627***
	(0.145)	(0.321)
unem	0.00398***	0.00278***

	(0.00113)	(0.00066)
lnecofree	-0.0587	-0.0661
	(0.162)	(0.134)
lnrulc	-0.462	-0.772**
	(0.274)	(0.292)
serv	-0.00702	-0.00236
	(0.006)	(0.00762)
N	366	366

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

Since within estimators allow for time varying variables only, we had to look for alternative approaches that share similar features with the standard FE model but also produce consistent estimates for the coefficients of time invariant variables.

$$Y_{i(k)t} = \beta X'_{it} + \gamma Z_i' + \alpha_i + \varepsilon_{it}, \qquad (4.3)$$

Where Z_i is a vector of time invariant variables

The discussion provided in the previous section revealed that Plumper and Troeger’s FEVD estimator has been frequently employed in empirical studies. For comparison purposes, both, the three step procedure and the STATA ado file were applied to estimate the models (see Tables A4.1.5 (A4.1.5.1) and A4.2.5 (A4.2.5.1) in the appendix section, A4). The former gives smaller standard errors, hence more significant coefficients, and this has been regarded as the main drawback of this estimator. Although, the authors claim to have accounted for this in their latest ado file, the “adjusted” standard errors, in this analysis turned out very high and there is a big difference between the FEVD and FE standard errors and significance levels for the coefficients of time varying variables as well. An example reflecting these differences is presented in Table A4.9.1 in Appendix A4.

The Hausman and Taylor (HT) is an alternative estimator that handles the issue of omitted time invariant variables. Since it accounts for both within and between variation, it is claimed to be more efficient that within estimation approaches (Hausman and Taylor, 1981). It requires distinguishing between the variables (time varying and time invariant) that are correlated with the unobserved country specific effects and those that are not.

$$Y_{i(k)t} = \beta_1 X'_{1it} + \beta_2 X'_{2it} + \gamma_1 Z_{1i}' + \gamma_2 Z_{2i}' + \alpha_i + \varepsilon_{it} , \quad (4.4)$$

X'_{1it} represents the set of variables that are time varying and uncorrelated with α_i

X'_{2it}represents the set of variables that are time varying and correlated with α_i

Z_{1i}' represents the set of variables that are time invariant and uncorrelated with α_i

Z_{2i}' represents the set of variables that are time invariant and correlated with α_i

α_i represents the unobserved country specific effect, ε_{it} is the error term, while, *i* denotes countries, and *t* denotes time

Although the distinction is not simple given that the country specific effect component is unobservable, education attainment and cognitive skills measures are perceived to be correlated with the α_i, whereas other variables are assumed to be uncorrelated. The potential correlation between these variables and α_i may be related to countries having different attitudes towards education; e.g. higher expenditure on education. Variables treated as exogenous are used as instruments for the potentially endogenous variables (i.e. *sedut, tedut, avyrs and ckills*). To check the suitability and validity of these instrumental variables, we were guided by the correlation matrix, which shows, generally, acceptable levels of correlation between the instruments and the endogenous variables. The estimated results presented in the table below (Table 4.7) show some differences across the estimators (FEVD and HT), mostly in terms of the levels of significance. While the coefficients of the FEVD model are highly insignificant, the significance of HT estimates corresponds to a large extent to those of FE model (see Tables A4.1.6 & A4.2.6 in the appendix section). Again, the Hausman test has been used to compare the FE with HT estimators and its results seem to favour the use of HT (see Tables A4.1.6.1 & A4.2.6.1 in Appendix A4). Although, the latter model is supposed to be more efficient, the incorrect specification of variables as correlated or uncorrelated with α_i might lead to inconsistent estimates. Moreover, this approach assumes that the error components are homoskedastic, which is highly unlikely to be true, and there seems to be no available options to correct for it.

Table 4.7 FEVD and HT estimated results

VARIABLES	**Model 1 FEVD** lnemsh	**Model 2 FEVD** lnemsh	**Model 1 HT** lnemsh	**Model 2 HT** lnemsh
lnsedut	0.228		0.292**	
	(7.184)		(0.124)	
lntedut	0.592		0.514***	
	(6.514)		(0.125)	
avyrs		-1.081		-1.058***
		(7.323)		(0.188)
sqravyrs		0.0495		0.0483***
		(0.343)		(0.00875)
cskills	0.432	0.944	-0.0858	0.45
	(5.456)	(3.991)	(5.221)	(4.661)
lnpatappr	0.0557	0.0521	0.0631**	0.0623**
	(1.45)	(0.919)	(0.0274)	(0.0269)
lnfdi	-0.00428	0.00525	-0.00658	0.00205
	(0.104)	(0.104)	(0.00513)	(0.00499)
lngdpc	1.224	1.436	1.386***	1.551***
	(10.12)	(5.551)	(0.128)	(0.11)
lnpop	-1.922	-1.627	-1.105***	-0.901***
	(3.698)	(3)	(0.316)	(0.283)
unem	0.00398	0.00278	0.00429***	0.00301***
	(0.0209)	(0.0181)	(0.00088)	(0.00092)
lnecofree	-0.0587	-0.0661	-0.00742	0.00347
	(6.537)	(5.674)	(0.176)	(0.172)
lnrulc	-0.462	-0.772	-0.495**	-0.809***
	(4.342)	(4.639)	(0.194)	(0.193)
serv	-0.00702	-0.00236	-0.00731*	-0.00319
	(0.121)	(0.104)	(0.00383)	(0.00384)
dist	-0.00117	-0.00106	-0.00139	-0.00125
	(0.00433)	(0.00284)	(0.00147)	(0.00131)
transdummy	-0.74	-0.274	0.21	0.572
	(13.4)	(8.456)	(1.6)	(1.43)
Constant	5.095	7.029	-1.573	1.428
	(113.9)	(74.89)	(26.79)	(23.94)
N	366	366	366	366

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

Finally, as previously argued, both estimators, FEVD and HT make strong assumptions that if not valid are likely to produce inconsistent estimates. Considering this, the estimated results for the time invariant variables included in these models should be interpreted with considerable caution. The estimated results from the Hsiao (2003) procedure have not been reported in this section given the assumptions of infinite sample properties required for inconsistent estimates, however they can be found in the appendix section (Tables A4.1.7 and A4.2.7).

Another source of estimate inconsistency is the presence of endogenous variables in the model due to potential simultaneity i.e. variables being determined within the system. Education attainment, patent applications and foreign direct investment are suspected to be subject to simultaneous causality in this empirical investigation. A potential feedback effect from exports to education attainment is likely to happen if we assume that the increased demand for more educated workers increases the rate of return from investing in additional schooling and hence raises the proportion of the workforce with higher levels of educational attainment. In a similar manner, a feedback effect may also occur from exports to innovation. As hypothesized in the literature, exporting firms are more likely to engage in innovating activities than their counterparts. Recently, several empirical studies have found supporting evidence for this hypothesis, even though, the latter tends to be limited to specific firms, countries and/or innovation categories (Salomon and Shaver, 2005, Damijan et. al., 2008, Girma et al., 2008, and Van Beveren and Vandenbussche, 2010). FDI is also likely to be influenced by a country's exporting. For instance, a higher degree of openness, commonly measured by export ratios, has been suggested to encourage foreign investment, though the empirical evidence is mixed (Charkrabarti, 2001). Whilst, most of these relationships are highly unlikely to occur simultaneously as it usually takes some time for these feedback effects to take place, it is always better to be cautious about any form of potential endogeneity and use appropriate estimation methods to account for it. Schaffer's (2010) instrumental variable estimation approach *(xtivreg2*) is applied to deal with these potential endogenous variables. Since finding suitable instruments is very difficult, the lagged values (one period) of the potential endogenous variables have been used as internal instruments in this investigation. The endogeneity test implemented by the *xtivreg2* shows mixed evidence with regard to potential endogeneity for the aforementioned variables. Nevertheless, it is never safe to draw any inference by just looking at the test results since this is rather a theoretical matter and it presence needs to be assessed on a theoretical basis. Moreover, the actual test depends highly on the variables chosen as weak instruments might invalidate the test results. Hence, taking all these issues into account, the estimated results should interpreted with great caution.

Table 4.8 IV estimated results

		Model 1			**Model 2**	
	EU-27	ETEs	N-ETEs	EU-27	ETEs	N-ETEs
VARIABLES	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh	lnemsh
lnsedut	0.342*	1.164***	0.0542			
	(0.187)	(0.43)	(0.177)			
lntedut	0.673***	0.515*	0.290*			
	(0.218)	(0.283)	(0.154)			
avyrs				-1.032***	-0.305	-0.208
				(0.295)	(0.885)	(0.177)
sqravyrs				0.0482***	0.0346	0.0095
				(0.0137)	(0.0353)	(0.00871)
lnpatappr	0.061	0.16	0.146**	0.0567	0.0713	0.133**
	(0.0533)	(0.105)	(0.0565)	(0.0546)	(0.144)	(0.0547)
lnfdi	-0.00599	0.0553	0.0065	0.00695	0.0395	0.0108**
	(0.00592)	(0.0831)	(0.0047)	(0.00503)	(0.073)	(0.00444)
lngdpc	1.198***	0.940***	0.0498	1.461***	0.645**	0.0974
	(0.2)	(0.284)	(0.244)	(0.153)	(0.252)	(0.237)
lnpop	-2.016***	5.427***	-0.115	-1.771***	5.147*	0.26
	(0.572)	(1.67)	(0.419)	(0.503)	(2.783)	(0.37)
unem	0.00323**	-0.00303	0.000703	0.00272**	-0.003	0.000764
	(0.0015)	(0.00205)	(0.00083)	(0.00124)	(0.002)	(0.0008)
lnecofree	-0.247	-0.964***	-0.139	-0.168	-0.958**	-0.21
	(0.241)	(0.352)	(0.225)	(0.226)	(0.38)	(0.23)
lnrulc	-0.565*	-0.735*	-0.556*	-0.798**	-0.863**	-0.583**
	(0.32)	(0.407)	(0.289)	(0.322)	(0.432)	(0.281)
serv	-0.00725	0.0167	-0.0364***	-0.00362	0.0157	-0.0365***
	(0.0089)	(0.0114)	(0.00508)	(0.00901)	(0.0113)	(0.005)
transindN		0.274			0.653	
		(0.47)			(0.51)	
N	349	134	215	349	134	215

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;

The interpretation of the estimated results is based on the instrumental variable (IV) fixed effects estimator for time varying variables and on fixed effects vector decomposition (FEVD) and Hausman and Taylor (HT) for time invariant variables. Although, due to their specific econometric properties, different estimators have been chosen for different purposes, it is important to note that they all seem to provide a consistent story. The overall results suggest that the impact of education attainment on export market share is subject to the level of education investigated, thus, highlighting the importance of distinguishing between different levels. Although, both measures of education attainment seem to have a positive impact on the export market share of EU-27, the share of population who have attained tertiary education exerts a relatively stronger impact. Namely, it is estimated on average holding other factors constant, that an increase of 1 percent in the share of the population aged 15 and over who have attained secondary education increases the export market share by 0.342 percent (significant at 10 %)[55] (see Table 4.8). In economic terms, this effect is not large, as it requires, at least a 10% rise in *sedut* (from 58.5 to 64.73) to increase export market share by 3.42%, which at the mean value of *emsh* in the sample would be an increase from 4.02 to 4.15. As expected, the effect of tertiary education is stronger in magnitude and in significance, i.e. an increase of 1 percent in the share of population with tertiary education increases the share of exports by 0.673 percent, ceteris paribus. Hence, these findings support the relative importance of tertiary education in explaining export market share compared to secondary education. However, it is important to note that this effect, in economic terms, is not very strong either, as it requires an increase of *tedut* from 17.64 to 19.40 (10%), to increase export market share by 6.73 %, which expressed in terms of the sample means would be an increase from 4.02 to 4.29.

The relationship between export market share and average years of schooling (Model 2) is of a non-linear nature. For levels up to 10.70 years of schooling, the marginal effect of this variable on export market share is negative, while, for higher levels of schooling, it becomes positive (see Table 4.8). All these results seem to suggest that higher levels of education are relatively more important for international competitiveness, thus supporting the hypothesis that more qualified

[55] The effect is calculated as follows: $\%\Delta emsh = \beta 1 \% \Delta sedut$. i.e. if *sedut* increases by 1 percent, we would expect the *emsh* ratio to increase by $\beta 1$ percent (e.g. 0.342*1% = 0.342%).

workers are more productive than their counterparts and thus contribute more to the international competitiveness of a country.

A comparison of results between transition economies (ETEs) and non-transition economies (N-ETEs) suggests that the share of population who have attained secondary and tertiary education, respectively, has a positive impact on export market share of ETEs, the impact of the former measure being relatively stronger. It is estimated on average, holding other factors constant, that an increase of 1 percent on the share of population with secondary (tertiary) education increases the export market share of ETEs by 1.164 (0.515) percent. When expressing these effects in terms of our sample means, a rise in *sedut (tedut)* from 68.62 to 75.48 (15.01 to 16.51)[56], increases the mean value of export market share from 0.73 to 0.81 (0.73 to 0.76). The relative importance of less qualified workforce (which is in abundance in these countries) might be due to the potentially low share of high skill and technologically-intensive goods exported by these countries. As Rosenzweig (1995, 1996) argues, higher levels of education are likely to have a greater impact on productivity when more complex tasks are to be performed, whereas the effect will be relatively smaller for simpler tasks. Since we are not able to make such a distinction given the nature of the data in the current analysis, we will explore this further in our next empirical chapter.

When the N-ETEs are investigated separately, the empirical evidence appears to support the importance of tertiary education in enhancing the international competitiveness of this particular group of countries. An increase of 1 percent on the share of population with tertiary education, ceteris paribus, increases the export market share by 0.290 percent. No supporting evidence is found for the impact of secondary education on the international competitiveness of these countries. Given their stage of development and their potentially higher level of export sophistication, this empirical finding is in accordance with a priori expectations. As Gemmell (1996) and Sianesi and Van Reenan (2003) suggest, tertiary education is more likely to impact growth in more developed countries, whereas, lower levels of education are more important for growth in developing countries. Despite the expected positive sign, is worth noting that the magnitude of the coefficient is not practically large. It requires an increase of 10% in *tedut, i.e.*

[56]A 10 % rise.

from 19.25 to 21.18, to increase export market share by 2.90 %, which at the mean value of *emsh* be an increase from 6.04 to 6.21. Concerning the average year of schooling, when the two samples of countries are investigated separately, the estimated coefficient of this variable (level and squared) becomes statistically insignificant. In the same vein, the quality of education, proxied by a cognitive skills index is found insignificant but with the expected sign (with the exception of Model 1 – HT estimates), see Table 4.7. This result might be attributed to the proxy not being sufficiently strong, its time invariant nature and also the methods (FEVD and HT) used to estimate its coefficient. Hence, taking all these issues into account, we are not able to draw any firm conclusions on the effect of this variable.

From the set of control variables, GDP per capita *(gdpc)*, population *(pop)*, long term unemployment *(unem)* and unit labour cost *(rulc)* are significant, while the rest are not statistically different from zero, though they have, in general, the expected signs. The empirical results suggest that GDP per capita *(gdpc)* has a positive impact on the export market share of countries for the whole sample. When its impact is investigated separately, the coefficient of this variable remains significant for ETEs only. The coefficient of population (*pop*) is negative for the whole sample, while it turns positive for the ETEs when the two subsamples are investigated separately. Although, country size is generally perceived to exert a positive impact on the share of exports, as bigger countries are expected to produce more output, and thus are more likely to export more, our data does not seem to support this hypothesis. For instance, a summary of shares of exports of countries covered in our sample shows that relatively small countries such as Belgium, have a an export share of 7.25% (on average), whereas, larger countries such as Spain, Norway, Poland and Czech Republic appear to have much smaller shares of exports: 5.2%, 2.4%, 2.1% and 1.6% respectively.

Surprisingly, the coefficient of the mismatch proxy exerts a counterintuitive (positive) impact for the whole sample, while when investigated separately for the two sub-groups of countries, its sign and significance levels appear mixed. Namely, the long term unemployment *(unem)* is negative for ETEs and positive for N-ETEs, however, in both cases it is insignificant. Finally, the estimated results suggest that, in the line with the theory, real unit labour cost *(rulc)* exerts a negative impact on the export market share of total EU-27 when estimated jointly and separately.

The effect of inward FDI stock *(fdi)*, patent applications *(patappr)* and the share of services *(serv)* is generally significant and with expected signs for N-ETEs. The estimated coefficient of economic freedom *(ecofree)* is negative but insignificant in the total EU-27 and N-ETEs and significant (negative) in the ETEs subsample. Surprisingly, the transition indicator index *(transindN)* was found to be statistically insignificant thus, suggesting that the progress of countries during transition did not contribute much to their international competitiveness. This might be a reflection of the transition process being completed by the majority of countries included in our sample by 2004. Similarly, the estimated coefficients of the transition dummy (*transdummy*) and distance *(dist)* are not statistically different from zero. The sign of the former differs across the two estimators (FEVD and HT), whereas, the latter exerts the expected sign (see Table 4.7). As elaborated in the previous chapter, vocational training is another important component of human capital that is likely to influence the international competitiveness of countries through boosting labour productivity. Given the data restrictions discussed in section 4.2, we were forced to conduct the empirical analysis for a shorter period of time (1999-2010). In addition, due to high collinearity between the percentage of employees participating in CVT courses (*emplcvt*) and training enterprises as percentage of all enterprises (*trngent*), the two indicators have been included separately in the regression analysis.

In line with the conventional human capital theory, the estimated results with Driscoll-Kraay standard errors suggest highly significant coefficients for both variables (see Table 4.9). In all models, the percentage of employees participating in CVT courses (*emplcvt*), and training enterprises as percentage of all enterprises (*trngent*) appear to influence positively the international competitiveness of EU countries, proxied by their export market share (see Tables A4.1.4.1/A4.1.4.2 and A4.2.4.1/A4.2.4.2 in Appendix A4). However, no conclusive causation inference can be drawn without checking first for potential endogenity in the hypothesised relationship. Some reverse causation going from export market share to training activities would be expected, since exporting firms might invest more in the latter in order to enhance the productivity of their employees. To correct for potential endogeneity of these variables, the IV approach previously discussed has been followed. The IV estimated coefficient for *emplcvt* remains significance only in Model 2 (at 10% level of significance), whereas, *trngent* is statistically significant at 10 % only in Model 1 (see Table 4.9). No distinction between transition economies and non-transition economies has been made given the limited sample size. Overall, given the data limitations discussed in the previous sections, these empirical findings should be considered only suggestive. The impact of training activities on international competitiveness will be investigated further with a more disaggregated set of data in Chapter 6.

Table 4.9 IV estimated results (training included)

VARIABLES	**Model 1**		**Model 2**	
	lnemsh	lnemsh	lnemsh	lnemsh
lnsedut	0.00413	0.0389		
	(0.224)	(0.246)		
lntedut	0.706***	0.729***		
	(0.198)	(0.186)		
avyrs			0.21	0.14
			(0.336)	(0.345)
sqravyrs			-0.00973	-0.00581
			(0.016)	(0.0161)
emplcvt	0.00624		0.00719*	
	(0.00398)		(0.0038)	
trngent		0.00382*		0.00322
		(0.00204)		(0.00203)
lnpatappr	0.0649	0.0806	0.0326	0.0689
	(0.0634)	(0.053)	(0.0659)	(0.0608)
lnfdi	-0.0116	-0.00633	-0.00213	0.00409
	(0.00878)	(0.00846)	(0.00764)	(0.00786)
lngdpc	0.872***	1.015***	1.262***	1.482***
	-0.218	-0.231	(0.241)	(0.254)
lnpop	-2.607***	-2.710***	-2.160***	-2.032***
	(0.764)	(0.618)	(0.656)	(0.539)
unem	-0.0005	-0.00044	0.000266	0.000567
	(0.00112)	(0.00118)	(0.00121)	(0.00121)
lnecofree	-0.155	-0.406	-0.321	-0.444
	(0.286)	-0.261	(0.298)	(0.292)
lnrulc	-0.746*	-0.972	-0.699*	-1.040*
	(0.386)	(0.654)	(0.381)	(0.613)
serv	-0.00304	-0.00763	-0.00385	-0.0061
	(0.0125)	(0.0153)	(0.0127)	(0.0148)
N	235	245	235	245

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;

Box 4.1 Comparative analysis using two versions of education data

High quality data is an essential requirement for reliable empirical results. Given that measurement errors in data are quite common, particularly when constructing stock estimates, the empirical findings should always be interpreted with great caution. As already discussed in Chapter 3, Barro and Lee have constructed measures of educational attainment based on survey and census data taken from various sources, at 5-year intervals. Since there was a large number of missing observations, they used forward and backward extrapolation to fill in the gaps. Even though they updated their dataset several times since 2010, these changes, in general, were not of significant magnitude, with the exception of the most recent version. In the most recent version of data (2.0) that we used in our previous estimations (see above), the authors updated the estimates of education attainment by using new survey and census data on attainment and also more recent data on enrolment ratios for many countries. To examine the importance of having accurate measures for the variables of interest when conducting empirical analyses, two versions of education attainment data (Versions 1.2 and 2.0)[57] have been used to assess the impact of human capital endowments on the international competitiveness of EU-27. To simplify the comparison, the estimated results from version 1.2 will be henceforth referred as the *old version* results[58], while the results from the updated dataset, 2.0, will be referred as the *new version* results.

The interpretation and comparison of the both pairs of results is based on the instrumental variable fixed effects estimator, which accounts for potential endogeneity in the models. The empirical findings suggest that the impact of education attainment on export market share tends to change when different versions of education attainment data are used. The new version results appear to support the relative importance of tertiary education in explaining export market share compared to secondary education for the whole sample of countries. Namely, on average, an increase of 1 percent in the share of population aged 15 and over who have attained tertiary education, holding other factors constant, increases the export market share by 0.673 percent. The share of population who have attained secondary education appears to have a weaker impact, i.e. an increase of 1 percent on *sedut*, ceteris paribus, increases the share of exports, on

[57] There is another updated version of data in between the two, 1.3. However, there are no significant difference between this and the previous version, 1.2.

[58] A summary of the main results using the old version education dataset can be found in Table A4.9 in appendix A4

average, by 0.342 (10% level of significance). The old version of education attainment estimates, on the other hand, appears to tell a different story. In the latter analysis, it is the share of population who have attained secondary education that appears to be the only education based determinant of the share of exports of EU-27, i.e. an increase of 1 percent on *sedut*, ceteris paribus, increases the export market share by 0.476 percent. In economic terms, the magnitude of the coefficient is not large, as it requires 10% rise in the mean *sedut*, i.e. from 57.03 to 62.73, to increase export market share by 4.76%, which at the mean value of *emsh* in the sample would be an increase from 4.02 to 4.21. The stock of population with tertiary education has a statistically insignificant effect.

The relationship between export market share and average years of schooling is of a non-linear nature in both analyses. However, the turning point differs slightly between the two. The new version results suggest that the marginal effect of this variable is negative up 10.70 years of schooling, and after that point, its effect becomes positive. The turning point for the old version analysis is slightly lower, 10.13, thus suggesting that the positive effect of years of schooling on competitiveness begins at a slightly lower level of education.

The differences in the results tend to persist also when the transition economies (ETEs) and non-transition economies (N-ETEs) are investigated separately. In the old version analysis, both, the stock of population 15 and over who attained secondary and tertiary education appear to have a significant impact on the export market share of ETEs. Specifically, an increase of 1 percent in the share of population who have attained secondary (tertiary) education, ceteris paribus, increases the export market share of ETEs, on average, by 1.937 (0.813) percent. The obtained results appear to also be economically significant, particularly for the share of population who have attained secondary education. Namely, an increase of the mean value of *sedut (tedut)* by 10%, i.e. from 65.90 to 72.49 (13.58 to 14.93), would increase export market share by 19.37% (8.13%), which expressed at the mean value of *emsh* in the sample would be an increase from 0.73 to 0.86 (0.73 to 0.78). No empirical evidence is found for either of the measures when N-ETEs are estimated separately. The new version analysis finds a similar evidence for ETEs, with slightly different levels of significance, i.e. an increase of 1 percent in the share of population who attained secondary (tertiary) education, on average, holding other factors constant, increases the export market share of ETEs by 1.164 (0.515) percent. The economic impact of secondary education appears to be twice as a higher as of tertiary education. In contrast to the old version findings, the coefficient of tertiary education is statistically significant in the N-ETEs subsample (an increase of 1 percent in the share of population who attained tertiary education, ceteris paribus, increases the export market share by 0.290 percent). For further explanations on the economic significance of the new version results see the interpretation section presented above.

Concerning the average years of schooling, when both samples of countries are assessed separately, using the old data set, the average years of schooling appears to have a negative impact up to 8.64 years for N-ETEs, and a positive impact for higher years of schooling. The same measure did not seem exert a significant impact on the export market share of the ETEs subsample. No empirical evidence is found for the role of average years of schooling on international competitiveness of either set of countries, when the new version of the data is used. The inconsistency of these two pairs of findings is clearly a result of the differences in the education attainment estimates used when conducting the empirical analyses.

4.5 Industry level empirical evidence

The determinants of the international competitiveness of the EU-27 are further investigated by introducing a new dataset of manufacturing industries. In addition to assessing the export market share of these countries at the country level[59], a modified version of Balassa's (1965) revealed comparative advantage index (RCA) has been introduced to capture the degree of international competitiveness at the industry level. We are employing the RCA/RXA index to represent the international competitiveness of countries while at the same time assessing its potential determinants. In this empirical analysis, the RXA is used to proxy the international competitiveness, namely, the export performance/specialisation of countries in given industries relative to EU-28. Furthermore, econometric models are established to investigate the potential

[59] Note that, in addition to the country level analysis; we have also assessed the export market share at the industry level, but since this was not of primary interest to us, the results are not reported here but can be found summarized in Table A4.8 in Appendix A4. The estimated results obtained from this analysis are consistent with the country level findings, suggesting that a higher level of education attained exerts a stronger impact on export market share of EU-27. That is to say, the impact of the share of population with tertiary education is more significant compared to that of secondary educated counterparts. Average years of schooling seem to reinforce further the hypothesized link between human capital and export market share, when being assessed at the industry level of aggregation.

impact of human capital endowments on the export performance of European countries in a set of ten manufacturing industry groups. These industries contributed 4.64 trillion dollars to the EU-28 real GDP in 2010, accounting for approximately 32% of their GDP. From 1995 to 2010, the share of these industries has increased by approximately 78%.

The statistical limitations of the competitiveness index used here, however, are more worrisome and should be accounted for to ensure the reliability and accuracy of the estimates. One of the main limitations, when used in econometric analysis, is the violation of the normality assumption due to its asymmetric distribution. As previously argued, this can be corrected by either taking the logarithmic of the actual index or using the "Revealed Symmetric Comparative Advantage" (RSCA) developed by Dalum et al. (1998). The index has also been criticised for generating extremely high values for some countries in some specific industries or products. In the analysis undertaken here, the high index values for Albania, Latvia, Cyprus and Malta in some industries are a result of those industries forming a large share of total domestic exports, but a very small component of total EU exports (see tables below). Albania and Malta are excluded from the estimations due to missing data, while the Latvia and Cyprus outliers industries do not seem to influence the estimated results.[60] The problem of inconsistency and instability are more difficult to deal with and hence are more likely to distort the estimated results.

The variables of interest remain the same given the unavailability of education attainment stock data at the industry level and so do the control variables. One might assume that since there are repeated values for the independent variables, this would increase the total number of observations and in turn might influence the significance levels of the parameter estimates. However, our comparative analysis assessing export market share, constructed at both, country and industry levels of aggregation reveals no supporting evidence for this proposition. Both estimation approaches seem to tell a consistent story and no differences in the level of statistical significance of the parameter estimates were found. In contrast to other estimation approaches, fixed effects estimator which represents our main model focuses on within rather than between variation, indicating thus less important implications for the model specification. Besides, fixed

[60] We estimated the models with and without the outliers and the difference in results were negligible, hence we decided to keep these latter two countries in the analysis.

effects models also account for unobserved individual effects, capturing thus some industry-country specific factors. It is important to note that in this empirical assessment we are not trying to draw any inference regarding particular sub-industries. While the effect of human capital endowments might be underestimated or overestimated for specific sub-industries, due to unavailability of more disaggregated information, the overall results are not likely to be distorted since those are based on mean values. Classification by technology intensity of these industries will be introduced in the next chapter where the hypothesised impact of human capital endowments on medium and high tech manufactures will be empirically assessed.

In order to estimate the two econometric models, the same methodologies as in the previous section was used: Driscoll-Kraay to correct for heteroskedasticity, serial correlation and cross sectional dependence (see Tables A4.6.1 & A4.7.1 for diagnostic tests – Appendix A4), the Fixed Effects Vector Decomposition (FEVD) and Hausman and Taylor (HT) to estimate the coefficients of time invariant variables, and finally, the country/industry fixed effects instrumental variable (IV) approach to account for potential endogeneity (for further details see Tables A4.6-A4.7.5.2 in the appendix section). While, the link between human capital endowments and export market share remains consistent also at the industry level (see Table A4.8 in Appendix A4), the introduction of the relative export advantage (RXA) as a measure of competitiveness seems to tell a different story. As previously argued, to correct for the asymmetry problem, either the logarithmic transformation of RXA or the RCSA index can be used. Given that both measures yielded similar results, only the outcomes of the logged RXA are reported in the Table 4.10.

The estimated results from Model 1 (Table 4.10) suggest that neither the share of population (15 and over) who have attained secondary education nor the share of population who have attained tertiary education (negative sign) appear to have a significant impact on the relative export advantage of the EU-27. These finding are not in line with a priori expectations and a potential reason for this might be the instability of the index over time and across countries. Another important feature to be noted is that the consistency of the index tends to change when different levels of aggregation are used. The index has been initially introduced by Balassa (1965) to measure the comparative advantage of countries in specific products but later its use has been extended to more aggregated dimensions of data: industries.

The marginal effect of average years of schooling is positive up to 11.72 year of schooling, and after that point it becomes negative. The estimated coefficients of *sedut* and *tedut* remain statistically insignificant even after distinguishing between the two subsamples of countries (ETEs and N-ETEs), with the exception of secondary education for N-ETEs. The latter appears to have a positive impact on the relative export advantage of these countries at 5% significance level. The average years of schooling, level and squared, are insignificant for both sets of countries, with the exception of the coefficient of the squared term, which is negative and statistically significant at 10 %, in the ETEs subsample.

Table 4.10 IV estimated industry results

	Model 1			Model 2		
	EU-27	ETEs	N-ETEs	EU-27	ETEs	N-ETEs
VARIABLES	lnrxa	lnrxa	lnrxa	lnrxa	lnrxa	lnrxa
Lnsedut	0.0942	-0.6	0.262**			
	(0.108)	(0.41)	(0.107)			
Lntedut	-0.122	-0.113	0.00831			
	(0.125)	(0.287)	(0.143)			
Avyrs				0.516***	0.901	0.0152
				(0.185)	(0.635)	(0.201)
Sqravyrs				-0.0220**	-0.0448*	0.00186
				(0.00857)	(0.0265)	(0.00932)
Lnpatappr	0.106***	-0.0283	0.111**	0.106***	0.11	0.137***
	(0.0339)	(0.109)	(0.0454)	(0.0342)	(0.112)	(0.0478)
Lnfdi	0.0189***	0.0659	0.0195***	0.0141***	0.0801	0.0191***
	(0.00561)	(0.0856)	(0.00589)	(0.00547)	(0.0814)	(0.00593)
Lngdpc	-0.0466	0.29	0.0467	-0.136	0.352	0.02
	(0.135)	(0.247)	(0.231)	(0.109)	(0.278)	(0.236)
Lnpop	-0.616	-3.026*	-1.332***	-0.835**	-0.169	-1.712***
	(0.377)	(1.595)	(0.449)	(0.338)	(2.036)	(0.388)
Unem	-0.00102	0.00045	-0.0005	-0.00047	0.000563	-0.00054
	(0.00062)	(0.00136)	(0.00067)	(0.0006)	(0.00136)	(0.00068)
Lnecofree	0.000329	0.263	0.104	0.00889	0.0988	0.0896
	(0.143)	(0.296)	(0.169)	(0.142)	(0.273)	(0.168)
Lnrulc	0.0255	0.24	-0.0228	0.096	0.196	-0.0446
	(0.176)	(0.236)	(0.275)	(0.173)	(0.232)	(0.273)
Serv	0.00599*	-0.00465	0.0151***	0.00313	-0.00115	0.0132***
	(0.00345)	(0.00788)	(0.0046)	(0.00355)	(0.00727)	(0.00465)
Transindn		-0.385			-0.46	
		(0.424)			(0.442)	
N	3,450	1,330	2,120	3,450	1,330	2,120

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;

Table 4.11 FEVD and HT estimation results

	Model 1		Model 2	
	FEVD	HT	FEVD	HT
VARIABLES	lnrxa	lnrxa	lnrxa	lnrxa
Cskills	-0.363	-0.412	-0.668	-0.637
	(0.572)	(0.452)	(0.55)	(0.564)
Dist	-0.00014	1.49E-05	-0.0003	-4.79E-05
	(0.00048)	(0.00013)	(0.00039)	(0.00016)
Transdummy	-0.00874	0.399**	-0.307	0.312
	(1.447)	(0.16)	(1.132)	(0.19)
N	3,600	3,600	3,600	3,600

Notes: (1) Education attainment variables, controls and year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

From the set of other explanatory variables, patent applications (*patappr*), the share of inward FDI (*fdi*) are statistically significant in both models, while the share of services *(serv)* and total population (*pop)* appear to be significant (but with counterintuitive signs) in Model 1 and 2, respectively. The importance of these particular determinants appears to be mainly influenced by the domination of non-ETE countries in the sample. When the two sets of countries are estimated separately, their estimated coefficients remain generally significant only in the N-ETEs subsample. The cognitive skills index which has been introduced to the analysis to capture the quality of education turned out to be statistically insignificant. The insignificance of the quality dimension of education might possibly be due to the lack of a more appropriate measure and estimation issues related to the actual index. The other two time invariant variables – *dist* and *transdummy* – are also insignificant with the exception of the latter in Model 1 (HT). For further details see Table 4.11 presented above.

4.6 Conclusions

This empirical chapter has made use of longitudinal data to investigate the impact of human capital on international competitiveness of EU-27, with particular focus on transition economies, for the period 1995-2010. When export market share is used to measure international competitiveness, in line with the new endogenous growth theories, the empirical findings suggest that human capital endowments exert a significant effect on international competitiveness of countries under investigation. In order to check the robustness of the results, various estimation methods have been employed, and the issue of potential endogeneity has been accounted for by following an instrumental variable approach.

The effects of secondary, tertiary education and average years of schooling have been robust in all models for the whole sample of countries. However, when the two sets of countries, ETEs and N-ETEs are estimated separately, the significance of education attainment levels tends to differ across them. The level of secondary education appears to exert a stronger impact in the ETEs subsample, while the share of population who have attained tertiary education seems to be the only education based determinant of the export share of N-ETEs. These empirical findings are in line with a priori expectations, considering the stage of development and the tendency of the latter group of countries to export more skill and technology intensive goods. The quality of education proxied by an averaged index of students' test scores in mathematics and science was not found to have a significant impact on international competitiveness. This counterintuitive result may be attributed to *cskills* not being a very strong proxy of the quality of education and estimation issues related to the index per se.

The hypothesised positive impact of vocational training on international competitiveness was initially supported, however after accounting for potential endogeneity, the coefficients of the two measures assessed lost some degree of significance. However, given the data restrictions, the latter results should be considered as only suggestive and no conclusive inference can be drawn in this regard. A more comprehensive analysis regarding the relationship between the training dimension of human capital and international competitiveness, at a firm level, will be carried out in Chapter 6. Overall, the obtained findings, when using export market share as a dependent variable, seem to suggest that investment in education as a key source of human capital development can have important effects on boosting the international competitiveness of European countries. However, when the relative export advantage index (RXA) is used to capture the degree of international competitiveness of our sample of countries, the empirical evidence fails to support its underlying hypothesised link with human capital endowments. It has been already argued that the reliability of the latter empirical findings might be subject to the reliability of the index per se, i.e. its various acknowledged statistical limitations.

To highlight the importance of having accurate measures for the variables of interest, a comparative analysis using two versions of education data has also been conducted. The estimated results using the most recent version of education data appear to tell a different story compared to the ones produced using an older version of the dataset, highlighting the importance of being particularly cautious when interpreting estimation results. To assess the hypothesised positive impact of human capital endowments on international competitiveness, with particular focus on technology intensive exports, a cross industry-country panel analysis for the period 1995-2010 will be conducted in Chapter 5.

CHAPTER 5

HUMAN CAPITAL AND TECHNOLOGY INTENSIVE EXPORTS: EMPIRICAL EVIDENCE

Contents

5.1. Introduction

The empirical assessment conducted in Chapter 4 indicated that the share of population who have attained secondary education exerts a positive and significant impact on the share of exports of the EU-27[61] and so does the share of population with tertiary education. However, when differentiating between non-transition (N-ETEs) and transition economies (ETEs), the impact of tertiary education turned out to be stronger on the export share of the former set of countries, with the share of population who attained secondary education having a larger effect on the share of exports of ETEs. The different stages of economic development of these countries and their distinct export structures were highlighted as potential reasons for these latter differences. That is to say, there is a higher tendency among developed countries to export more sophisticated, technology-intensive goods, with less advanced economies being more involved in exporting less skill and technology intensive goods. In line with theoretical underpinnings, a higher level of education attained is more likely to enhance productivity of workers when more advanced activities are to be performed. This hypothesis is tested empirically in this chapter using OECD and UNCTAD medium and high tech export data based on ISIC and SITC revision 3 classifications. In addition to proxying international competitiveness by the share of medium and high tech exports, two alternative measures, i.e. export specialization (RXA) and export sophistication (EXPY) are introduced into the empirical analysis. Human capital endowments are captured by the share of population who have attained secondary and tertiary education, the average years of schooling, and a measure of the quality of education. To assess the relative importance of different levels of education on the medium and high technology intensive exports of EU-27, for the period 1995-2010, a range of estimation techniques are employed. The remainder of this chapter is organized as follows: section 5.2 discusses the specification of the dependent variables, their data sources and descriptive statistics. Furthermore, it examines the characteristics and evolution of EU-27's export share, export specialization and sophistication in medium and high technology intensive industries over the period 1995-2010. Section 5.3 provides a brief discussion on the model specification and estimation methodologies. The following section (5.4) reports and interprets the estimated findings extracted from the various empirical assessments conducted in this chapter. In order to address the potential endogeneity in

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[61] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Germany, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, and the United Kingdom.

the estimations, a fixed effects IV estimation approach was employed, instrumenting the endogenous variables by their lagged values. The last section (5.5) summarizes the main empirical findings and concludes.

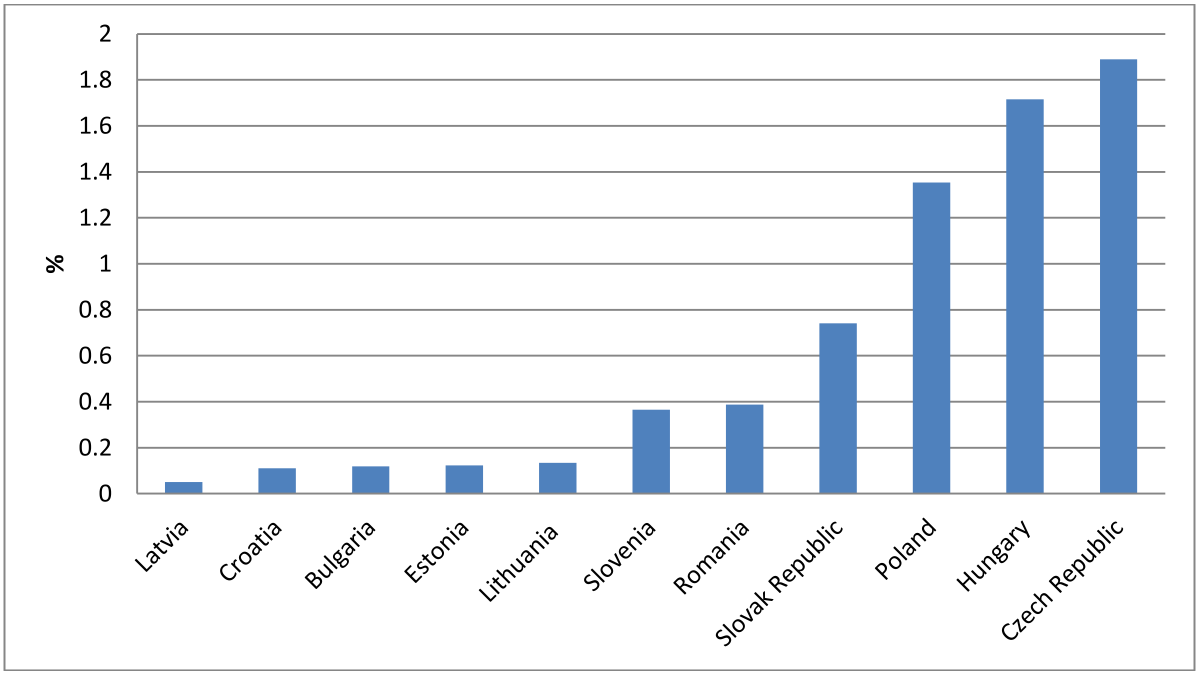
5.2 Data and variable specification

As discussed in Chapter 2, several approaches to measuring international competitiveness have been proposed in the literature. Among the wide range of indicators, trade/export based measures appear to have received particular emphasis given their well-established theoretical basis and data availability. In order to assess the relative competitiveness of 27 EU countries in exporting medium and high technology intensive manufactures, three distinct measures are adopted in this empirical assessment: export market share, relative export advantage and export sophistication index.

Export market share (emshind) is defined as the share of a country's exports in medium and high tech industries in the exports of same industries in EU-28 measured as percentages, for the period 1995-2010. As constructed, it is expected to reflect the degree of competitiveness of each country relative to this particular set of countries in medium and high tech manufacturing exports. Data used to construct this measure are taken from the *OECD STAN Bilateral Trade Database by Industry and End-use category, edition 2012*, based on 2 digit level, ISIC revision 3 (OECD, 2013b).

Figures below present the trend over the period 1995-2010 for export market share in medium-high and high tech manufactures for transition and non-transition European economies. There seem to be large disparity of shares between these two sets of countries, with the average export market share being 0.63 for ETEs and 6.31 for N-ETEs. Based on their relative performance, transition economies can be re-grouped in three distinct categories: low share (Bulgaria, Croatia, Estonia, Latvia, and Lithuania), medium share (Romania, Slovak Republic and Slovenia) and high share (Czech Republic, Hungary, and Poland). The current classification is determined as follows: the low category refers to countries with shares of medium-high and high technology manufactures of less than 0.2%, medium implies shares from 0.2% to 0.8%, whereas, the countries with shares greater than 0.8% are classified as high share performers. Averaged export market shares for 11 transition countries are presented in Figure 5.1.

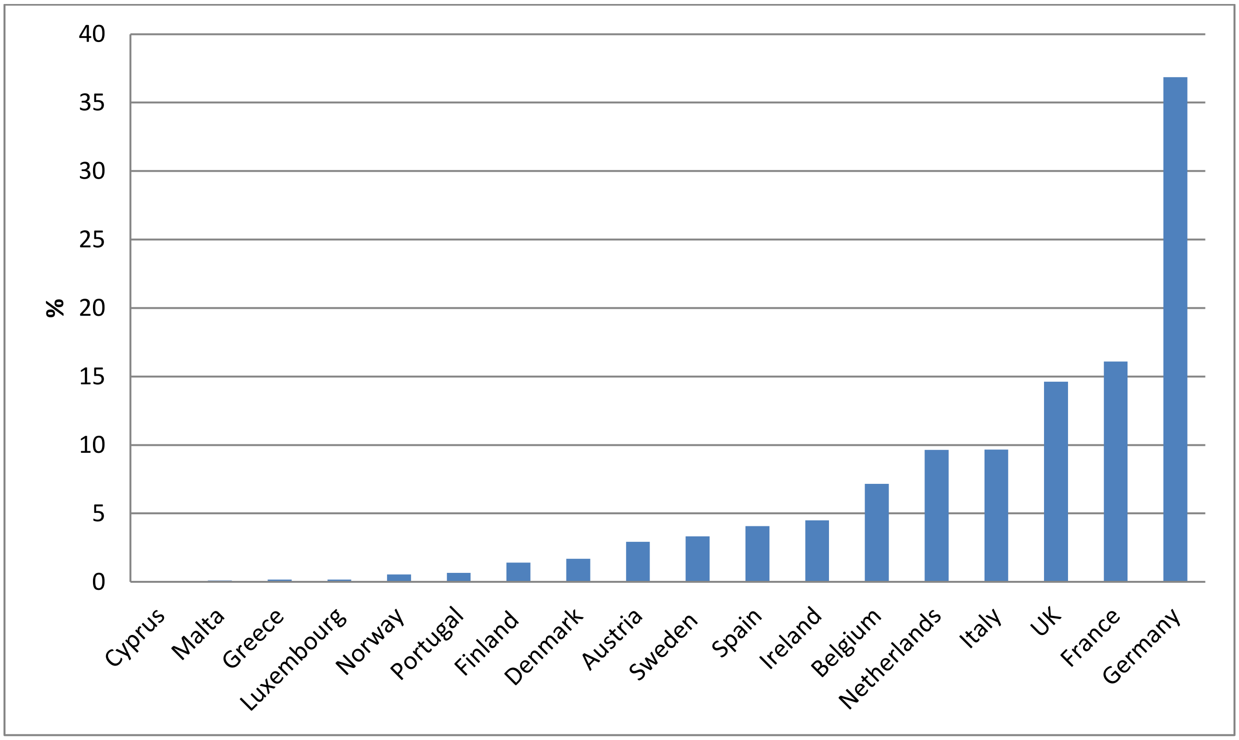
Figure 5.1 Export market share of European transition economies in medium-high and high tech industries, percentages (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

Figure 5.2 presented below displays the export market share of N-ETEs. Countries with lowest market shares, on average, are Cyprus, Greece, Luxembourg, Malta, Norway and Portugal). Austria, Denmark, Finland, Ireland, Spain and Sweden appear to rank higher in terms of their averaged export market share. Germany is clearly the best performer, followed by France, UK, Italy, Netherlands, and Belgium. In order to check whether the actual figures are driven by the size of the country and its economy, a relative export index is computed and presented below.

Figure 5.2 Export market share of non- transition economies/EU-18 in medium-high and high tech industries, percentages (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

The relative export index (RXA) represents the relative export advantage of country *i* in industry *k*. It is defined as the ratio of a country's exports of industry *k* relative to its total exports and to the corresponding exports of EU-28. A more detailed explanation for this measure has been provided in Chapters 2 and 4. Data used to construct this index are taken from the OECD's *STAN Bilateral Trade Database by Industry and End-use category, edition 2012*, based on the ISIC[62] revision 3 (OECD, 2013b). The OECD has classified the manufacturing industries into four groups of technological intensity: *low, medium-low, medium-high and high tech*. This classification follows Hatzichronoglou's (1997) approach and it is based on R&D intensity indicators: *R&D expenditures divided by value added, R&D expenditures divided by production and R&D expenditures plus technology embodied in intermediate and capital goods divided by production* (OECD Science, Technology and Industry Scoreboard 2003, p. 146). While industries ranked in Table 5.1 as 1, 2, 3, 4, 6, 7 and 10 (i.e. Food products, beverages and

[62] "The International Standard Industrial Classification of All Economic Activities (ISIC) is the international reference classification of productive activities. Its main purpose is to provide a set of activity categories that can be utilized for the collection and reporting of statistics according to such activities". United Nations (2008, p.iii).

tobacco, Textiles, textile products, leather and footwear, Wood and products of wood and cork, Pulp, paper, paper products, printing and publishing, Other non-metallic mineral products, Basic metals and fabricated metal products and Manufacturing n.e.c. and recycling) are classified as low and medium-low tech, the technology intensity of Chemical, rubber, plastics and fuel products, Machinery and equipment, and Transport equipment (i.e. industries 5, 8, 9) is mixed. Namely, the majority of manufactures pertaining to industry 5 are medium-low tech (e.g. 23, 25) with the exception of Chemicals excluding Pharmaceuticals (i.e. ISIC 24 excluding 2423) which is medium-high tech.[63] Industry 8 is a mixture of medium-high and high tech manufactures, with the share of the latter being relatively higher. Industry 9, on the other hand, covers a mixture of medium-low, medium-high and high tech manufactures. Motor Vehicles, Trailers and Semi-Trailers (i.e. Industry 34) are solely medium-high, whereas, industry 35 covers medium-low, medium-high and high tech manufactures. The share of the medium-high products is relatively higher than the other two.

Table 5.1 Manufacturing industries according to ISIC rev. 3

No.	Manufacturing industries	Abb.	ISIC code	Technology intensity
1	Food products, beverages and tobacco	FBT	15-16	Low
2	Textiles, textile products, leather and footwear	TLF	17-19	Low
3	Wood and products of wood and cork	PWC	20	Low
4	Pulp, paper, paper products, printing and publishing	PPP	21-22	Low
5	Chemical, rubber, plastics and fuel products	CRPF	23-25	M. low/ M. high/ high
6	Other non-metallic mineral products	NMM	26	M. low
7	Basic metals and fabricated metal products	BMF	27-28	M. low
8	Machinery and equipment	ME	29-33	M. high/high
9	Transport equipment	TE	34-35	M. low/M. high/high
10	Manufacturing n.e.c. and recycling	MR	36-37	Low

Source: STAN Bilateral Trade Database by Industry and End-use category. Ed. 2012 ISIC Revision 3

A more disaggregated classification with special focus on medium-high and high tech manufacturing industries is presented in Table 5.2. Railroad and Transport Equipment, n.e.c (RTE), Motor Vehicles, Trailers and Semi-Trailers (MVTST), Electrical Machinery and Apparatus, n.e.c. (EMA), Machinery and Equipment, n.e.c (ME), and Chemicals excluding

[63] The manufacture coded 2423 is high tech.

Pharmaceuticals (ChePh) represent medium-high tech manufactures, whereas, high tech refers to the following categories: Pharmaceuticals (Ph), Office, Accounting and Computing Machinery (OACM), Radio, Television and Communication Equipment (RTCE), Medical, Precision and Optical Instruments (MPOI), and Aircraft and Spacecraft (AS).

Table 5.2 Medium-high and high tech manufacturing industries according to ISIC rev. 3

Medium-high and high tech manufactures	**ISIC code**	**Tech intensity**
Chemicals excluding Pharmaceuticals (ChePh)	24, excluding 2423	Medium-high
Pharmaceuticals (Ph)	2423	High
Machinery and Equipment, n.e.c (ME)	29	Medium-high
Office, Accounting and Computing Machinery (OACM)	30	High
Electrical Machinery and Apparatus, n.e.c. (EMA)	31	Medium-high
Radio, Television and Communication Equipment (RTCE)	32	High
Medical, Precision and Optical Instruments (MPOI)	33	High
Motor Vehicles, Trailers and Semi-Trailers (MVTST)	34	Medium-high
Aircraft and Spacecraft (AS)	353	High
Railroad and Transport Equipment, n.e.c (RTE)	352+359	Medium-high

Source: STAN Bilateral Trade Database by Industry and End-use category. Ed. 2012 ISIC Revision 3

The pattern of export specialization of ETEs and N-ETEs economies in ten different manufacturing industry groups is displayed in the tables below. Their relative export advantage indices (RXAs) are reported in separate Tables, 5.3 and 5.4. A greater value than 1 implies that a given country has a relative export advantage in exporting this specific manufacture and is indicated by a bold font in the table below. The export specialization of these countries in specific medium-high and high tech industries can be found in Tables A5.1 and A5.1.1 in Appendix A5.

Table 5.3 Relative export advantage (RXA) of non-transition economies/EU-18, by industry (1995-2010)

No.	**Industry**	**Tech intensity**	**Austria**	**Belgium**	**Cyprus**	**Denmark**	**Finland**	**France**
1	FBT	Low	0.70	**1.15**	**6.30**	**3.69**	0.26	**1.44**
2	TLF	Low	0.89	**1.06**	**1.15**	**1.17**	0.24	0.83
3	PWC	Low	**3.75**	0.80	0.08	**1.38**	**5.43**	0.54
4	PPP	Low	**1.91**	0.69	0.51	0.62	**7.32**	0.72
5	CRPF	M. low/M. high/high	0.57	**2.10**	**1.27**	0.85	0.52	**1.13**
6	NMM	M. low	**1.20**	0.98	0.74	0.93	0.65	0.88
7	BMF	M. low	**1.61**	**1.14**	0.30	0.66	**1.37**	0.90
8	ME	M. high/high	0.94	0.43	0.55	**1.09**	**1.47**	0.77

No.	Industry	Tech intensity						
9	TE	M. low/M. high/high	0.93	0.83	0.66	0.25	0.35	**1.41**
10	MR	Low	**1.87**	**1.57**	0.70	**1.63**	0.28	0.61

No.	Industry	Tech intensity	Germany	Greece	Ireland	Italy	Luxembourg	Malta
1	FBT	Low	0.51	**2.81**	**1.50**	0.76	0.82	0.54
2	TLF	Low	0.53	**3.77**	0.16	**3.32**	0.92	**1.36**
3	PWC	Low	0.55	0.44	0.31	0.46	**1.49**	0.02
4	PPP	Low	0.84	0.52	**1.14**	0.58	**1.32**	**1.00**
5	CRPF	M. low/M. high/high	0.81	**1.22**	**3.11**	0.63	0.83	0.56
6	NMM	M. low	0.74	**1.98**	0.27	**2.10**	**2.08**	0.13
7	BMF	M. low	0.99	**1.85**	0.15	**1.14**	**5.03**	0.13
8	ME	M. high/high	**1.29**	0.31	**1.51**	**1.08**	0.63	**4.08**
9	TE	M. low/M. high/high	**1.71**	0.19	0.06	0.58	0.34	0.16
10	MR	Low	0.65	0.39	0.21	**2.32**	0.45	**1.38**

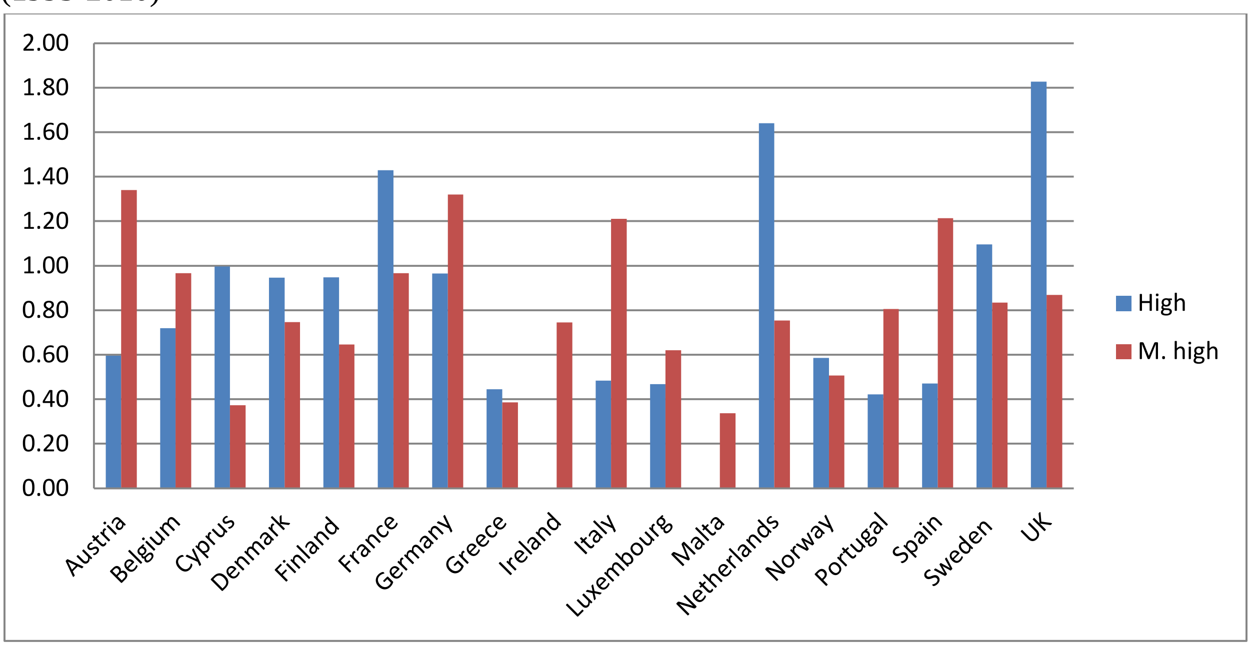
No.	Industry	Tech intensity	Netherlands	Norway	Portugal	Spain	Sweden	UK
1	FBT	Low	**2.37**	**1.73**	**1.01**	**1.40**	0.36	0.77
2	TLF	Low	0.58	0.18	**4.78**	**1.20**	0.30	0.58
3	PWC	Low	0.29	**1.30**	**4.40**	0.72	**3.87**	0.16
4	PPP	Low	0.85	**1.15**	**1.36**	0.82	**3.50**	0.87
5	CRPF	M. low/M. high/high	**1.60**	**1.11**	0.52	0.83	0.73	**1.17**
6	NMM	M. low	0.42	0.44	**2.37**	**2.03**	0.49	0.61
7	BMF	M. low	0.70	**3.16**	0.69	**1.09**	**1.28**	0.77
8	ME	M. high/high	**1.23**	0.67	0.57	0.48	**1.25**	**1.23**
9	TE	M. low/M. high/high	0.32	0.55	0.86	**1.99**	0.88	**1.10**
10	MR	Low	0.45	0.60	**1.01**	0.70	0.75	0.97

Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3
Note: RXA>1 indicates a relative export advantage in industry *j*

The table above suggests that for Austria, Greece, Luxembourg and Portugal, the relative export advantage is revealed to be mainly in low and medium-low tech industries. Belgium's relative export advantage is spread across different technology intense industries, i.e. low, medium-low and medium-high, and high, and so is the comparative advantage of Cyprus, Denmark, Finland, France, Ireland, Italy, Malta, Netherlands, Norway, Spain and Sweden. Finally, as expected, Germany and the UK hold relative export advantage in medium-high and high technology intensive industries mainly. Note that the pattern of relative export advantage has changed significantly over time, with some of these countries shifting from low tech to more technology intensive industries. Namely, Austria has gained comparative advantage on numerous medium-high tech manufactures (Machinery and Equipment, Electrical Machinery and Apparatus, Motor Vehicles, Trailers and Semi-Trailers, Railroad and Transport Equipment). Similarly, Cyprus has improved its relative position in several medium-high and high tech products (e.g. Pharmaceuticals, Radio, Television and Communication Equipment, Medical, Precision and Optical Instruments). Denmark and Finland have also lost their relative advantage on several low tech industries, while they improved their comparative position in a number of medium-high and high tech manufactures. On the other hand, France, Greece, Ireland, Italy, Luxembourg, Malta, Norway, Portugal, and Sweden have lost some degree of their relative comparative advantage in many manufacturing industries.

Given that our main interest lies in medium-high and high technology rather than low and medium-low industries, the figures below present the average relative export advantage of N-ETEs (EU-18) in the former two categories. It is important to note that the RXA indices are initially calculated for each industry and then are averaged over all medium-high and high tech industries, respectively. The export advantage of each industry within the medium-high and high tech groupings can be found in Tables A5.1 and A5.1.1 in Appendix A5.

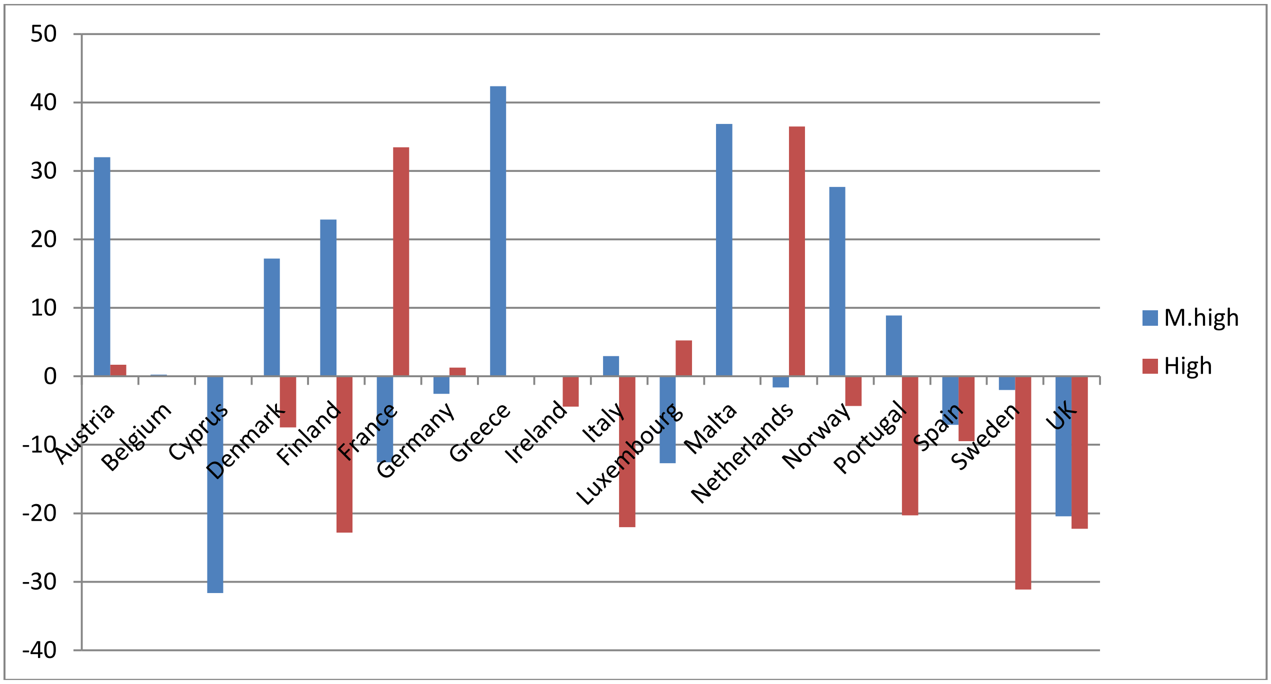
Figure 5.3 RXAs of non-transition economies/EU-18 in medium-high and high tech industries (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

The change in the relative export advantage of N-ETEs from 1995 to 2010 is brought out in Figure 5.4. Some of the industries are excluded from the figure due to extremely high values, e.g. Belgium, Cyprus, Greece, Ireland and Malta. The actual figure shows that many countries have witnessed a significant growth rate in medium-high and high tech exports (including Belgium an outlier), e.g. Austria, Greece, Malta, Norway, Cyprus, Greece, France and Netherlands, respectively. On the other hand, a decreasing trend is evident in several other countries, including some high performers, e.g. UK, Spain, Germany and France.

Figure 5.4 The percentage change in the RXA of non-transition economies (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

On the other hand, the trend in the relative export advantage of ETEs is displayed in tables and figures below. The results summarized in Table 5.4 indicate that, Albania, Bulgaria, Croatia, Estonia, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia, on average, hold relative export advantage mainly in low and medium-low tech industries. Lithuania and Croatia hold relative advantage in some medium-high tech products as well (e.g. Railroad and Transport equipment and Electrical Machinery and Apparatus, respectively), whereas the Slovak Republic exerts a relative advantage in several medium-high and high tech products: Electrical Machinery and Apparatus, Radio, Television and Communication Equipment, Motor Vehicles, Trailers and Semi-Trailers, Railroad and Transport Equipment. The relative export advantage of Czech

Republic is mixed. The latter appears to have an advantageous position in numerous manufacturing industries, i.e. low tech, medium-low and medium-high and high tech. Hungary exerts an advantageous position in two low tech industries and a number of medium-high and high tech manufactures (e.g. Office, Accounting and Computing Machinery, Electrical Machinery and Apparatus, Motor Vehicles, Trailers and Semi-Trailers, Railroad and Transport Equipment).

Table 5.4 RXAs of European transition economies, by industry (1995-2010)

No.	Industry	Tech intensity	Albania	Bulgaria	Croatia	Czech Republic	Estonia	Hungary
1	FBT	Low	0.85	**1.25**	**1.35**	0.46	**1.40**	0.98
2	TLF	Low	**33.60**	**4.39**	**2.81**	0.98	**2.19**	**1.08**
3	PWC	Low	**1.85**	**1.57**	**4.33**	**1.74**	**9.38**	0.97
4	PPP	Low	0.55	0.37	0.72	0.91	0.74	0.44
5	CRPF	M. low/M. high/high	0.12	**1.16**	**1.09**	0.54	0.74	0.56
6	NMM	M. low	0.81	**1.50**	**2.23**	**2.40**	**1.10**	0.87
7	BMF	M. low	**1.31**	**2.97**	0.70	**1.62**	**1.00**	0.69
8	ME	M. high/high	0.11	0.40	0.49	**1.23**	0.86	**1.83**
9	TE	M. low/M. high/high	0.02	0.12	0.82	**1.05**	0.38	0.99
10	MR	Low	0.87	0.71	**1.27**	**1.36**	**1.71**	**1.16**

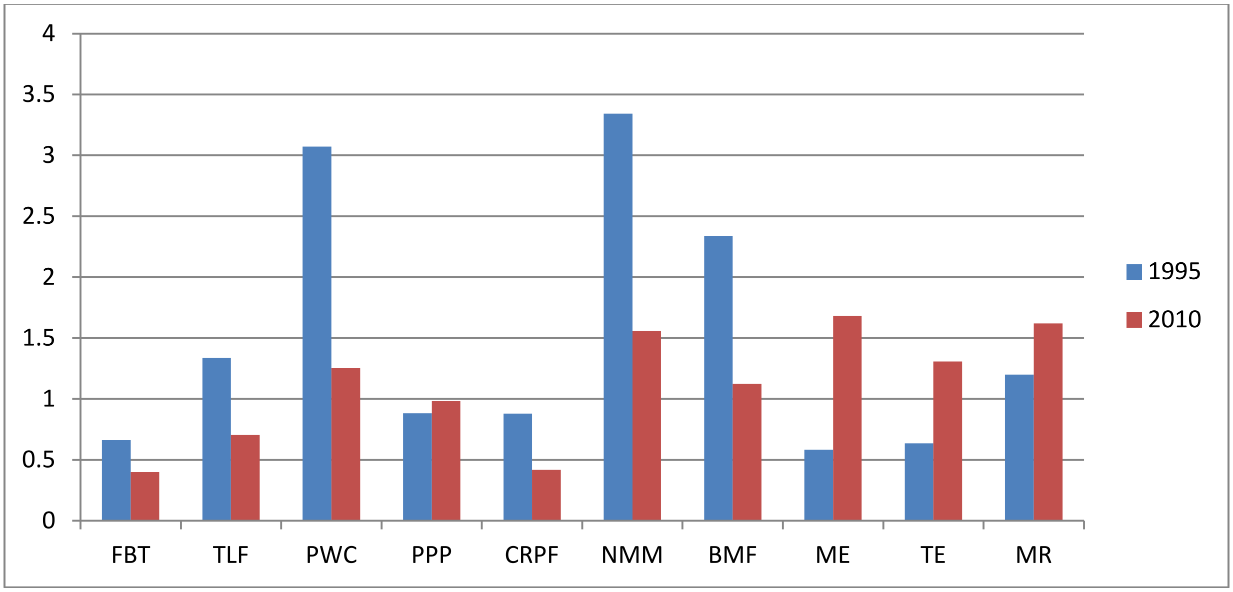
No.	Industry	Tech intensity	Latvia	Lithuania	Poland	Romania	Slovak Republic	Slovenia
1	FBT	Low	**1.69**	**1.83**	**1.24**	0.29	0.41	0.42
2	TLF	Low	**2.30**	**2.75**	**1.46**	**6.07**	**1.11**	**1.28**
3	PWC	Low	**32.26**	**4.36**	**3.13**	**3.95**	**1.74**	**2.90**
4	PPP	Low	0.66	0.46	0.94	0.20	**1.13**	**1.27**
5	CRPF	M. low/M. high/high	0.52	**1.79**	0.58	0.69	0.70	0.83
6	NMM	M. low	**1.23**	0.79	**1.47**	0.95	**1.45**	**1.45**
7	BMF	M. low	**1.50**	0.42	**1.70**	**1.76**	**1.99**	**1.55**
8	ME	M. high/high	0.31	0.39	0.60	0.55	0.84	0.88
9	TE	M. low/M. high/high	0.23	0.52	1.09	0.48	**1.38**	0.84
10	MR	Low	**1.70**	**1.48**	**2.57**	**1.75**	0.94	**2.27**

Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

Note: RXA>1 indicates a relative export advantage in industry *j*

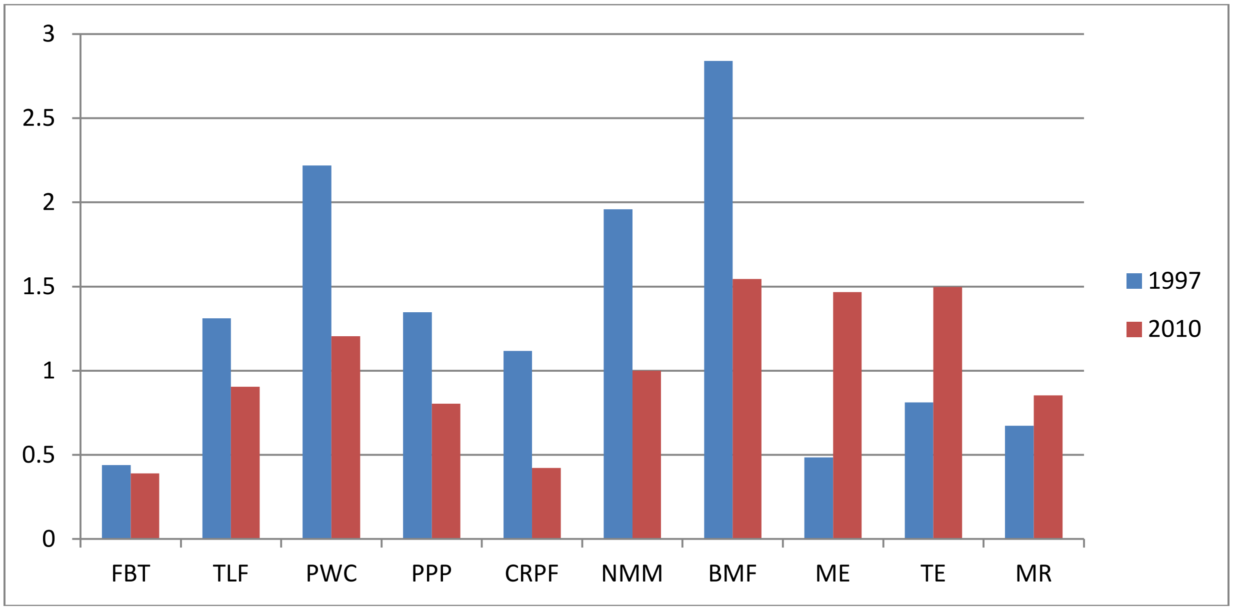
It is important to emphasise that the export structure of some of these countries has shifted away from low and medium-low industries to medium-high and high tech intensive industries. For instance, the Czech Republic has lost comparative advantage in exporting many low and medium-low tech manufactures, while, it has gained relative advantage in several medium-high and high tech industries. Similarly, the Slovak Republic has lost some of its advantageous position in exporting low and medium-low tech manufactures, while improving its position in some medium-high and high tech industries. Hungary has also improved its position in a number of medium-high and high tech products, though, it lost its advantageous position in most of the manufacturing industries (see Figures 5.5, 5.6 and 5.7 below).

Figure 5.5 RXAs of medium-high and high tech in the Czech Republic, by industry



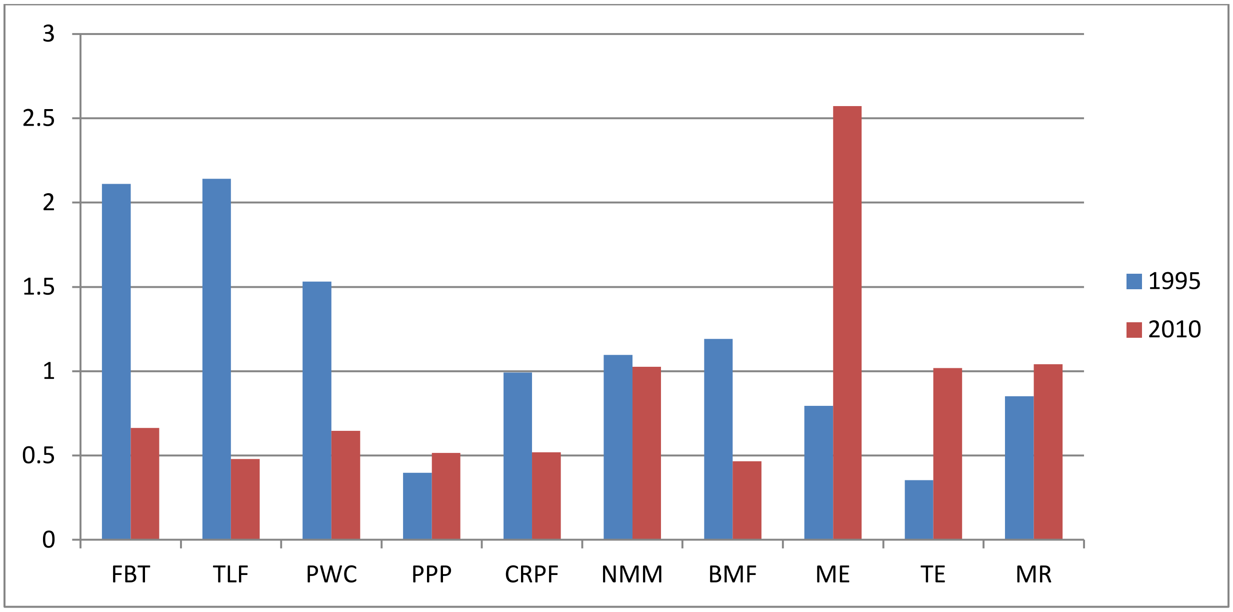
Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

Figure 5.6 RXAs of medium-high and high tech in Slovak Republic, by industry



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

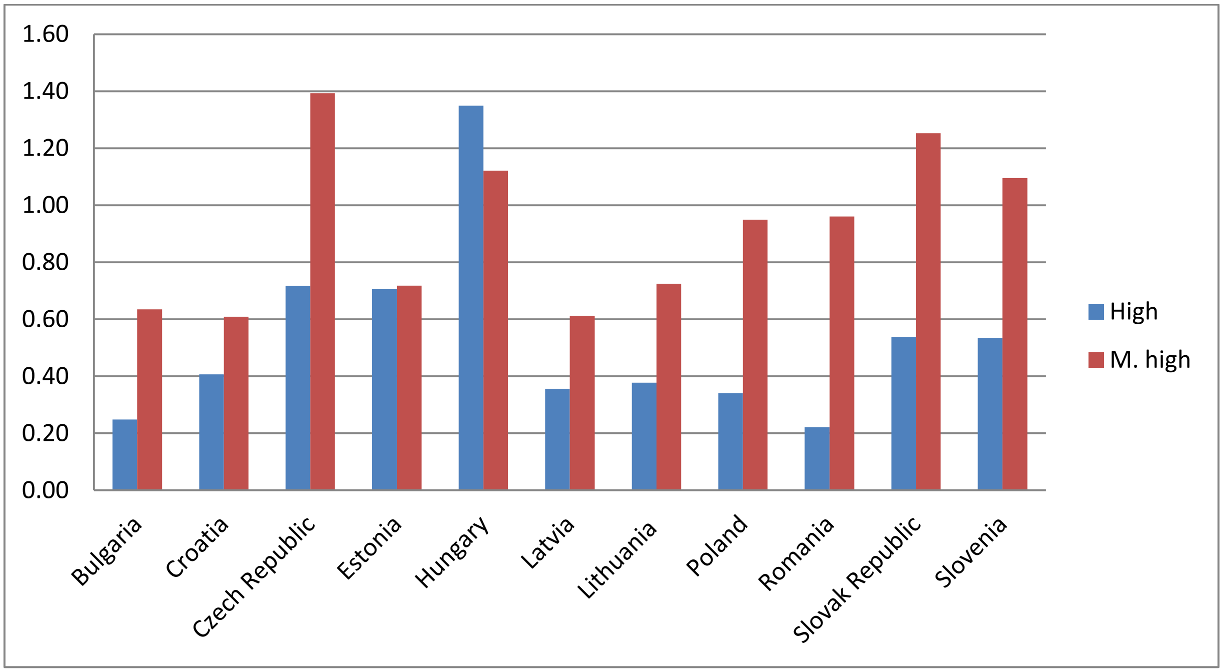
Figure 5.7 RXAs of medium-high and high tech in Hungary, by industry



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

Additional evidence supporting the relative export advantage of these countries in medium-high and high tech exports is provided in Figures 5.8 and 5.9. Namely, the Czech Republic, Hungary, the Slovak Republic and Slovenia appear to hold an advantageous position in exporting medium-high tech manufactures. Hungary exerts relative export advantage on high tech exports as well. Note that some countries (e.g. Estonia, Poland, and Romania) hold advantageous positions on some specific medium-high and high tech industries, but this is not reflected in the actual figure due to averaging.

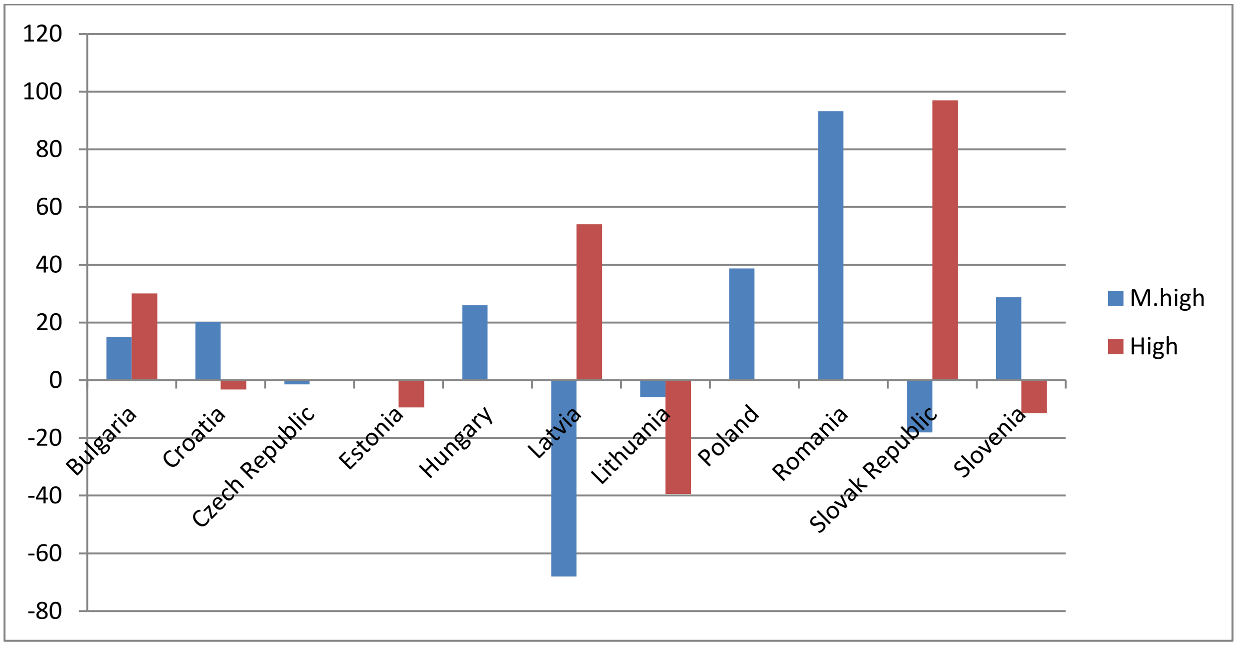
Figure 5.8 RXAs of European transition economies in medium-high and high tech exports (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

The change in the relative export advantage (RXA) of ETEs in medium-high and high tech manufactures is brought out in Figure 5.9. The percentage change in the relative export advantage of some countries in some industries has been extremely high, hence a reason for excluding them from the figures below. Outlier industries- countries are: Estonia's medium-high and Czech Republic, Hungary, Poland and Romania's high tech industries. Namely, the relative export advantage of Estonia in medium-high tech industries has increased from 1995 to 2010, by 136%. The percentage change in the RXAs of Czech Republic, Hungary, Poland and Romania in high tech industries is 473%, 258%, 194%, and 541 %, respectively. The actual figure shows that the majority of transition economies (including outliers) have improved their advantageous position in both tech categories.

Figure 5.9 The percentage change in the RXA of European transition economies (1995-2010)



Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3

Export sophistication index (EXPY) is a measure of the sophistication of a country's export basket. This index has been introduced by Hausmann et al. (2007) to capture the productivity level associated with a country's export portfolio. The index covers 89 product groups[64] which have been classified by the Innovation Union Scoreboard (European Commission, 2011) as medium and high tech manufactures.[65] Data used to construct this measure are taken from UNCTAD's database: *Merchandise trade matrix - detailed products, exports in thousands of dollars, annual, 1995-2013, SITC revision 3* (UNCTAD, 2014a). In contrast to the classification used to construct our alternative measures of international competitiveness (sectoral approach), i.e. ISIC, the actual measure is calculated using the product approach - three digit export data according to SITC[66], rev. 3. It is also important to note that there were some missing data for some product groups for some countries; hence the results should be interpreted with great caution.

[64] SITC: 266, 267, 512, 513, 525, 533, 54, 553, 554, 562, 57, 58, 591, 593, 597, 598, 629, 653, 671, 672, 679, 71, 72, 731, 733, 737, 74, 751, 752, 759, 76, 77, 78, 79, 812, 87, 88 and 891.

[65] Note that Innovation Union Scoreboard provides no explanation for this classification but this data has been widely used by researchers.

[66] "SITC is the Standard International Trade Classification which is a statistical classification of the commodities entering external trade. It is designed to provide the commodity aggregates requited for purposes of economic analysis and to facilitate the international comparison of trade-by-commodity data" (OECD, 2002, p.226).

Construction of the export sophistication index (EXPY):

Stage 1:

Initially, an index called ***PRODY*** is constructed. It is defined as the weighted average of the per capita GDPs of countries exporting a product, where the weights reflect the revealed comparative advantage of each country in that specific product.

$$PRODY_k = \sum_j \frac{(x_{jk}/X_j)}{\sum_j (x_{jk}/X_j)} Y_j$$

x_{jk}/X_j is the share of product *k* in country *j*'s total exports

$\sum x_{jk}/X_j$ is the sum of the shares across all countries exporting product *k*

Yj is the per capita GDP of country *j*.

Stage 2:

Subsequently, the export sophistication index ***(EXPY)*** is constructed. It is defined as the weighted average of ***PRODY*** for a country, where the weights reflect the shares of products in country's total exports.

$$EXPY_i = \sum_l \left(\frac{x_{il}}{X_i}\right) PRODY_l$$

i represents countries, whereas *l* denotes goods

Source: Hausmann et al. (2007)

The pattern of export sophistication across countries, averaged over 1995-2010 is presented in Table 5.5. Although, the **EXPY** index appears to be highly correlated with per capita GDP for the majority of countries (see Table A5.1.2), there are some slight divergences within the sample. For instance, Malta[67] has higher levels of **EXPY** relative to its income level, exceeding the indices of many developed countries. This might be attributed to some extent to the high share of specific product groups on its total domestic exports, e.g. Articles of rubber, n.e.c., Apparatus for electrical circuits; board, panels, Cathode valves and tubes, Ships, boats and floating structures, and Instruments and appliances, n.e.c., for medical, etc. The same seems to apply to some other

[67] Malta is excluded from the estimations due to missing data for some of the explanatory variables.

countries as well, e.g. the UK, and to a lesser extent to the Netherlands and Sweden. The opposite holds for Norway, i.e. higher levels of income are not followed by higher levels of **EXPY**, thus ranking Norway lowest in export sophistication.

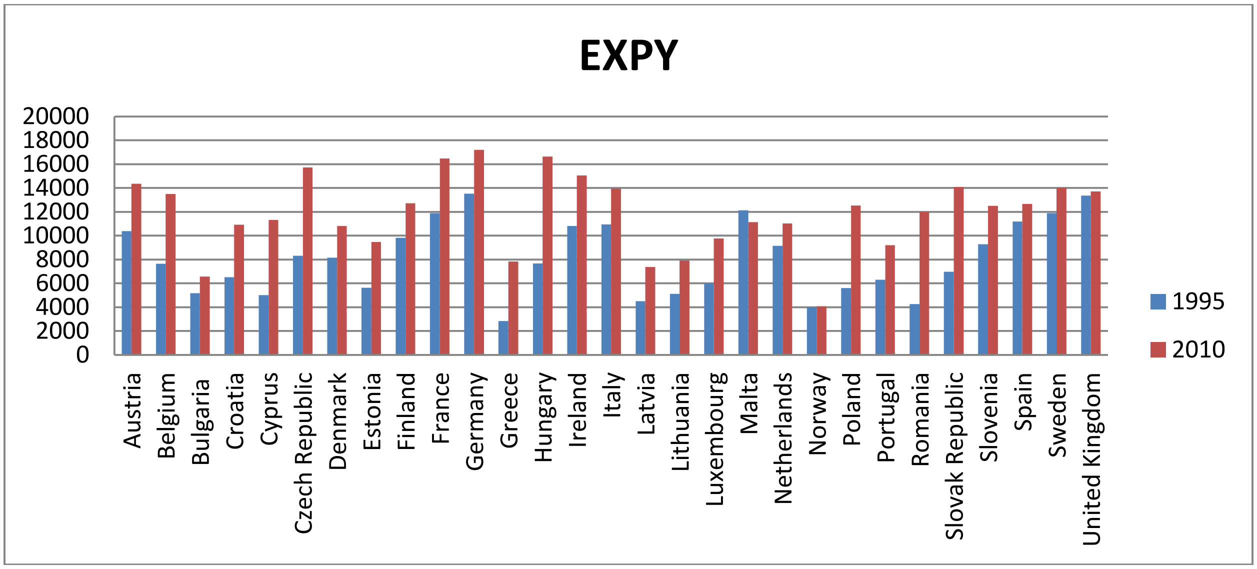
Table 5.5 Export sophistication index (EXPY), averaged (1995-2010)

Country	**EXPY**		**Country**	**EXPY**
Norway	3916.801		Belgium	12392.16
Latvia	5094.703		Slovenia	12440.93
Bulgaria	5620.625		Spain	12799.93
Greece	6316.746		Austria	13184.91
Lithuania	7052.907		Finland	13192.69
Romania	7146.258		Italy	13203.98
Estonia	8230.534		Czech Republic	13897.19
Croatia	9091.67		Malta	14428.62
Portugal	9309.66		Sweden	14470.44
Cyprus	9632.925		United Kingdom	14960.95
Poland	9960.49		France	15349.67
Luxembourg	10087.11		Hungary	15388.42
Denmark	10823.73		Ireland	15413.5
Netherlands	11661.67		Germany	16673.41
Slovak Republic	11744.59			

Source: Own calculations based on UNCTAD Merchandise trade matrix SITC revision 3

Figure 5.10 presented below shows that the export sophistication of EU-27 (excl. Malta) has risen significantly over time; with extremely high rates for some countries. While, the pattern of export sophistication appears to be quite stable for more developed countries, it has changed rapidly for selected transition economies, e.g. Czech Republic, Hungary, Poland, Romania and Slovak Republic.

Figure 5.10 Export sophistication index (EXPY)



Source: Own calculations based on UNCTAD Merchandise trade matrix SITC revision 3

The export market share and the relative export advantage measures discussed above have been also constructed at the country level, using less disaggregated data:

MhstechC/mstechC/hstechC represent the shares of a country's medium and high skill and technology-intensive exports over the exports (the same product group) of EU-28, constructed for each technology category separately and jointly. Data used to construct these measures are taken from the UNCTAD's database: Merchandise trade matrix - product groups, exports in thousands of dollars, annual, 1995-2013 SITC revision 3 (UNCTAD, 2014b).

RXAmidhigh/RXAmid/RXAhigh represent the relative export advantage of country *i* in the medium and high-skill and technology-intensive industries, constructed for each tech category separately and jointly. Data used to construct these measures are taken from the UNCTAD's database: Merchandise trade matrix - product groups, exports in thousands of dollars, annual, 1995-2013, SITC revision 3 (UNCTAD, 2014b).

Table 5.6 Descriptive statistics[68]

Variable	n	Mean	S.D.	Min	Quantiles .25	Mdn	.75	Max
lnemshind	1371	-0.13	1.99	-5.35	-1.61	-0.17	1.32	4.01
lnemshmhtech	4570	-0.43	2.29	-9.44	-2.05	-0.39	1.35	4.16
lnemshhtech	2285	-0.61	2.38	-9.44	-2.39	-0.66	1.29	4.14
lnemshmtech	2285	-0.26	2.18	-8.78	-1.69	-0.16	1.40	4.16
lnrxa	1371	-0.34	0.73	-3.58	-0.74	-0.25	0.13	1.73
lnrxamhtech	4570	-0.63	1.10	-6.55	-1.16	-0.49	0.07	3.25
lnrxahtech	2285	-0.79	1.24	-6.55	-1.47	-0.73	-0.03	3.25
lnrxamtech	2285	-0.46	0.91	-6.24	-0.81	-0.35	0.13	1.86
lnEXPY	464	9.24	0.42	7.95	9.01	9.37	9.56	9.84
lnmstechC	464	-0.19	2.02	-4.95	-1.86	-0.08	1.36	3.92
lnhstechC	464	-0.13	1.92	-4.13	-1.72	-0.49	1.26	3.49
lnRXAmid	464	-0.46	0.71	-2.18	-1.04	-0.38	0.19	0.69
lnRXAhigh	464	-0.36	0.75	-1.99	-0.78	-0.49	-0.01	2.18

The correlation coefficients between the potential measures of competitiveness reveal that the more the disaggregated the data, the more correlated the export market share ratios and relative export advantage indices become (see Table A5.1.3). For comparison purposes the estimated results obtained using both, country and industry aggregated data will be discussed although the main focus of the investigation is placed on the latter dimension.

5.3 Model specification and estimation methodology

The baseline model specification adopted in this analysis is similar to the one used in the previous chapter, with the exception of the dependent variable(s).

$$Y_{ikt} = \beta X'_{it} + \alpha_i + \varepsilon_{it}, \qquad (5.1)$$

$i = 1, . . . , 27, \; t = 1, . . . ,16$

Where Y_{ikt} is the export market share (emsh), relative export advantage (*RXA*) and export sophistication (*EXPY*) of medium and high tech manufactures, X_{it} is a vector of explanatory variables, α_{ik} is the unobserved industry and country specific effect and ε_{it} is the error term, *i*

[68] The descriptive statistics of variables in levels can be found in Table A5.1.4 in appendix A5.

denotes countries, *t* denotes time, and *k* denotes industries. For reasons already explained in Chapter 4, all the models are augmented by a set of time dummies.

The variables of interest remain the same as in the previous chapter given the unavailability of education attainment stock data at more disaggregated levels and so do the control variables. The education attainment dimension is, as in the previous chapter, represented by the percentage of population aged 15 and over who have attained secondary education *(sedut),* the percentage of population aged 15 and over who have attained tertiary education *(tedut)* and the average number of years of schooling for the same group of population *(avyrs).* A cognitive skills measure introduced by Hanushek and Woessmann (2009) is employed to assess the hypothesised role of the quality of education *(cskills).* To assess the hypothesised role of innovation, the number of patent filings by residents *(patappr)* has been introduced to the modelling strategy of this investigation. In line with the theoretical and empirical considerations discussed previously, this variable is expected to exert a positive and significant impact. Note that research and development expenditure (% GDP) and patent grants were left out of the analysis due to large share of missing data. The foreign direct investment *(FDI)* represented by the inward foreign direct investment stock (% GDP) has been introduced to capture the hypothesised role of transnational corporations (TNCs) on the export engagement of host countries. Additional control variables entail GDP per capita as a measure of the level of development of a country (*gdpc*), and population as a proxy of its size *(pop).* Another potential driver of export engagement in tech intensive goods is unit labour cost, which in the present empirical analysis is proxied by a real unit labour cost index *(rulc)* derived from Eurostat. In line with the existing empirical evidence, a negative coefficient for the latter measure is expected to be found. The hypothesised importance of the geographical characteristics of a country for its international competitiveness will be also assessed through the use of a distance measure. The ease of access to the main EU markets is represented by distance from each country's capital city to Brussels *(dist).* Given the focus of our research, a transition indicator *(transindN)* and a transition dummy *(transdummy)* have been introduced to the model specification. The former represents a country's progress in transition, covering large scale privatisation, small scale privatisation, governance and enterprise restructuring, price liberalisation, trade and foreign exchange system, and competition policy. The transition dummy equals to 1 if a country has gone through the transition process and 0 otherwise. The potential impact of the economic freedom level of a country *(ecofree)* is captured by an equal weight index covering property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labour freedom, and monetary freedom. To capture the phenomenon of labour market mismatch, an unemployment measure, i.e. long term unemployment rate (% of total unemployment) has been included in the estimations *(unem).* The potential impact of the size of the non-tradable sector is captured by a World Bank measure, defined as services, etc., value added as a % of GDP *(serv).* A higher share of services in a country, holding everything else fixed, is likely to reduce its propensity to export. A more detailed description of independent variables can be found in Section 4.2.

In principle, employing industry level data for the set of explanatory variables seems more sensible, however, given the unavailability of more disagregated information, and supported by international competitiveness/comparative advantage literature, we do not expect this to have major implications for our model specification. As discussed in Section 4.5, using repeated data for explanatory variables does not appear to influence the significance of the overall parameter estimates. In this Chapter, for comparative purposes, the shares of a country's medium and high technology intensive exports and the relative export advantage of countries in the medium and high technology intensive manufactures were constructed using different levels of aggregation. The final results reveal that irrespective of the level of aggregation used, the link between human capital endowments and international competitiveness remains unchanged.

Hence, we argue that, in spite of the lack of more disaggregated data, the stock of human capital at the national level is still expected to play an important role in explaining the international competitiveness of particular industries. In line with the theoretical consideration discussed in this thesis, a more highly qualified educated labour force is more likely to enhance a country's ability to compete in exporting more technology intensive goods. For instance, building on the theoretical framework of Heckscher-Ohlin-Vanek, Corvers and Grip (1997) suggest that it is the factor endowments measured at the country level that are more likely to explain the industry export patterns. Since countries tend to focus on exporting goods that are produced using their abundant endowments, country characteristics are expected to play an important role in explaining their export patterns at a sectoral level. A more highly skilled labour force was found to exert a significant and positive impact on the revealed comparative advantage of technology-intensive industries. The key reason for focusing on country specific rather than industry specific determinants, according to the authors is that the national human capital stock tends to depend on country-specific characteristics, i.e. its educational system. By assessing the importance of linking macro and micro theories, with particular focus on the field of sociology, Liska (1990) argues that explanatory variables measured at broader levels are no less significant in testing micro theoretical hypothesis. The author argues that while they might not explain as much of the total variance as less aggregated variables (e.g. individual level variables) they play a key role in linking micro and macro level theories. The argument that aggregated factors have no role in explaining micro level phenomena according to Gräbner and Kapeller (2015) is a "dogmatic fallacy".

Two separate models will be estimated in this Chapter: Model 1 focuses on the impact of the stock of population (15 and over) with secondary (tertiary) education as their highest level attained while, Model 2 assesses the effect of average years of schooling on tech intensive goods exported by EU-27. The empirical methodology employed in this chapter is the same as in the previous chapter: Driscoll-Kraay approach to correct for heteroskedasticity, serial correlation and cross sectional dependence, Fixed Effects Vector Decomposition (FEVD) and Hausman and Taylor (HT) to estimate the coefficients of time invariant variables, and finally, the country and industry fixed effects instrumental variable (IV) approach to account for potential endogeneity. As discussed in Section 4.4, reverse causation from international competitiveness to education, innovation and FDI is likely to occur, hence, instrumenting the potential endogenous variables is required. Although, we have considered competitiveness measures constructed at both industry and country levels, for the emsh and RXA analyses, the industry level findings are of primary interest, given that more disaggregation allows us to make use of a larger number of observations and to also draw a clearer inference about different tech intensive industries separately. Estimated results of Driscoll-Kraay and IV are presented in the section below.

5.4 Empirical evidence

Even though considerable research has been dedicated to the construction of indices to measure international competitiveness, the determinants of their variation across countries and time have not been profoundly investigated. Hence, to fill in this gap, the impact of human capital endowments on the international competitiveness of EU-27, the latter being proxied by several indices has been assessed in this chapter. The focus of this investigation is placed on ten medium-high and high tech industries based on the ISIC classification, revision 3. Given the variety of model specifications used in the estimations this section is split into two sub-sections. The first sub-section presents and interprets the results when export market share and relative export advantage are used to proxy international competitiveness, whereas, in the second sub-section the findings from the export sophistication index are reported and commented upon.

5.4.1 Export market share and relative export advantage

The empirical findings obtained from the Driscoll-Kraay and IV estimation approaches are presented in Table 5.7 (for further details see Tables A5.2.2, A5.3.2, A5.2.6 and A5.3.6 in Appendix A5). In line with expectations, the fixed effects IV estimated results suggest that, the share of population 15 and over who have attained tertiary education exerts a positive impact on the share of medium-high and high tech goods exported in the sample of countries relative to EU-28. It is estimated on average, that an increase of 1 percent in the share of population with tertiary education increases the export market share of medium-high and high tech manufactures by 0.60 percent, ceteris paribus. In economic terms, however, this effect is not very large as it requires a rise of 10 percent in the mean value of *tedut* (i.e. from 17.64 to 19.40) to increase export market share by 6.0%, i.e. from 4.22 to 4.47. No empirical evidence is found for the impact of the share of population with secondary education and average years of schooling (see columns 2 and 4 in Table 5.7). In addition, the actual analysis has been extended by including another category of technology intensive exports, i.e. medium-low manufactures. The estimated results from the extended analysis are generally consistent with the initial analysis with the exception of the average years of schooling which, in the latter becomes statistically significant. Its marginal effect is negative up to 12.30 years of schooling, and after that point it turns positive.[69] The latter finding is in line with our expectations as we would not expect low levels of education - less than 12 year of schooling - to influence positively the productivity of workers when engaged in producing and exporting medium and high tech intensive manufactures. The quality of education, proxied by the cognitive skills index, developed by Hanushek and

[69] A summary of the main results is presented in Tables A5.9 and A5.9.1.

Woessmann (2009), does not appear to exert a significant impact on the share of medium and high tech exports (see columns 1-4 in Table 5.8, and for further details see Tables A5.2.4/ A5.2.5 and A5.3.4/A5.3.5 in the Appendix section). As previously argued, its lack of variation within countries and the limitations of the methodologies adopted to estimate its coefficient might have led to the insignificant effect. From the set of control variables, the GDP per capita (positive sign) and total population (negative sign)[70] are revealed to have a significant impact in both models, (see columns 2 and 4 in Table 5.7). The estimated results from the Hausman and Taylor (HT) approach reveal a significant (positive) coefficient for transition dummy in Model 2 only. No supporting evidence is found in either model when the Fixed Effect Vector Decomposition (FEVD) method is followed (see columns 1-4 in Table 5.8).

In order to discriminate between transition and non-transition economies, two pairs of estimations have been conducted. The full set of results from these separate samples can be found in the Tables A5.2.6.1, A5.2.6.2, A5.3.6.1 and A5.3.6.2. The education attainment indicators do not seem to have any explanatory power in the ETEs model. When N-ETEs are investigated separately, the share of population 15 and over who have attained secondary education exerts a significant impact on the share of medium and high tech exports. Namely, it is estimated on average, holding other factors constant, that 1 percent increase in the share of population with secondary education decreases the export market share by 0.32 percent, ceteris paribus. When expressed in economic terms, an increase of 10 percent in the mean value of *sedut* (from 52.87 to 58.15) increases export market share by 3.2%, which at its mean value represents an increase from 6.40 to 6.60. Neither the share of population with tertiary education nor the average years of schooling (level and squared) are significant in this particular group of countries. The coefficient of patent applications is significant in both samples of countries, but with different signs, i.e. negative for ETEs and positive for N-ETEs. The contribution of control variables to the explanatory power of model is not very impressive. The unemployment rate exerts a negative impact on the export market share of ETEs only; while, population (negative) and unit labour cost (negative) exert a significant impact on the export market share of N-ETEs.

[70] A potential explanation for this result might be that bigger countries have larger domestic markets and in turn are less incentivized to engage in export activities.

When discriminating between medium-high and high tech exports, the stock of population who have attained tertiary education appears to influence the share of both, medium-high and high tech exports of EU-27, when the two categories are estimated separately (see Tables A5.2.6.3 and A5.2.6.4). It is estimated on average, holding everything else constant that an increase of 1 percent in the share of population who have attained tertiary education increases the share of medium-high tech manufactures exported by these countries by 0.40 percent and the share of high tech exports by 0.78. When these effects are applied at the mean values of the measures, the results reveal that a 10 percent increase in *tedut* (i.e. from 17.64 to 19.40) is needed to increase the (mean) share of medium-high (high) tech exports by 4.0% (7.8%), i.e. from 4.20 to 4.37 (4.23 to 4.56). The latter findings indicate that the impact is relatively stronger when more tech intensive manufactures are exported. This further highlights the relative importance of highly educated population when more technology intensive goods are to be produced and exported. The estimated coefficient of the share of population who have attained secondary education, and average years of schooling are statistically insignificant across all models. For further details see Tables A5.2.6.3- A5.2.6.4.2 and A5.3.6.3- A5.3.6.4.2.

On the other hand, there is no empirical evidence that supports the hypothesis that education attainment indicators have a significant impact on international competitiveness when the latter is proxied by the relative export advantage (RXA) of EU-27 in medium-high and high tech manufactures. The coefficients of secondary, tertiary education and cognitive skills are insignificant across all models for the entire sample, while the average years of schooling, level and squared, are significant but with counterintuitive signs, i.e. its marginal effect is positive until 9.60 years of schooling, and after that point it becomes negative (see columns 6 and 8 in Tables 5.7, and for the full set of results see Tables A5.4.2, A5.4.5, A5.5.2 and A5.5.5). The IV estimation results presented in column 6 and 8 (Table 5.7) show that GDP per capita (*GDPc*) and total population (pop) exert a positive and negative impact on the relative export advantage of EU-27, respectively. The coefficient of patent application (*patappr*) is negative in Model 2, while the share of services (*serv*) is positive (10 % significance level) in Model 1. Being a transition country appears to have a positive impact on the relative export advantage, when the analysis is conducted using the Hausman and Taylor (HT) approach. The FEVD estimates show no significant association between the two, when the latter method is employed (see columns 5-8 in Table 5.8). For further details on the latter set of results see Tables A5.4.3/A5.4.4 and A5.5.3/A5.5.4.

The insignificance of secondary and tertiary levels of education in explaining the relative advantage in exporting medium-high and high tech manufactures is also evident in the N-ETEs subsample (see Table A5.4.5.2 in Appendix A5). While, for transition economies, the share of population who have attained tertiary education turns significant but with a negative sign (see Table A5.4.5.1 in the appendix section), the estimated coefficients of the level and squared terms of average years of schooling are insignificant in both subsamples (see Tables A5.5.5.1 and A5.5.5.2 in Appendix A5). No supporting evidence is found for the role of different levels of education attainment either in the RXA of medium-high or high tech exports of EU-27, when the two categories are estimated separately (Tables A5.4.5.3, A5.5.5.3, A5.4.5.4 and A5.5.5.4 in the appendix section). When distinguishing between N-ETEs and ETE-s, *tedut* appears to exert a negative impact on the share of both, medium-high and high tech exports, only in the ETEs subsample. The marginal effect of average years of schooling on the share of medium-high tech exports is positive up to 10.48 year of schooling and after that point it becomes negative. No supporting evidence is found when high tech exports are estimated instead (for further details see Tables A5.4.5.3.1, A5.4.5.3.2, A5.5.5.3.1, A 5.5.5.3.2, A5.4.5.4.1, A5.4.5.4.2, A5.5.5.4.1 and A5.5.5.4.2 in Appendix A5).

Table 5.7 Driscoll-Kraay and IV estimated results

Estimator	Driscoll-Kraay	IV (xtivreg2)	Driscoll-Kraay	IV (xtivreg2)	Driscoll-Kraay	IV (xtivreg2)	Driscoll-Kraay	IV (xtivreg2)
Tech intensity	M. high & high	M. high & high	M. high & high	M. high & high	M. high & high	M. high & high	M. high & high	M. high & high
VARIABLES	lnemshmhtech	Lnemshmhtech	lnemshmhtech	lnemshmhtech	lnrxamhtech	lnrxamhtech	lnrxamhtech	lnrxamhtech
lnsedut	0.00665	0.14			0.0684	0.0995		
	(0.178)	(0.202)			(0.0839)	(0.194)		
lntedut	0.448***	0.594**			-0.0492	0.0685		
	(0.141)	(0.238)			(0.0951)	(0.228)		
avyrs			-0.897***	-0.551			0.329**	0.616*
			(0.22)	(0.369)			(0.167)	(0.351)
sqravyrs			0.0341***	0.0191			-0.0195***	-0.0321**
			(0.0102)	(0.0169)			(0.00722)	(0.0161)
lnpatappr	-0.0673	-0.0771	-0.0886***	-0.109	-0.0870***	-0.0846	-0.103***	-0.111*
	(0.0528)	(0.0691)	(0.030	(0.0703)	(0.0233)	(0.0668)	(0.0231)	(0.0672)
lnfdi	0.00307	-0.00298	0.0115*	0.00942	0.00875**	0.00723	0.00732**	0.00567
	(0.00428)	(0.00964)	(0.0065)	(0.0094)	(0.00371)	(0.00967)	(0.0037)	(0.00952)
lngdpc	1.542***	1.572***	1.867***	1.983***	0.529**	0.499**	0.577***	0.621***
	(0.273)	(0.24)	(0.13)	(0.181)	(0.233)	(0.233)	(0.207)	(0.18)
lnpop	-4.393***	-4.431***	-3.764***	-3.764***	-1.742***	-1.995***	-1.726***	-1.821***
	(0.47)	(0.671)	(0.393)	(0.586)	(0.301)	(0.654)	(0.299)	(0.568)
unem	0.00353*	0.00206	0.00246**	0.00204	-3.80E-05	-0.000757	0.000291	9.93E-05
	(0.00187)	(0.00133)	(0.001)	(0.0013)	(0.00085)	(0.00129)	(0.00079)	(0.00121)
lnecofree	0.216	-0.0612	0.222	0.0641	-0.0297	-0.0937	0.0408	-0.00605
	(0.305)	(0.272)	(0.191)	(0.274)	(0.206)	(0.267)	(0.167)	(0.271)
lnrulc	0.0191	-0.0859	-0.193	0.00844	0.197	0.18	0.25	0.00914
	(0.432)	(0.303)	(0.215)	(0.0086)	(0.274)	(0.298)	(0.231)	(0.00813)
serv	0.00578	0.00713	0.00950**	-0.195	0.0132***	0.0132*	0.0106***	0.277

	(0.00664)	(0.00845)	(0.0043)	(0.3)	(0.00302)	(0.00792)	(0.00302)	(0.292)
N	3,600	3,450	3,600	3,450	3,600	3,450	3,600	3,450

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

Table 5.8 FEVD and HT estimated results

VARIABLES	FEVD MODEL 1 lnemshmhtech	FEVD Model 2 lnemshmhtech	HT MODEL 1 Lnemshmhtech	HT Model 2 lnemshmhtech	FEVD MODEL 1 lnrxamhtech	FEVD Model 2 lnrxamhtech	HT MODEL 1 lnrxamhtech	HT Model 2 lnrxamhtech
cskills	-0.838	0.0739	0.766	1.559	-0.215	-0.0846	0.533	0.704
	(4.035)	(2.775)	(3.109)	(2.782)	(1.566)	(1.205)	(1.194)	(1.199)
dist	-0.00294	-0.00266	-0.00133	-0.00123	-0.00091	-0.00095	0.000126	4.31E-05
	(0.00335)	(0.00195)	(0.00088)	(0.00079)	(0.0013)	(0.00085)	(0.00034)	(0.00034)
transdummy	-1.771	-0.908	1.071	1.614*	-0.543	-0.391	0.845**	0.970**
	(10.19)	(5.696)	(0.967)	(0.868)	(3.955)	(2.477)	(0.397)	(0.398)
N	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600

Notes: (1) Education attainment variables, controls and year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

5.4.2 Export sophistication

In their empirical analysis, Hausmann et al. (2007) introduced human capital as one of the key determinants of the level of export sophistication. Although, their estimated results appear to suggest a positive correlation between the two, the causality direction was not clearly defined, due to potential reverse causation. As the authors themselves claim, there might be a potential causal effect going from export sophistication to human capital. This issue has already been elaborated in the previous empirical chapter, where it was argued that the increased demand for more educated workers increases the rate of return from investing in additional schooling and hence raises the proportion of the workforce with higher levels of educational attainment.[71] Although the feedback effect is highly unlikely to occur simultaneously, it is always advisable to be cautious about it. Hence, to account for potential endogeneity in this relationship, human capital variables were instrumented by their lagged values using the fixed effects instrumental variable approach. As previously discussed in Chapter 3, the positive association between the two has been supported by numerous empirical studies (e.g. Zhu et al., 2009, Jarreau and Poncet, 2009, Weldemicael, 2010, Anand et al., 2012). In contrast, the current investigation finds no evidence that supports the positive impact of human capital endowments on export sophistication when the entire sample of countries is estimated (see columns 2 and 4 in Table 5.9).

Not many of the set of control variables are statistically significant, even though the explanatory power of the models based on their R square is quite high. The level of GDP per capita exerts a robust positive impact in both models, while, the unemployment rate and the share of services appear to have a negative and positive impact on EXPY, in models 1 and 2, respectively (columns 2 and 4). For further details see Table A5.6.2, A5.7.2, A5.6.5 and A5.7.5 in Appendix A5. The significance of the transition dummy differs across estimators (FEVD and Hausman and Taylor). The estimates of the Hausman and Taylor approach suggest that being a transition economy has, other things being equal, a positive impact on the level of export sophistication. This is not empirically supported by the alternative estimator, i.e. FEVD (see columns 1-4 in Table 5.10). When ETEs and N-ETEs are estimated separately, *tedut* is found to exert a statistically significant impact in the N-ETEs subsample. Namely, it is estimated on average,

[71] A potential reverse effect is also likely to occur from innovation (patent applications) and FDI to export sophistication.

holding other factors constant, that an increase of 1 percent in the stock of population who have attained tertiary education, increases the export sophistication index by 0.23 percent (10 % significance level). If this effect is interpreted at the mean value, an increase of 10 percent in *tedut*, i.e. from 19.25 to 21.17, increases *EXPY* by 2.3 percent, i.e. from 12,101 to 12,379. This supports the hypothesis that investing in higher levels of education may play an important role in enhancing the export sophistication of this set of countries. The insignificance of the coefficients of the average years of schooling (level and squared) and cognitive skills is persistent across the two samples of countries. The statistical significance of control variables appears to diverge across country groups: the coefficients of GDP per capita (*gdpc*) and long term unemployment (*unem*) rate are statistically significant in the ETEs subsample, while, the share of inward FDI (*fdi*), total population (*pop*), and the share of services (*serv*) appear to have a significant impact on EXPY, only for N-ETEs (see Tables A5.6.5.1, A5.6.5.2, A5.7.5.1 and A5.7.5.2 in Appendix A5).

Table 5.9 Driscoll-Kraay and IV estimated results

Estimator	Driscoll-Kraay	IV (xtivreg2)	Driscoll-Kraay	IV (xtivreg2)
VARIABLES	lnEXPY	lnEXPY	lnEXPY	lnEXPY
lnsedut	-0.239*	-0.183		
	(0.118)	(0.166)		
lntedut	0.028	0.0579		
	(0.0703)	(0.177)		
avyrs			-0.159	-0.0419
			(0.23)	(0.247)
sqravyrs			0.00344	-0.00129
			(0.0103)	(0.0111)
lnpatappr	0.00129	-0.00874	-0.0074	-0.0201
	(0.00951)	(0.0494)	(0.0111)	(0.0481)
lnfdi	0.00495*	0.00555	0.00592**	0.00655
	(0.00244)	(0.00451)	(0.00248)	(0.00407)
lngdpc	0.611***	0.607***	0.714***	0.721***
	(0.0898)	(0.18)	(0.078)	(0.134)
lnpop	-0.641**	-0.819*	-0.320**	-0.498
	(0.252)	(0.433)	(0.135)	(0.411)
unem	0.000216	-0.00016	-7.76E-05	-0.00017
	(0.00068)	(0.00086)	(0.00036)	(0.00086)
lnecofree	0.0979	0.0215	0.074	0.0165

	(0.148)	(0.219)	(0.119)	(0.202)
rulc	0.284	0.194	0.00804**	0.00922*
	(0.228)	(0.274)	(0.00307)	(0.00551)
serv	0.00640*	0.00861	0.28	0.227
	(0.0032)	(0.00589)	(0.182)	(0.259)
N	366	349	366	349

Notes: (1) Year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Robust standard errors in parentheses;

Table 5.10 FEVD and HT estimated results

Estimator	FEVD	FEVD	HT	HT
	MODEL 1	MODEL 2	MODEL 1	MODEL 2
VARIABLES	lnEXPY	lnEXPY	lnEXPY	lnEXPY
cskills	0.568	0.721	0.243	0.454
	(1.68)	(0.932)	(1.585)	(1.063)
dist	-0.00013	-4.48E-06	0.0001	0.000175
	(0.00133)	(0.00065)	(0.00045)	(0.0003)
transdummy	0.46	0.774	0.900*	1.056***
	(4.129)	(1.947)	(0.503)	(0.347)
N	366	366	366	366

Notes: (1) Education attainment variables, controls and year dummies are included in the estimations but are not reported in the table

(2) ***p<0.01, **p<0.05, *p<0.1; Standard errors in parentheses;

As previously emphasized, more aggregated data have been used to construct additional measures of international competitiveness, i.e. the shares of a country's medium and high skill and technology-intensive exports relative to EU-28 (*mhstechC/ mstechC/ hstechC),* and the relative export advantage of countries in the medium and high-skill and technology-intensive sector (*RXAmidhigh/RXAmid/RXAhigh).* The key motivation for using different aggregation level measures was to be able to compare the estimated results and see if the aggregation level, particularly for RXA indices, does influence the final results.

The empirical findings suggest that, overall, both aggregation levels tell a consistent story. Given that the new measures cover all medium tech intensive manufactures, i.e. medium-low and medium-high, the estimated results tend to resemble those from the "extended" analysis, discussed briefly above. The share of population 15 and over who have attained tertiary education appears to have a positive impact on the share of medium and high tech exports of EU-27. No evidence is found for its impact on the high tech exports, when this category is examined separately. The coefficient of the average years of schooling is significant across all models (i.e. medium and high jointly, and medium and high separately). Its marginal effect is negative up to 11.9 for the former two models, and 12.02 for high tech manufactures, and after that point it becomes positive. None of the variables of interest exerts a significant impact on the relative export advantage (RXA) of EU-27. The estimated results for these analyses are summarized in Tables A5.8 and A5.8.1 in Appendix A5.

To summarize, the empirical analyses conducted in this chapter seem to provide sufficient evidence to support the hypothesised positive link between the share of population who have attained tertiary education and the share of medium and high tech exports by EU-27. In line with a priori expectations, the effect is relatively stronger for high tech manufactured exports. No empirical evidence is found for either the share of population who have attained secondary or tertiary education when competitiveness is represented by the relative export advantage index (RXA). The empirical findings from the export sophistication analysis appear to support the importance of the share of population with tertiary education on the export sophistication of non transition economies only (EU-17). No supporting evidence is found for the role of the quality of education, measured by the cognitive skills index, on international competiveness of EU-27 in neither of the empirical models.

5.5 Conclusions

This chapter examined the impact of human capital endowments on the medium and high tech exports of EU-27, using a cross industry-country panel dataset over the period 1995-2010. In addition to the share of medium and high tech intensive exports, two alternative measures of international competitiveness have been introduced, the relative export advantage index (RXA) and the export sophistication index (EXPY).

According to many schools of thought, education is regarded as a key determining factor of labour productivity, which, in turn is expected to enhance the international competitiveness of countries. In particular, a higher level of education attainment is more likely to enhance the productivity of workers when more advanced activities are to be performed. Hence, this investigation, aimed to assess the impact of the share of population who have attained tertiary education on technology intensive manufactures exported by 27 European countries. In addition, the analysis has made use of another three education based indicators: the share of population who have attained secondary education, average years of schooling and a cognitive skills index. In line with a priori expectations, the empirical findings suggest that the share of population 15 and over who have attained tertiary education has a positive impact on the share of medium and high tech manufactures exported by EU-27. This result is consistent across the two model specifications, i.e. with and without the medium-low tech category included. As expected, the impact appears to be relatively stronger when these countries export high tech manufactures. These findings further reinforce the hypothesis that more educated individuals are more likely to enhance labour productivity and consequently improve the international competitiveness of countries engaged in more sophisticated and technology intensive manufactures When transition (ETEs) and non-transition economies (N-ETEs) are assessed separately, the impact of tertiary education becomes insignificant in both subsamples. The share of population who have attained secondary education is found to exert a negative impact on the share of medium and medium and high tech manufactures exported by N-ETEs.

When international competitiveness is measured by the relative export advantage index (RXA), the estimated human capital results are generally found to be insignificant, with very few exceptions. Namely, in the ETEs subsample, the share of population 15 and over who have attained tertiary education appears to influence negatively the share of medium-high and high tech manufactures exported by these countries. The marginal effect of average years of schooling is subject to the competitiveness measure adopted, though, in the majority of models and sub-samples it appears statistically insignificant or with a counterintuitive sign. No supporting evidence is found for the hypothesized influence of the quality of education on the technology intensive exports in any of the model specifications.

The estimated results from the export sophistication analysis are mixed. No supporting evidence is found for the role of education attainment indicators on the export sophistication of all EU countries, while, the estimations of the separate samples of countries appear to find some supporting evidence for the underlying link. In accordance with a priori expectations, the empirical findings suggest that higher levels of export sophistication in non-transition economies are partly determined by higher levels of education. This implies that the higher the share of population who have attained tertiary education, the higher the export sophistication of EU-17.

CHAPTER 6

HUMAN CAPITAL AND INTERNATIONAL COMPETITIVENESS: A MICRO-LEVEL ANALYSIS

Contents

6.1 Introduction

The aim of this chapter is to investigate the impact of human capital endowments on international competitiveness by employing firm level data for 30 transition[72] European and Central Asian countries. The theoretical framework informing this empirical analysis has been developed in Chapter 3 and it focused on explaining the relationship between human capital and international competitiveness through the underlying mechanism of labour productivity, innovation and technology adoption. As an extension of the country and industry level empirical analyses conducted in the previous chapters, this investigation aims to re-examine this relationship by adopting a micro level perspective. First, the impact of the share of employees with higher education, on-the-job training and years of experience of the top manager on export intensity is assessed. Second, the same set of measures is employed to examine the potential impact of human capital on the export market share of surveyed firms. To empirically test these relationships, a diversified modelling strategy has been adopted: a Tobit model, a Fractional Logit approach, and a Poisson regression model. Furthermore, to check the robustness of the findings, an empirical model using multiple imputation has been estimated. To assess the relative importance of human capital endowments on the export engagement of firms in the sample, a distinction between manufacturing, services and primary goods industries has been introduced. European transition countries as the main group of interest in this investigation are estimated separately and their results are compared and contrasted with those of other transition economies. The remaining parts of this chapter are organized as follows: section 6.2 discusses data, variable specification and descriptive statistics. The subsequent section, 6.3, outlines the empirical modelling strategy, the advantages and disadvantages of each estimation approach and ways to handle missing data, with particular focus on multiple imputation. Section 6.4 reports and interprets the final estimates and marginal effects from the baseline model specification and also briefly summarizes the augmented model outcomes. Finally, section 6.5 summarizes the main estimated findings and concludes.

[72] Turkey is also included.

6.2 Data and model specification

This empirical analysis uses firm level data taken from the Business Environment and Enterprise Performance Surveys (BEEPS) conducted by the European Bank for Reconstruction and Development (EBRD) and the World Bank. To the best of our knowledge, there are very few research studies that have used this large scale dataset to investigate the area of international competitiveness. The BEEPS enterprise survey was first undertaken in 1999-2000 and since then there have been five waves of data in total. In this empirical analysis, the latest data survey which was conducted in 2011-2014 will be employed and it covers approximately 16,000 enterprises in 30[73] countries, making it the largest and most comprehensive BEEPS firm-level dataset available.[74] BEEPS provides a wide range of indicators on several business (environment) areas, such as performance measures, competition, access to finance, corruption and infrastructure. Although the main interest lies in the human capital dimension, given the large set of available indicators, this empirical investigation will be able to account for some other relevant competitiveness-enhancing factors. Note that in addition to the cross section data, BEEPS has recently introduced a panel dataset covering three rounds of data (2002-2009). Despite the well-known advantages of undertaking panel analysis, the BEEPS panel component is very restricted and is less likely to produce efficient estimates. One of the initial objectives of this research was to assess the potential impact of human capital on a firm's export persistence (i.e. distinguishing between permanent, sporadic and non-exporters), however, given the data limitations, this analysis was postponed for future research. The present empirical analysis is derived from the theoretical framework and empirical research discussed in Chapter 3. The new endogenous growth theory has been the main theoretical base used in the previous macro level empirical analyses: more educated and higher skilled individuals are more likely to innovate and/or adopt new sophisticated technologies, which consequently boosts labour productivity and raises an economy's competitiveness. A similar approach is adopted for the micro level analysis, where the impact of the quality (human capital) of the labour force on firm's engagement in

[73] 17 of these countries belong to Central and Eastern Europe (CEECs) and the remaining 13 are part of the Commonwealth of Independent States (CIS) (excluding Turkey).

[74] Recently, BEEPS has provided a combined dataset covering its latest round of data and the Middle East and North Africa Enterprise Surveys. However, this is extended country coverage is beyond the scope of the current investigation.

international markets is explained through its enhancing impact on labour productivity and its close relationship with innovation. More productive firms, in turn, following Melitz's (2003) theoretical framework, as one of the most prominent in the micro level literature, self-select themselves into international markets. A similar contribution to the productivity-export nexus has been made by Bernard et al. (2003). Their theoretical approach has been further extended in the literature, by including other firm characteristics that are likely to influence export behaviour. Two distinct measures have been used to capture the degree of international competitiveness of firms. The first measure, which is defined as the share of exports in firm's total sales, reflects the export intensity of the establishment. The second indicator is constructed using a combined set of BEEPS firm level data and OECD industry/country data and it represents the export market share of the firm within the industry that it operates. This measure is defined as the ratio of exports of firm *i* in industry *k* over the total exports of EU-28 and EU-28+/EA40[75] in the corresponding industry. Industry *k* refers to total manufacturing, services and primary goods, respectively. The latter indicator, following the previous discussions, is considered to be a more precise measure of competitiveness, as it reflects the degree of importance of a firm in a specific industry within the industry exports of EU-28. Note that this definition provided by European Commission, was originally used at the country level, however, following Dosi et al. (2013), it was also adopted for the micro level analysis.

As the main component of interest, human capital is represented in this dataset by several proxy measures: the education level of the workforce, the extent of on-the-job training, the share of skilled workers, and top manager's education and experience. The first measure is defined as the percentage of full-time employees who have completed a university degree. The importance of on-the-job training will be captured by a dummy variable, which takes the value of one if the firm has offered formal training programmes for its employees and zero otherwise. The third proxy measure is defined as the percentage of skilled full-time production workers in a firm's total full-time workforce, while the final dimension represents the level of education and years of experience of the top manager in the sector that the establishment operates in.[76] Education of this

[75] EA40 refers to EU-28 plus Euro-Asian economies (EA): Albania, Belarus, Georgia, Macedonia FYR, Moldova, Montenegro, Serbia, Bosnia-Herzegovina, Kazakhstan, Russia, Turkey and Ukraine.

[76] In BEEPS, this indicator is defined as: "the years of Top Manager's managerial experience in the type of sector that the establishment presently operates. Top Manager refers to the individual who has the highest executive rank.

manager in the original dataset has five categorical responses: primary school or less, secondary school, bachelor, master degree, and doctorate. Since, on theoretical grounds it is expected that a highly educated manager is more likely to influence a firm's engagement in export markets; a dummy variable was constructed, indicating whether the manager had completed higher education. This takes the values of one if the top manager has completed a bachelor, master and/or doctorate degree, and zero, if primary school or less and secondary is his/her highest level of education attained. Due to the very high percentage of missing values, the share of workforce classified as skilled and top manager's level of education are left out of the baseline model specification. These will be taken into account when estimating the imputed model. In line with the theoretical framework discussed in the previous chapters, all these measures are expected to exert significant positive effects on the international competitiveness of the surveyed firms.

As previously emphasized, the positive impact of human capital on export intensity is mainly explained through the mechanism of labour productivity. More skilled and competent employees are more likely to perform better at work, hence, enhancing the productivity level of the firm. Furthermore, a highly qualified labour force tends to be better endowed with skills that are particularly relevant for exporting - foreign languages, intercultural competence - which would facilitate the process of exporting, through creating and maintaining contacts with clients in international markets (Van Dijk, 2002, Eickelpasch and Vogel, 2009). A similar explanation can be adopted for the role of firm's top manager on its export activities. Even though, according to Syverson (2011), the impact of managers on firms' productivity has not been very much explored, a significant positive result is expected to be found in this analysis. As the author argues, managers are "conductors of an input orchestra", as they organize the application of labour, capital and inputs. Similar to a conductor, poor managerial skills could cause "discordant" production processes (p. 336). Moreover, as Nazarov and Akhmedjonov (2011) argue, better managers are more likely to adopt new technologies, employ a more educated workforce and offer more on-the-job training to their workers.

This person may be the owner if he or she works as a senior company official" (see explanation notes on EBRD and World Bank, 2012, p.13).

To shed more light on the predictive power of human capital on international competitiveness, a labour cost measure will be also introduced, the latter being defined as the total cost of labour (including wages, salaries and benefits) divided by the total number of employees. This proxy variable has been extensively used in the literature, mainly due to the lack of better or more direct information on the level of skills and competencies of workers, i.e. education, training and experience. A justification for the use of this measure is that, in competitive markets, the level of compensation proxied by the average wage tends to be highly correlated with the skill structure of the labour force. In his research study, Wagner (2012) argues that average wage per worker can be considered a plausible measure of the intensity of human capital. He estimated export intensity and propensity models by including, separately, the average wage and the share of medium and highly qualified employees, and found that irrespective of the measure used, the results were in line with the expectations. Numerous other studies have used labour cost measures to capture the human capital intensity when modelling firms' engagement in international markets (e.g. Aitken et al., 1997, Wakelin, 1998a, Günther and Nobert, 1999, Barrios et al., 2001, Ruane and Sutherland, 2004, Arnold and Hussinger, 2004, Cassiman and Martínez-Ros, 2007, Dosi et al., 2013).

A significant body of literature has argued that engaging in innovative activities tends to boost firm's labour productivity, which in turn is reflected in more productive firms entering international markets. Among the most recent econometric analyses supporting this hypothesis are Cassiman and Martinez-Ros (2007), Cassiman et al. (2010), Calder (2010), Aw et al. (2011), Cassiman and Golovko, (2011), Becker and Eagger (2013), and Gashi et al. (2014). This hypothesis will be tested by employing two distinct sets of innovation related measures: an input measure represented by R&D spending and several output proxies: introduction of new products/services, new production/supply methods and new organisational/ management practices or structures. In line with previous empirical studies, both innovation output and innovation inputs are expected to exert a positive impact on international competitiveness of firms. There have been various discussions as to which innovation measure is more likely to have a stronger impact. Evidence on the appropriateness of these measures is mixed, there are studies who have found supporting evidence for both approaches. Despite the widespread use of R&D intensity, product and process innovations have been considered as more appropriate proxy measure by some researchers. For instance, Dosi et al. (2013) argue that R&D can be considered only a partial measure of innovation as it does not account for additional improvements in product and processes, especially in SMEs. Furthermore, Harris and Moffat (2011) claim that R&D activities do not always lead to innovation, and there might be significant time differences between the two. However, the statistically significant parameter for R&D in their investigation has been attributed to its enhancing impact on firm's knowledge assets. In the same vein, Love and Roper (2013) argue that R&D establishes the foundation for innovation through its potential ability to generate new knowledge. In addition, skilled and competent R&D employees tend to enhance firm's ability to absorb external knowledge. Hence, given the ongoing debate in this area, and assisted by the richness of the dataset, the effects of each measure on firms' participation in international markets will be examined in this investigation. A relative measure of technology[77], i.e. comparing the technology of the firm with its main competitor will be also used in the analysis. This particular measure is based on firms' self-assessment of their technological level by comparing it to that of their main competitor, i.e. less advanced, the same, or more advanced. For practical reasons, this measure is transformed into a binary variable, by grouping similar and more advanced technology compared to the main competitor in one category (i.e. dummy=1), whereas leaving the less advanced technology as the reference category (dummy=0).

The econometric model has been augmented by a set of control variables, which have been derived from various strands of research. Firm size is one of the most investigated characteristics in the literature on firm internationalization. According to Wagner (1995, 2001, 2012), the positive impact of a firm's size on its export activities comes from the ability of larger firms to absorb the fixed costs associated with exporting and efficiency gains from economies of scales in production. Furthermore, larger firms tend to benefit from more specialized management and marketing practices, have higher risk-taking capacities due to their greater diversification, face fewer constraints in accessing finance and have advantages in competing for more qualified workers. In the same vein, Bernard and Jensen (2001) argue that a larger size is a reflection of firm being successful in the past, and it also entails lower average or marginal costs which, in

[77] Due to the high share of missing values for this measure, we will only be able to check its potential impact on international competitiveness after imputing the missing data.

turn, are likely to have a positive impact on firm's engagement in international markets. However, there seem to be limits to these advantages, according to Wagner (2012) organization costs increase as the operation scale increases and after some threshold point expansion becomes no longer profitable. Furthermore, as Wakelin (1998a) argues, large firms might have no incentives to penetrate international markets if they exert monopoly power in their domestic markets. Similarly, Cassiman and Martinez-Ros (2007) claim that, after some point, firms might consider foreign direct investment rather than exporting as a way of participating in international markets. In this empirical investigation, size is measured by the number of employees, and to avoid potential endogeneity, its lagged values have been used (i.e. the number of employees three years[78] previous). A similar approach has been followed by Gashi et al. (2014). In line with the arguments above, a squared term of this variable is added to control for potential non-linearity.

The age of the establishment is another plant characteristic perceived to have some explanatory power on firm's engagement in international markets, though it has been less frequently investigated in the empirical literature (Roberts and Tybot, 1997, Barrios et al., 2001, Van Dijk, 2002, Arnold and Hussinger, 2004 Gashi et al., 2014, Wagner, 2014). By capturing the experience of the firm, age is expected to have a positive impact on the firm's international competitiveness. However, the link between these two does not seem to be very clear according to Van Dijk (2002), who argues that although older firms might be more likely to engage in international markets given their business experience, younger firms may be more likely to use new advanced technologies which enhance productivity and product quality. In his recent study, Wagner (2014) found empirical evidence supporting the positive link between the age of the firm and export propensity and intensity. In addition, the number of exporting destinations and products exported appeared to be positively affected by age. Arnold and Hussinger (2004), on the other hand, argue that age might be more important for relatively newer firms and experience gains are likely to be significant only until a certain threshold point. In our analysis, the number of years of experience of the establishment is constructed by subtracting the year of firm's establishment from the year the survey is conducted. Following the discussion above, and in line

[78] Given that a certain percentage (4%) of firms had not been in business three years previously, in order to not lose observations, we decided to fill the "missing" values with the number of employees in the earliest year available/last fiscal year. The same approach was followed for other missing values.

with existing empirical research, we test for non-linearities between firm's size and age and export intensity by also introducing these in quadratic terms. Both measures have been transformed to logarithms given their non-normal, skewed distributions.

The ownership structure, with particular emphasis on foreign ownership is considered as another important determinant of international competitiveness (Roberts and Tybout, 1997, Aitken et al., 1997, Bernard and Jensen, 1999, 2001, 2004, Greenaway et al., 2005, Alvarez and Lopez, 2005, Greenaway and Kneller, 2007, Roper et al., 2006, Engelmann and Fuchs, 2008). Foreign-owned firms are more likely to engage in international markets through exporting as they are generally more integrated into international business networks. In addition to having more access to new and more advanced technologies, human capital, management know-how, marketing expertise allows them to produce more efficiently (Van Dijk, 2002, Greenaway et al., 2004, Martínez-Ros, 2007). In the present analysis, foreign ownership is represented by a dummy variable which takes the value of one if more than 50 percent of a firm's assets are foreign-owned, and zero otherwise. Given the major firm ownership transformations carried out during the process of transition in these countries, the presence of state-owned firms is also controlled for. A firm is considered to be state-owned if more than 50 percent of its assets belong to the state. Although the percentage of these firms in the dataset is fairly low, in line with previous empirical studies, the impact of the state ownership dummy is expected to be negative due to underlying inefficiencies of these types of firms. As argued in the EBRD Transition Report (2005), state-owned firms in transition economies perform less efficiently than foreign-owned and private firms.

To consider the influence of access to external finance on international competitiveness, a dummy for firms that have a line of credit or a loan from a financial institution has been included into the model specification. As summarized in Manova (2013), financial constraints tend to have a greater negative impact on export related activities compared to domestic production. This appears to be in line with previous strands of literature which argue that exporting entities are more likely to depend on external finance than domestically engaged firms mainly due to extra fixed and variable costs related to exporting, greater risks, and the larger working capital required. Among the empirical studies that have investigated the relationship between exporting and firm's finance access and constraints are: Muûls (2008), Bellone et al. (2010), Bernard et al. (2010), Berman and Hericourt (2010), Minetti and Zhu (2011), Feenstra et al. (2011), Eck et al. (2012), Gashi et al. (2014), Alvarez and Lopez (2013). In line with the existing empirical evidence, a positive coefficient for the access to finance proxy measure is expected to be found in this analysis.

Location of the establishment is another measure controlled for in the empirical analysis. Being located in the capital city is expected to exert a positive impact on the firm's international competitiveness as it tends to capture the potential economies of agglomeration.[79] Marshall (1920) was the first who discussed the geographic concentration of firms in the same industry and the underlying benefits of location economies (Fujita et al., 1999). Aitken et al.'s (1997), Becchetti and Rossi's (2000) and Koenig's (2009) studies reveal that co-location, i.e. firms operating close to each other, has a positive and significant impact on firms' propensity to export. Focusing on the innovation-based, agglomeration economies, Dobkins (1996) argued that co-location is likely to positively influence export performance of firms. In their recent study, Cainelli et al. (2014) investigated the impact of localisation economies and related variety[80] on the internationalization of Italian manufacturing firms. Their findings suggest that both forms of agglomeration have a positive influence on firm's export decision, this being consistent with the view that firms benefit from co-location through gaining relevant information about international markets. Different measures of knowledge spillovers linked to agglomeration (e.g. export spillovers from MNEs and other exporters) have been used in the literature, however due to the lack of more comprehensive measures in BEEPS, the modelling is restricted to using location in the capital city as a proxy measure for agglomeration. Following Gashi et al. (2014) a dummy variable which takes the value of 1 if a firm is located in the capital city and zero otherwise has been introduced to the hypothesis testing.

In the same vein, this empirical investigation aims to test the potential impact of a firm's participation in any business association, and foreign material inputs on its international

[79] Agglomeration economies are: "the benefits that come when firms and people locate near one another together in cities and industrial clusters'' (Glaeser, 2010, p.1).

[80] While the localization effect refers to firms being co-located with other firms that operate in the same industry, the related variety effect refers to firms operating in related industries.

competitiveness. Bennett (1998) and Gashi et al. (2014), referring to SMEs, argue that being a member of a business association is crucial for networking and as a consequence it is likely to have a positive influence on competitiveness. The main contribution of being a member of a business association, according to the former author, is "improvement of collective industry standards, through codes of conduct, information, collective events, benchmarking and management seminars" (p. 243).

Another potential determinant investigated in this analysis is the share of imported input materials. It has already been established in previous research that importing foreign intermediate inputs is likely to enhance firm's productivity. Among the studies that have found supporting evidence for this nexus are Kasahara and Rodrigue (2008), Halpern, Koren and Szeidl (2009), Smeets and Warzynski (2010), Bas and Strauss-Kahn (2014). As argued by Feng et al. (2012) the impact of importing intermediate inputs can be even stronger if domestic and foreign input materials complement each other or if the latter are more technologically advanced.[81] Studies that have focused on the relationship between foreign inputs and engaging in exporting activities are scarcer. Bas and Strauss-Kahn (2014) and Bas (2012) have found evidence supporting the positive impact of imported materials on exports. The former study shows that increasing the variety of imported inputs increases the number of exported products, whereas the latter suggests that a reduction in the foreign input tariffs increases the probability of a firm being engaged in export activities. In the same vein, Feng et al. (2012) argue that firms' shares of imported inputs generally exert a positive impact on their export volume and scope, and similar results were found in the context of transition economies by Aristei et al. (2013) and Gashi et al. (2014). Note that due to the issue of missing data, these particular variables will be included only in the imputed model.

Measures of capital intensity or investment activities have also been extensively used in empirical models of export propensity and intensity. Investing in physical assets is expected to be positively associated with a firm's probability of joining international markets and maintaining their market power (Wakelin, 1998a, Sterlacchini, 1999, Hollenstein, 2005,

[81] Lo Turco and Maggioni (2013), on the other hand, contradict this view by suggesting that importing intermediate inputs from low income countries exerts a positive impact on firms' export propensity, however, the same does not hold when these inputs are imported from more developed countries.

Greenaway and Kneller 2007, Gashi et al., 2014, among others). As Dosi et al. (2013) argue, as a measure of the degree of a firm's investment in acquiring and renewing machinery, buildings and other physical assets, investment intensity can represent new technologies and innovative processes that would reduce the cost of production and consequently influence export propensity and intensity. The ratio of total capital stock to the number of employees or to total sales could be used to proxy these effects, however, given that data on stock values are rarely available, studies sometimes tend to use flow indicators. However, using flow[82] rather than stock data when calculating capital and/or investment intensities does not accurately capture their effects, hence these are excluded completely from the analysis. It is also worth noting that these flow variables in the BEEPS dataset have a very high incidence of missing data, which would have prevented their inclusion in the main econometric model.

In order to account for industry characteristics, the empirical model has been augmented by a set of industry dummies. Initially, an aggregated industry dummy differentiating between manufacturing, services and primary goods was considered. To be able to control for the technology intensity of goods, the former category has been further disaggregated into low tech, medium-low, medium-high and high-tech intensive goods using ISIC rev. 3 while services and primary goods are grouped in one category. The low and medium-low technology intensive goods have been grouped in one single category given the similarities in the estimated coefficients, whereas, the latter two technology categories (medium-high and high) have been included separately. Finally, the assessment also controls for time invariant country-specific characteristics (e.g. economic, political, cultural and institutional influencing factors) by including country dummies. Variable descriptions are presented in Table 6.1.

Table 6.1 Variable descriptions

Variable descriptions	**Variable name**	**Expected sign**
Direct exports as a % of total annual sales	exp_int	Dep. variables
Export market share	exp_share_industryEU28 exp_share_industryEA40 exp_share_totalEU28	Dep. variable

[82] The BEEPS dataset offers only flow data on spending on machinery, land and buildings.

	exp_share_totalEA40	
% of full time employees who completed a university degree	emp_edu	+
Provision of formal training programs for permanent employees	emp_trng	+
The share of skilled production workers in a firm's total full-time workforce	skilled_emp	+
Top manager's level of formal education completed	manager_edu_dummy	+
Top manager's number of years of experience working in this sector	manager_exp	+
Labour cost - Average wage*	avrg_tlc	+
Spending on R&D (dummy)	RD_exp	+
New products/services introduced over the last 3 years (dummy)	new_prod_serv	+
New production/supply methods introduced over the last 3 years (dummy)	new_methods	+
New organisational/management practices or structures introduced over the last 3 years (dummy)	new_org_str	+
Higher/same level of technology compared to the that of the firm's main competitor (dummy)	tech_dummy	+
Number of permanent, full-time individuals working 3 fiscal yrs ago	size	+
Size squared	size_sqr	
Establishment's age/business experience	age	+
Age squared	age_sqr	
Foreign ownership (dummy)	foreign	+

State ownership (dummy)	state	-
Access to finance (dummy)	credit	+
Location in the capital city (dummy)	location	+
Participation in a business association (dummy)	bus_assoc	+
Foreign material inputs or supplies	f_inputs	+
Manufacturing/Tech intensity (dummies):		
Low tech goods	low_tech	
Medium-low tech goods	mlow_tech	+
Medium-high tech goods	mhigh_tech	
High tech goods	high_tech	
Country dummies	dcountry1-dcountry30	

Note: (*) The variable was initially measured in local currency units and has been converted to Euros.

6.2.1 Descriptive statistics

A summary of descriptive statistics reveals that the percentage of exporting firms in the entire sample is fairly low. Only 16 percent of the firms have been engaged in exporting activities, with an average share of exports of approximately 39%. In line with previous empirical studies (Bernard and Jensen, 1995, 1999, 2001, Bernard and Wagner, 1997, 2001, Girma et al. 2004, etc) exporters appear to have better performance characteristics than non-exporting firms, i.e. exporters are larger, more productive, have more educated and experienced managers, are more inclined to offer training programmes for their employees, are more engaged in innovation activities, are more likely to be foreign-owned, have better access to finance, pay higher wages, and are more likely to produce medium and high tech intensive goods compared to non-exporters. Education of the workforce in our sample is a remarkable exception in this regard. Surprisingly, the descriptive statistics reveal that exporters have, on average, lower shares of employees with higher education. On average, the percentage of employees who completed a university degree is 5.9 percentage points lower for exporting firms compared to non-exporting firms (see Table 6.2). Note that, in order to account for the size differences across firms these averages have been weighted by the number of employees.

In terms of the size, exporters are, on average, 2.5 times larger than non-exporters. The age/experience of exporting firms is approximately 36% longer than of their non exporting counterparts. Concerning on-the-job training, nearly 49.1% of exporting firms seem to have offered formal training programmes compared to 35.5 % of non-exporting firms. They also seem to have more experienced top managers, i.e. the years of experience of the top managers are, on average, 18.6% higher for firms engaged in exporting activities. The share of skilled production workers is the same across these firms, while, exporters seem to have, on average, more highly educated top managers than non-exporters. The same applies to input and output measures of innovation. For instance, about 22.2 % of exporting firms have been engaged in R&D activities, while this share is much lower for firms that sell only domestically (8.2 %). On average, the share of exporting firms that have introduced new products/services, production/supply methods and new organisational/management practices or structures is relatively higher compared to non-exporting firms (around 30%, 37.3% and 28.4 % of exporting firms, respectively, have been engaged in these three innovation activities over the three previous years, compared to just 19.4%, 21.5% and 18% of their non-exporting counterparts). Similarly, the share of imported input materials appears to be, on average, 43% higher for exporting firms. The above outlined differences between these two groups of firms are also supported by the t-test and Kruskal-Wallis.

There seem to be negligible differences in terms of whether a firm is located in the capital city or not, its participation in a business association and its technological progress compared to its main competitors. The null hypotheses of Kruskal-Wallis and t-test have not been rejected, suggesting no differences between exporters and non-exporters. In line with previous studies, foreign ownership seems to be significantly higher for exporters. The share of foreign-owed firms among exporters is 12%, whereas, it is as low as 2.8% for domestically engaged firms. Whilst, state ownership is slightly higher amongst non-exporters, an average difference of 7.3%. Although the average wage at first seem to be higher for non-exporting firms, after accounting for two extreme outlier observations[83], a reverse relationship is revealed. Consistent with previous studies,

[83] Immensely large values.

exporting firms in our sample, on average, appear to pay higher wages compared to their counterparts, i.e. the average wage is 89% higher in the exporting set of firms.[84]

Table 6.2 Descriptive statistics by export intensity

	Exporters		**Non-exporters**		**t-test**	K. Wallis
Variable |	Obs	Mean	Obs	Mean	p.value	p. value
emp_edu |	2532	21.73813	12589	27.68514	0.0000	0.0001
emp_trng |	2631	.4918282	13037	.3551431	0.0000	0.0001
manager_exp |	2599	19.09504	12794	16.10489	0.0000	0.0001
manager_edu_d|	499	.59318	800	.38625	0.0000	0.0001
skilled_emp|	1668	58.35299	4212	58.47339	0.9307	0.7072
RD_exp |	2662	.2227648	13090	.0827349	0.0000	0.0001
new_org_str |	2675	.2990654	13120	.1947409	0.0000	0.0001
new_prod_s~v |	2673	.3737374	13124	.2150259	0.0000	0.0001
new_methods |	2670	.2846442	13126	.1797196	0.0000	0.0001
location |	2701	.2188078	13182	.2103626	0.6057	0.6010
size |	2674	125.7214	13121	49.26225	0.0000	0.0001
age |	2671	18.46069	13053	13.56094	0.0000	0.0001
foreign_du~y |	2650	.1196226	13071	.028766	0.0000	0.0001
state_dummy |	2652	.010181	13068	.0094888	0.9569	1.0000
avrg_tlc |	1886	11041.36	9354	5839.983	0.0346[85]	0.0001
credit |	2620	.519084	13004	.3141341	0.0000	0.0001
f_inputs|	1703	37.3810	4330	26.17968	0.0000	0.0001
tech_dummy|	425	.88705	853	.898007	0.5657	0.5595
bus_assoc|	246	.59756	507	.5936884	0.8707	0.8708
CEEC_dummy |	2701	.5386894	13182	.3074647	0.0000	0.0001
tech_int_l~y |	2701	.3054424	13180	.1789074	0.0000	0.0001
te~mlowdummy |	2701	.1780822	13180	.0982549	0.0000	0.0001
t~mhighdummy |	2701	.1480933	13180	.0537936	0.0000	0.0001
tech_int_h~y |	2701	.0303591	13180	.0141882	0.0000	0.0001
nonclass_t~h |	2701	.338023	13180	.6548558	0.0000	0.0001

Notes:
(1) The null hypothesis for the t-test is that there is no difference in the mean values between exporters and non-exporters.
(2) The null hypothesis for Kruskal-Wallis test is that the two groups of firms (i.e. exporters and non-exporters) come from the same population.

[84] The differences between these groups of firms are even more evident when we look at firms' total labour costs, rather than labour costs per employee, i.e. total wages paid by exporting firms are, on average, 632.4% higher than those of their non-exporting counterparts. However assessing the average wage measure seems more appropriate as it accounts for the size differences across firms, i.e. it prevents firms with a lower number of employees driving the final results of the former measure.
[85] As the t test assumes normality in the data, we have also compared the mean values of the avrg_tlc in logarithm terms and its p value is 0.0000.

In line with previous findings, a rough measure of productivity[86] seems to reveal that exporters are nearly 33% more productive than their non-exporting counterparts. Access to external finance appears to be higher among exporters as well: 52% of exporters have had a line of credit or a loan from a financial institution compared to 31.4% of non-exporters. A comparison between European transition economies (i.e. CEECs) and non-European transition economies (CIS, including Turkey) reveals that around 53.8 % of exporters belong to the former group of countries. The differences in the share of exported output among these groups of countries do not appear to be significantly large. The summary statistics reveal that Central and East European countries have exported, on average, 4% more output compared to their counterparts. With regard to the technology intensity of produced goods, the average share of low tech, medium-low, medium-high, and high tech producers is 30.8%, 17.5%, 14.8 and 3% among exporting firms, respectively. The shares of non-exporting firms are much lower, i.e. 17.8%, 9.8%, 5.3% and 1.4%, respectively. Exporters appear to less likely engage in services and primary goods, as compared to their non-exporting counterparts. The differences between exporters and non-exporters are reported in Table 6.2. In addition, the p values of the t-test and Kruskal-Wallis test are reported in the table to assess if there are any significant differences between these two groups of firms. Note that the descriptive statistics for the entire sample are presented in Table A6.1 in the appendix section.

There are some outlier firms that seem to contribute further to the human capital gap between exporters and non-exporters. For instance, there are a number of firms that have a very high share of highly educated workforce (up to 100%) but are not engaged in any exporting activities (services and primary goods mainly). Whereas, on the other hand, there are several firms that export nearly all of their output but have zero percentage of employees with a higher education degree. To explore this further, industry characteristics and the technology intensity level of manufactured goods have also been taken into account. Again, the outcomes are contrary to expectations, since firms that are engaged in exporting services (mostly) and primary goods appear to be better endowed with an educated labour force than their manufacturing counterparts. It is important to note that the majority of firms that are engaged in selling internationally operate in the manufacturing industry and their average share of exports in sales is around 41%. An

[86] This measure is constructed as total sales over total number of employees.

additional interesting finding is that even the non-exporting service and primary goods firms have, on average, a higher share of educated labour force compared to both exporting and non-exporting manufacturing firms. A further investigation involves assessing manufacturing firms by their technology intensity level (ISIC rev.3). According to this classification, the majority of manufacturing firms seem to export low-tech goods (45.8%), followed by medium-low (27.2%), medium-high (22.5%) and a very small proportion (4.5%) appear to export high tech goods. This remains true even after distinguishing between European and non-European transition economies. Firms from both groups of countries appear to be more engaged in exporting manufacturing goods, and their exports have been mainly concentrated on low and medium-low tech goods. With regard to their average percentage of highly educated labour force, in line with expectations, high tech exporters seem to have a better educated workforce, followed by medium-high, medium-low and low-tech exporters. However, contrary to expectations, their share of educated workforce remains lower than that of their non-exporting counterparts. With regard to the export market share variable, the summary statistics show that, on average, firms with higher shares[87] of exports in relation to EU-28 and EU-28+/EA40 have higher shares of employees with higher education compared to firms with lower shares of exports. The same applies to on-the-job training, i.e. firms that have higher shares of exports appear to be more inclined to offer formal training programmes to their employees. Surprisingly, the years of experience of the top manager appear to be, on average, lower for higher share exporters compared to their lower share counterparts, although the differences are not very large.

6.3 Estimation methodology

Guided by the theoretical framework discussed earlier in the chapter, an empirical model has been developed to examine the impact of human capital endowments on firms' engagement in international markets through exporting. We make use of a large cross section of firms from 30 European and Euro-Asian transition economies[88] (and Turkey). First, the impact of various dimensions of human capital on firm's share of international sales - export intensity is assessed.

[87] The mean value has been used here as a threshold level, i.e. higher and lower than the average export market share.

[88] Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kosovo, Kyrgyzstan, Latvia, Lithuania, FYR Macedonia, Moldova, Mongolia, Montenegro, Poland, Romania, Russia, Serbia, Slovak Republic, Slovenia, Tajikistan, Turkey, Ukraine, and Uzbekistan.

Second, the impact of the level of education, training and experience on firm's export market share is examined. The latter is defined as the share of exports of a firm over the total exports of EU-28 and EU-28+/EA40[89] in the corresponding industry. Firm's share of exports, as explained in section 6.2, is introduced to capture relative international competitiveness.

The baseline model specification is presented below:

$$Y_i = \beta_1 X_i + \beta_2 Z_i + u_i, \qquad i = 1, 2, \ldots, N \text{ firms} \qquad (6.1)$$

where Y_i denotes export intensity and export market share, respectively, X_i is a vector of human capital endowments, whereas, Z_i represents other firm-specific characteristics explained in more details in the previous section, and u_i denotes the error term. The baseline model has also been augmented by country and industry specific dummies[90] to capture country-specific characteristics (e.g. economic, political, cultural, institutional and other country unobserved factors) and industry-specific features (for manufacturing, services and primary goods). Furthermore, to account for the technology level of manufacturing goods, different technology intensity categories have been introduced into the model. Interaction terms between human capital and industry/tech intensity dummies have also been included to assess the impact of different dimensions of human capital on international competitiveness of firms engaged in different tech intensive activities. The same set of variables are used to predict both export intensity and export market share, as firm's human capital endowments and other characteristics are expected to have a similar impact on these two competitiveness dimensions. In order to assess any potential collinearity between the predictors in the baseline regression model, the variance inflation factors and the correlation matrix have been computed. The outcomes from both approaches appear to show no warning signs of potential multicollinearity in the data (see Table 6.3). The correlation matrix can be found in Table A6.2.

[89] This refers to EU-28 plus Albania, Belarus, Georgia, Macedonia FYR, Moldova, Montenegro, Serbia, Bosnia-Herzegovina, Kazakhstan, Russia, Turkey, and Ukraine.

[90] Given the nature of the data, the model does not control for sunk costs and unobserved heterogeneity.

Table 6.3 Collinearity diagnostics

Variable	VIF	Sqrt VIF	Tolerance	R-Squared	Eigenval	Cond Index
emp_edu	1.29	1.14	0.7725	0.2275	8.3050	1.0000
emp_trng	1.18	1.08	0.8505	0.1495	1.4585	2.3863
manager_exp	1.22	1.10	0.8209	0.1791	1.0369	2.8300
lnavrg_tlc	1.10	1.05	0.9061	0.0939	1.0279	2.8424
RD_exp	1.26	1.12	0.7915	0.2085	1.0033	2.8771
new_org_str	1.44	1.20	0.6966	0.3034	0.9472	2.9610
new_prod_serv	1.44	1.20	0.6933	0.3067	0.8209	3.1807
new_methods	1.57	1.25	0.6358	0.3642	0.7540	3.3188
location	1.05	1.02	0.9549	0.0451	0.6464	3.5843
lnsize	1.36	1.17	0.7361	0.2639	0.5987	3.7245
lnage	1.36	1.16	0.7369	0.2631	0.5232	3.9842
foreign_dummy	1.08	1.04	0.9300	0.0700	0.4659	4.2222
state_dummy	1.03	1.02	0.9698	0.0302	0.4489	4.3015
credit	1.11	1.05	0.9035	0.0965	0.3668	4.7581
low_mlow_tech	1.18	1.09	0.8439	0.1561	0.2828	5.4192
mhigh_tech	1.10	1.05	0.9054	0.0946	0.1731	6.9266
high_tech	1.04	1.02	0.9609	0.0391	0.0818	10.0776
CEEC_dummy	1.40	1.18	0.7149	0.2851	0.0473	13.2529
Mean VIF	1.23					
Condition Number						27.0919
Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)						
Det(correlation matrix) 0.1301						

To examine the impact of human capital on international competitiveness, a variety of econometric techniques have been used. From the range of estimation approaches commonly employed in the literature, some studies have relied on two stage estimators arguing that the probability of exporting and its intensity are determined by different underlying mechanisms. The Heckman selection approach has been frequently employed in this context and it involves two separate regression models. While this method requires at least one different regressor in the selection equation, there have been cases in the research work that have used the same set of determinants for both models (Cameron and Trivedi, 2009). According to Wagner (2001), two stage estimation approaches do not make sense theoretically in this particular context, as firms do not independently decide on whether to export or not, and how much to export. He argues that firms decide on exporting the quantity of goods that maximizes their profits and this might be zero. Hence, by arguing that the same mechanism is expected to determine both, the probability of firms engaging in exporting activities and their export intensity and market share, the econometric strategy focuses entirely on one stage estimator methods.

Given that in this sample, export intensity and export market share are zero for a significant number of firms (84%) and positive and roughly continuous for others, a "corner solution model" has been employed in this econometric analysis. A standard Tobit approach (see Wooldridge, 2002 for further details on this approach) will be used to estimate the underlying model. The Tobit estimation relies on the strong assumptions of normality and homoskedasticity, and any departure from these results in inconsistent estimates. Concerning the specification of the model, an informal way of assessing the appropriateness of a Tobit model, according to Wooldridge (2002), is to compare the Tobit estimates with those of Probit after adjusting the former with the estimated standard error of the regression, σ (i.e. $\beta j/\sigma$). If the estimates produced by the two estimators are significantly different, this suggests that the model is not well specified.

Despite its widespread use, Tobit has been criticized for not being an appropriate estimation approach when the dependent variable is by definition bounded by zero and one. While, in the sample, the upper bound is not highly represented, there are a very high number of observations in the lower bound (i.e. non-exporters). To address these criticisms, as a robustness check, we have implemented another estimation approach, which has been designed to account for the bounded nature of data. Quasi-likelihood estimation methods for models with fractional dependent variable have been developed by Papke and Wooldridge (1996). In this analysis a "fractional logit" model, which is modelled by a generalized linear model (GLM) with Binomial distribution and Logit link function will be employed. As outlined above, the key rationale for adopting such an estimator is to account for the bounded nature of the data in our sample. Furthermore, the actual approach does not rely on the assumption of normality, which is likely to be violated in our regression model. However, it is important to note that although the GLM framework has been extensively used in biostatistics, it has not been often employed in econometric studies. Hence, Cameron and Trivedi (2009, p. 321) hesitate to advocate its use in econometric modelling. Wagner (2001, 2012), Van Dijk (2002), and Eickelpasch and Vogel (2009) are among the few studies that have adopted this estimation method when assessing the determinants of firms' export to sales ratio. It is important to note that, in the first empirical study the obtained estimates were quite consistent across different estimation approaches (e.g. Tobit and Fractional Logit), whereas in the second study some differences in the significance level of the estimated results have been found. Despite some recent applications of this method, it still remains under explored in empirical research, especially in the field of international competitiveness.

To assess the consistency of the estimated results, we have additionally employed a third estimation approach, the Poisson regression model. This model has been designed to model non-negative, count dependent variables, with its main advantage being its ability to accommodate zero outcome values. In contrast to the Tobit's strong assumption of normality, this approach relies on a Poisson distribution of the dependent variable.[91] It is important to note that a Poisson distribution imposes restrictions on the conditional moments of the dependent variable that are frequently violated, e.g. the variance-mean equality (Wooldridge, 2002). A situation where the conditional variance is greater than the mean is very often observed when modelling count data. This situation is called "overdispersion[92]" and is the opposite of "underdispersion" which occurs when variance is smaller than the mean (Wooldridge, 2002). However, irrespective whether the assumption of a Poisson distribution is satisfied, Wooldridge (2009) argues that we will still be able to obtain consistent and asymptotically normal estimates. If the variance assumption is violated, the produced standard errors are incorrect, thus they should be properly adjusted. In the same vein, Cameron and Trivedi (2009) argue that if the distribution and variance assumptions fail, the quasi-maximum likelihood approach can be applied, which is similar to the Poisson maximum likelihood estimator (MLE) but uses robust variance estimates (p. 560).

Alternative specifications have been adopted in the research literature. For instance, a commonly used approach to dealing with overdispersed count data is the negative binomial regression model (Cameron and Trivedi, 2009). In addition, given that excess zero observations might be a possible cause of overdispersion, zero-inflated Poisson regression models and zero-inflated

[91] While, this approach has been primarily designed to model count data, there are research studies that have estimated Poisson regression models with continuous outcomes, as well. As Gourieroux, Monfort and Trognon (1984) and Santos Silva and Tenreyro (2006) argue, data are not required to be Poisson distributed and furthermore, the dependent variable does not need to be an integer for the estimator to produce consistent results.
[92] Note that overdispersion is likely to be problematic in GLM models as well.

negative binomial models have been used in various disciplines. However, a key feature of these approaches is the tendency to model zeros and positive values separately, as these are perceived to be determined by different mechanisms. As previously argued, we expect these outcome values to be generated by the same decision-making process, hence making these estimation strategies unsuitable for this current analysis. Hence, in this investigation, following Cameron and Trivedi's suggestion, a Poisson regression model has been employed with the vce (robust) option, to account for any distribution departures and overdispersion.

A prevalent issue when conducting survey-based analyses is missing data, which mainly occur when no responses are given to the survey questions. For the majority of variables in the dataset, the fraction of missing information[93] is fairly low (less than 5%), however, there are some explanatory variables that have high rates of missing data and due to that we were forced to exclude them completely from the baseline model specification.[94] The most common approach to dealing with survey non-response observations is **listwise deletion**, i.e. excluding missing observations completely from the analysis. If data are perceived to be missing completely at random (MCAR), listwise deletion would still produce consistent estimates but with large standard errors due to less information being used. However, this tends to become particularly problematic when the proportion of explanatory variables with missing data is substantial, as this would shrink considerably the total number of observations, and as a result, would lead to less efficient results (Cameron and Trivedi, 2005). The impact of this approach is more severe when the MCAR assumption does not hold and data are missing at random (MAR) or not at random (MNAR). In this case, the obtained coefficient estimates will be biased. However, as the authors argue, listwise deletion might still be suitable if the probability of missing observations for explanatory variables does not depend on the dependent variable. It also appears to be sensible when the share of incomplete cases, i.e. missing values, is not very large, e.g. five percent or less (Schafer, 1997).

[93] Note that all responses coded as: don't know, refused, and does not apply are treated as missing values, given the difficulty of identifying the underlying reasons for those non-responses.
[94] avrg_tlc (29.01%), skilled_emp (62.95%), f_inputs (62.02%), tech_dummy (91.95%), manager_edu_dummy (91.82%), bus_assoc (95.26%)

A more innovative[95] strategy, which has become increasingly popular in handling missing data in survey analysis is the **multiple imputation** technique introduced by Donald Rubin. In order to mitigate the risk of making incorrect inferences from our incomplete data, as a robustness check, the model will be also estimated with imputed data through multiple imputation. According to Rubin (1987), multiple imputation involves replacing each missing observation with a set of *m* plausible values. Each set of imputed values is used to create a complete dataset, resulting in *m* complete datasets, which are then analyzed using any standard analyzing technique. The required number of imputations *m* appears to be subject to the rate of missingness, with 2-10 values being sufficient when there are not many missing values (Rubin, 1987). However, when the rate of missingness is relatively higher, a larger set of imputed values might be required to produce more reliable results. For instance, Schafer and Graham (2002) used 20 imputations for a share of nearly 80% of incomplete data. On the other hand, White et al. (2011) argue that number of imputations should be even higher, e.g. equal to the fraction of missing data. Once the datasets are analyzed, the results are combined[96] in order to produce the final estimates and standard errors.

The ultimate aim of multiple imputation, according to Rubin (1996), is not to generate information through simulated values but to address incomplete data in a way that leads to valid statistical inference. Nonetheless, in order for this approach to produce valid statistical inference, certain requirements must be satisfied. As emphasized in the imputation literature, the assumption about the pattern of missingness is one of the key requirements of this technique. Multiple imputation is generally perceived to produce valid inference when data are missing at random (MAR). In addition, both the model used for imputation and analysis (based on imputed data) should be correctly specified and in some sense, relate to each other (Allison, 2000). However, according to Collins et al. (2001), a slight departure from the MAR assumption, in many cases, has not proved to exert a significant impact on estimates and standard errors. There is no clear practical guidance on how much missing information is too much for multiple imputation to produce valid inference. According to White et al. (2011), subject to the validity of

[95] Although, it was introduced in the early 70s, it has received greater attention lately given its easier implementation in various software packages.

[96] The combination of estimates is undertaken using Rubin's rules, which are based on a Bayesian asymptotic theory. The combined variance-covariance matrix involves within imputation as well as between imputation variability (White et al., 2011)

MAR and the imputation procedure being applied accurately, any rate of missing data can be imputed. However, they also note that any departure from these is likely to have a stronger impact on estimates when the share of imputed data is larger. Hence, particular attention should be paid when the fraction of missing values is 30 - 50 percent. It is pertinent to note that there are very few empirical studies in the area of international competitiveness that have discussed or used multiple imputation in their investigations (Hollenstein, 2005, Gashi et al. 2013). Concerning the implementation of multiple imputation in Stata, various approaches have been introduced in recent years. The two main methods supported by this statistical software when the missing pattern of data is arbitrary are: multiple imputation using the multivariate normal regression (MVN) and multiple imputation using chained equations (MICE). The first approach relies on a well-established theoretical basis; however, it has been mainly designed to handle normally distributed continuous variables (Schafer, 1997). Given that this is highly likely to be violated in practice, other alternative approaches have been developed. MICE as a more innovative approach, has introduced more flexibility to the process of multiple imputation. Its key feature is the ability to address different types of variables (e.g. continuous, categorical, unordered categorical, ordered categorical) using a broad range of imputation methods (White et al., 2011, Royston and White 2011). It is worth noting that a drawback of this approach is the lack of a strong theoretical rationale. A detailed comparison of multivariate normal imputation (MVN) and multiple imputation using chained equations (MICE) can be found in Lee and Carlin (2010). Considering the need to impute binary and potentially non-normally distributed variables in this empirical analysis, the latter approach is adopted.

An important issue that has received particular attention in this literature is the specification of the imputation model, i.e. which variables to be included in the model. In addition to the variables to be used in the analysis model[97], Rubin (1996) suggests including as many predictive variables as possible as these might contain potential information about missing data. In the same vein, Collins et al. (2001) argue that it is always beneficial to use a larger number of "auxiliary" variables in the imputation model. According to their assessment, the cost of using more variables is very small compared to the benefits, i.e. a reduced possibility of omitting a relevant cause of missing data and an increased chance of having more efficient and unbiased estimates.

[97] This refers to the model used for hypothesis testing. This model is specified using the complete (imputed) dataset.

Similarly, White et al. (2011) argue that variables that are likely to determine the incomplete variable and also determine if that particular variable is missing should be part of the imputation model. Raghunathan et al. (2001) provide some evidence that including more predictor variables can result in relatively smaller standard errors compared to a model with fewer variables used.

As it is not feasible to include the entire BEEPS dataset (too many variables) into the imputation model, it was decided to rely on a less extensive set of potentially predictive variables and the dependent variable. While, the majority of studies seem to emphasize the importance of including the outcome variable in the imputation model (Schafer and Graham 2002, Allison 2002, White et al., 2011), whether imputed values should be retained for estimation is still unclear. For instance, von Hippel (2007) proposed a "multiple imputation, then deletion" method (MID), which excludes the dependent variable imputed values prior to the analysis stage, i.e. these values are not used to produce the ultimate estimates and standard errors. According to the author, the imputed values of the outcome variable add nothing but estimation error, hence they should be excluded from the analysis. Young and Johnson (2010), through the use of an observed dataset, compared the two techniques: when the imputed values of the dependent variable were deleted from the analysis model and when those were retained in the model. They found no major differences in the final results, hence suggesting that it might be sensible to keep these values in the analysis model if the number of datasets created is sufficient. Schafer and Graham (2002) argue that missing values of the dependent variable do not essentially differ from those on independent variables; hence, raising awareness about the potential problems associated with ignoring this type of missing information. Given that the fraction of missing information in the dependent variables is fairly low (1.1%), this is not expected to have any particular impact on the ultimate estimates.

The robustness of the results was also checked by controlling for possible sources of endogeneity in the baseline model. The direction of causality between education, innovation and a firm's engagement in exporting activities might not be very well determined; if it was hypothesized that there might be some feedback effects from the latter to the former measures. For instance, one can argue that exporting firms might be more likely to attract/hire highly educated individuals and are also more likely to engage in innovative activities. However, it is argued that, even if such a feedback effect is likely to exist, it does not occur simultaneously, but it rather takes some time to materialize. To shed more light on this issue, various robustness checks have been carried out in this chapter. First, an instrumental variable approach has been adopted, by instrumenting education by the average share of educated workforce by industry and country.[98] Second, by making use of the BEEPS panel dataset, the share of employees with higher education has been regressed on lagged values of export intensity. In the former approach, the Wald test[99] from IVTobit fails to reject the null hypothesis of exogeneity of education at 5% and 1% (see Table A6.6.1), whereas in the second approach no supporting evidence is found for the hypothethised impact of lagged values of firm's export intensity on its current share of educated workforce.[100] Furthermore, as noted above, the summary statistics reveal that exporting firms have, on average, lower shares of educated individuals than non-exporters, which suggests that reverse causation is not likely to be present in the analysis.

The second robustness check has also been applied to on-the-job training and the input measure of innovation, R&D expenditure[101], i.e. these measures have been regressed on lagged values of export intensity, and again, no evidence supporting the presence of endogeneity was found.[102] With regard to the output measures of innovation, we argue that endogeneity is not likely be of concern, as these are not measured in the same period as the dependent variable. These binary values refer to the preceding three year periods and there is no reason to hypothesize that the current values of export intensity could have influenced previous years' innovation activities. Average labour cost, as an alternative measure of human capital, might be thought of being endogenous, if we assume that exporting firms' potentially higher wages might be due to their participation in international markets. However, as Schank et al. (2010) argue, exporting firms are likely to pay higher wages because they are more productive not due to their engagement in export activities. Given that the average labour cost is not a key human capital proxy, no other robustness checks have been conducted to examine the direction of causality.

[98] This measure aims to reflect the level of the workforce education required by firms to produce and export.
[99] This is also confirmed by a similar test conducted after using IV Poisson (see Table A6.6.2).
[100] See Table A6.6 for estimated results.
[101] As these are binary variables, it is much harder to detect any potential endogeneity. Furthermore, IV approaches (e.g. ivtobit) do not handle binary endogeneous variables.
[102] See Table A6.6 for a summary of results.

6.4 Empirical evidence

This section reports and interprets the results drawn from the various estimation methodologies explained in the previous section. Given the variety of model specifications used in the estimations, for practicality, the present section is split into two sub-sections. The first sub-section presents the results when export intensity is used to capture international competitiveness of firms, whereas in the second sub-section, we briefly report and comment on the findings from the export market share model(s).

6.4.1 Export intensity

The results reported in this section are mainly extracted from the baseline model specification established in section 6.3. In addition, an augmented regression model, which was developed after applying multiple imputation, will be briefly discussed. The entire sample estimates from the three estimation methods used in this analysis are initially reported and discussed. To examine the impact of human capital endowments on the export intensity of firms operating in different industries, with particular focus on the manufacturing sector, interaction terms between human capital proxies and three technological intensity dummies[103] (i.e. low and medium-low, medium-high and high-tech goods) have been introduced. A country group distinction has also been introduced to the modelling strategy. Models for European[104] transition economies, henceforth, referred asCEECs, and Euro-Asian[105] transition economies, henceforth, referred as CIS have been estimated separately and their results are also reported and interpreted in this section. As highlighted in section 6.3, in order to assess the robustness of the results, three different estimation approaches have been adopted, though acknowledging the limitations of each method. Tobit[106], as one of the most extensively used approaches in the literature, is very sensitive to the violation of non-normality.[107] Furthermore, it has also been criticized by some

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[103] The reference group being services and primary goods
[104] Central and East European countries (CEECs)
[105] The Commonwealth of Independent States (CIS) and Turkey
[106] As a rough check of the appropriateness of the Tobit model, following Wooldridge (2002), we have compared the adjusted Tobit estimates with those of the Probit. The outcome of this check reveals no significant differences between the two estimation methods, suggesting that the Tobit estimates are consistent (see Table A6.3.6 in the appendix section).
[107] The ***tobcm*** test has been applied to check potential non-normality in our estimations. It is pertinent to note that this test is applicable only for models with zero lower bounds, and no upper limits. In our empirical analysis, we have used both lower and upper limits in Tobit, which makes the test unsuitable, however, given the lack of alternative tests, we had to rely on its outcome. The issue of non-normality in our estimations is likely to be due to

researchers for not being able to model the bounded nature of export intensity properly (Wagner, 2001, Van Dijk, 2002, Eickelpasch and Vogel, 2009, Hobdari et al., 2011). Fractional Logit, on the other hand, has been designed to account for the bounded nature of the data; however, it has not been very much explored in the related research work. Poisson, as an alternative estimator, appears to have its own drawbacks, e.g. overdispersion and sensitivity to the presence of too many zeros in the data. Given that all these methods have their own advantages and disadvantages, instead of choosing a preferred model for interpretation, the estimates from the three models are reported and commented upon jointly.[108]

The estimated results based on the full sample show that, in line with the expectations, and consistent with previous research studies, a higher share of employees with higher education has a positive and significant[109] impact on firm's export intensity (see columns 1, 3, and 5 of Table 6.4). The interpretation of results in Tobit and Fractional Logit is commonly undertaken using marginal or partial effects, while, Poisson estimates can be interpreted as either semi-elasticities or average marginal effects.[110] In Wooldridge (2009, p. 541), two types of partial/marginal effects for Tobit model are discussed: the 'conditional partial' effects for the expected values of the dependent variable *(y),* where y is greater than 0, and 'unconditional marginal' effect, where $E(y|x)$. The main difference between the two is that the former option produces the expected values of y for the sub-population where y is only positive, while the latter covers the zero sub-population as well. In our estimation strategy, we adopt the latter approach for interpretation given that we are interested in examining the effects of variables on the whole population of firms.[111]

According to the Tobit's 'unconditional'[112] marginal effects, holding everything else constant, an increase of 10 percentage points in the share of employees with a university degree *(emp_edu)* increases the share of international sales in a firm's total sales *(exp_int)* by 0.2 percentage points

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the dependent variable being highly skewed (too many zero values). Note that for the positive values, the variable is normally distributed.

[108] A robust estimator of variance (i.e. VCE (robust)) has been used for all estimates

[109] The statistical significance of their coefficient estimates is lower in Fractional logit and Poisson (10%)

[110] For comparison purposes we have decided to interpret the marginal effects.

[111] Current exporting firms and firms that are likely to engage in exporting in the future, i.e. potential exporters.

[112] For comparison purposes, the "conditional" marginal effects have been also computed but have not been reported.

(column 1, Table 6.4). If this effect is interpreted at the mean value, an increase of 10 percentage points on *emp_edu*, i.e. from 34% to 44%, increase the mean value of *exp_int* from 6.24% to 6.44%. The average marginal effects of education in Fractional Logit and Poisson reveal that, ceteris paribus, an increase of 10 percentage points on the share of employees with higher education *(emp_edu)* increases export intensity by 0.1 percentage points (see columns 3 and 5 of Table 6.4). While, the effect of the quality of workforce appears to be statistically different from zero, its economic effect, similar to the Tobit results, is relatively small, i.e. the mean value of export intensity increases from 6.24% to 6.34%. No supporting empirical evidence is found for the impact of on-the-job training *(emp_trng)* and top manager's years of experience *(manager_exp)* on a firm's extent of exporting. The estimates of these two variables are positive but statistically insignificant across the three estimation methods. A possible explanation for this insignificant impact might be that SMEs, which are highly represented in our sample, might be less inclined to offer training programmes compared to larger firms.[113] As Bryan (2006, p. 637) summarizes, "smaller budgets, shallow hierarchies, the lack of understanding of its benefits, higher labour turnover, and greater firm instability" are among the key reasons highlighted in the literature why smaller firms do not engage extensively in on-the-job trainings. As hypothesized, the summary statistics of our sample of firms reveal that SMEs are less involved in offering training programmes compared to large firms. On average, 68 % of large firms in our sample have provided on-the-job training, compared to around 36 % of SMEs. The estimated results reveal supporting evidence for the impact of this dimension of human capital[114] on larger firms' extent of exporting only.

While the top manager's level of education and year of experience might be considered as complementary rather than alternative proxies of his/her human capital, due to very high share of missing information for the former measure, we were forced to rely primarily on the partial effect of manager's years of experience[115] in the sector where the firm operates. The potential

[113] The lack of more superior measures (e.g. the quality, frequency and duration of training) might be another potential reason for this insignificant results.
[114] The share of educated workforce, on the other hand, appears to have a stronger impact on the export intensity of SMEs compared to large firms.
[115] Note that, as reported, this measure contains very large values, implying highly experienced managers. However, some of these values do not seem very plausible, e.g. 60 or 65 years of experience, thus, raising doubts about the accuracy of this measure. Three very large observations (70-100) have been already excluded from the sample

impact of his/her level of education is estimated in the augmented model, discussed below, after using multiple imputation to fill in the missing data. Following previous studies, in an alternative regression model, the average labour cost *(lnavrg_tlc)* is used as a proxy measure for human capital endowments (columns 1, 3 and 5, Table 6.4). Its coefficient exerted a positive and significant impact on firm's export intensity in the Tobit model, whereas, the Fractional Logit and Poisson models did not produce any statistically significant parameters for this measure.

Table 6.4 Full sample estimated results (marginal effects)

	Tobit		Fractional Logit		Poisson	
VARIABLES	exp_int	exp_int	exp_int	exp_int	exp_int	exp_int
emp_edu	0.000203***	0.000365***	0.000136*	0.000466***	0.000137*	0.000476***
	(3.78e-05)	(4.89e-05)	(7.18e-05)	(0.000102)	(7.59e-05)	(0.000115)
emp_trng	0.00269	-0.00230	0.00104	-0.00926	0.00121	-0.00660
	(0.00193)	(0.00288)	(0.00330)	(0.00601)	(0.00336)	(0.00677)
manager_exp	6.00e-05	-0.000250*	1.66e-05	-0.000507*	1.97e-05	-0.000599*
	(8.70e-05)	(0.000150)	(0.000150)	(0.000307)	(0.000146)	(0.000350)
int_edu_lowmlow		-0.000500***		-0.000862***		-0.000884***
		(7.51e-05)		(0.000146)		(0.000161)
int_edu_mhightech		-0.000245**		-0.000394**		-0.000333*
		(9.56e-05)		(0.000181)		(0.000186)
int_edu_hightech		-0.000273*		-0.000236		-0.000175
		(0.000161)		(0.000260)		(0.000248)
int_trng_lowmlow		0.0105**		0.0136*		0.0101
		(0.00467)		(0.00697)		(0.00755)
int_trng_mhigh		0.0142**		0.0266***		0.0202**
		(0.00701)		(0.00911)		(0.00918)
int_trng_high		-0.00436		-0.00227		-0.00535
		(0.00859)		(0.0158)		(0.0148)
int_mngexp_lowmlow		0.000465**		0.000644*		0.000728*
		(0.000189)		(0.000356)		(0.000389)
int_mngexp_mhigh		0.000423*		0.000711		0.000783*
		(0.000245)		(0.000442)		(0.000448)
int_mngexp_high		0.000758*		0.00114		0.00131*
		(0.000458)		(0.000815)		(0.000763)
new_org_str	0.00497**	0.00516**	0.00663*	0.00655*	0.00628	0.00596
	(0.00245)	(0.00247)	(0.00394)	(0.00394)	(0.00382)	(0.00383)
new_prod_serv	0.00533**	0.00509**	-0.00449	-0.00517	-0.00423	-0.00481

estimations. Values greater than 60 were also initially excluded, but given the negligible differences in the final results, they were preserved in the final estimations.

	(0.00226)	(0.00227)	(0.00376)	(0.00377)	(0.00370)	(0.00370)
new_methods	0.00280	0.00287	0.00594	0.00632	0.00563	0.00609
	(0.00251)	(0.00254)	(0.00426)	(0.00424)	(0.00414)	(0.00412)
location	-0.00484**	-0.00443**	-0.0151***	-0.0143***	-0.0135***	-0.0128***
	(0.00216)	(0.00219)	(0.00409)	(0.00413)	(0.00417)	(0.00423)
lnsize	0.0196***	0.0200***	0.0305***	0.0310***	0.0348***	0.0355***
	(0.00290)	(0.00288)	(0.00523)	(0.00517)	(0.00541)	(0.00542)
lnsize_sqr	-0.000851**	-0.000894**	-0.00151**	-0.00156***	-0.00203***	-0.00210***
	(0.000360)	(0.000357)	(0.000611)	(0.000603)	(0.000609)	(0.000610)
lnage	0.00473	0.00596	0.00848	0.00978	0.00751	0.00897
	(0.00508)	(0.00513)	(0.00857)	(0.00854)	(0.00870)	(0.00869)
lnage_sqr	-0.00155	-0.00173*	-0.00325*	-0.00335**	-0.00307*	-0.00319*
	(0.000985)	(0.000991)	(0.00166)	(0.00165)	(0.00164)	(0.00163)
foreign_dummy	0.0571***	0.0562***	0.0513***	0.0508***	0.0438***	0.0434***
	(0.00809)	(0.00796)	(0.00526)	(0.00522)	(0.00464)	(0.00462)
state_dummy	-0.0104*	-0.0108*	-0.0378**	-0.0378**	-0.0396**	-0.0397**
	(0.00592)	(0.00576)	(0.0157)	(0.0155)	(0.0177)	(0.0174)
credit	0.0109***	0.0111***	0.00928***	0.00942***	0.00996***	0.0101***
	(0.00199)	(0.00200)	(0.00310)	(0.00309)	(0.00310)	(0.00310)
low_mlow_tech	0.0455***	0.0465***	0.0582***	0.0599***	0.0625***	0.0649***
	(0.00297)	(0.00747)	(0.00354)	(0.00895)	(0.00397)	(0.00989)
mhigh_tech	0.0925***	0.0802***	0.0740***	0.0599***	0.0765***	0.0629***
	(0.00718)	(0.0173)	(0.00457)	(0.0119)	(0.00477)	(0.0121)
high_tech	0.100***	0.0967**	0.0821***	0.0683***	0.0842***	0.0679***
	(0.0151)	(0.0428)	(0.00826)	(0.0240)	(0.00778)	(0.0210)
RD_exp	0.0156***		0.0123***		0.0109***	
	(0.00316)		(0.00396)		(0.00379)	
lnavrg_tlc	0.00282***		0.00153		0.00171	
	(0.00101)		(0.00163)		(0.00164)	
No. of observations: 14,026						

Notes: (1) Country dummies included but not reported

(2) RD_exp and lnavrg_tlc are estimated separately from other innovation and human capital measures, respectively

(3) *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses

Once we distinguish between manufacturing, services and primary good sectors, the following evidence is revealed: the three estimation approaches suggest that a highly educated workforce *(int_edu_lowmlow, int_edu_mhightech, int_edu_hightech)* has a lower impact on export intensity of manufacturing firms compared to those operating in services and primary goods sectors (see columns 2, 4, 6 of the table above). A potential explanation for this, seemingly counterintuitive result, is that manufacturing firms in our sample are mainly engaged in exporting low and medium-low tech goods, where the qualification of the workforce might not be of primary importance. This explanation is consistent with the interaction terms between medium-high and high-tech goods and education (*int_edu_mhightech, int_edu_hightech)*, i.e. the effect of education on the manufacturing sector exports appears to get smaller or insignificant for more tech intensive goods. The statistics also show that, on average, manufacturing firms in the sample have lower shares of employees with higher education compared to their counterparts. Offering formal training programmes to employees *(int_trng_lowmlow, int_trng_mhightech, int_trng_hightech)*, on the other hand, appears to have a stronger impact on a firm's extent of exporting in the manufacturing industry (i.e. medium-low and low and medium-high tech) compared to services and primary goods. Similarly, a stronger positive impact is found for manager's years of experience *(int_mngexp_lowmlow, int_mngexp_mhightech, int_mngexp hightech)* in almost all technology intensive goods, although its significance level decreases or disappears in some cases (e.g. interaction with medium-high and high tech goods in Fractional Logit).

A firm's expenditure on R&D *(RD_exp)* appears to have a positive impact on firm's export intensity. The estimated coefficient of new organisational/management practices or structures introduced over the three previous years *(new_org_str)* turned out to be positive and significant across the three models. The introduction of new products and/or services *(new_prod_serv)* was found to have a positive and significant impact on the extent of exporting only in the Tobit model, whereas, new methods introduced over the three previous years *(new_methods)* did not seem to have any statistically significant impact on the export intensity of firms in any of the models. Note that, following previous discussion on whether input or output measures are better proxies of innovation, and also to avoid for potential correlation between the two, we have assessed their influences separately. As outlined in section 6.2, while R&D is highly likely to establish the basis for innovation, it might require some time until an innovation output is generated. Given that the existing evidence in this regard is mixed, assessing the impact of these two dimensions separately seems more sensible.

From the set of control variables, location in the capital city *(location)*, which has been introduced to capture potential economies of agglomeration, turned out to have a negative impact on firm's export intensity. Although this result is contrary to expectations, it should be noted that this is not a very comprehensive measure of potential knowledge spillovers or agglomeration. Furthermore, the data shows a very low concentration of firms in the capital cities. The size of the firm *(lnsize)*, as hypothesized, appears to have a positive impact on firm's share of international sales up to a certain threshold point, and after that it becomes negative *(lnsize_sqr).* Weak evidence is found for the potential role of firm's business experience *(lnage)* on its export intensity, its estimated parameter appears to be statistically insignificant (positive sign) up to a certain point and after that it becomes significant with a negative sign *(lnage_sqr).* In line with previous studies, the ownership structure appears to be an important determinant of a firm's participation in international markets via exporting. Being foreign-owned *(foreign_dummy)* tends to positively influence a firm's export intensity compared to being domestic-owned. Whereas, the estimated parameter for state ownership *(state_dummy)* is significant[116] and negative, suggesting that being owned by the state rather than by a private owner(s) exerts a negative impact on the extent of a firm's engagement in exporting activities.

Given the existing discussion in the literature that exporting firms are more likely to depend on external finance, we have hypothesized a positive coefficient for the access to finance dummy. The results from the three estimators/models suggest that having a line of credit or a loan from a financial institution *(credit)* has a positive impact on firm's export intensity. To account for industry characteristics, we have introduced manufacturing dummies[117] classified by their technology intensity (i.e. low_mlow_tech, mhigh_tech, and high_tech). Operating in the manufacturing sector seems to have positive impact on firm's share of international sales, with its impact becoming stronger in magnitude for firms producing and exporting medium-high and high-tech goods. Country specific conditions, as captured by country dummies[118] *(dcountry)*, are generally found to be statistically significant, implying that economic, institutional, cultural and other country-specific factors explain a firm's extent of exporting. The entire sample results are reported in Tables A6.3, A6.4 and A6.5, whereas, the estimated results from the industry sub-analysis are presented in Tables A6.3.1, A6.4.1 and A6.5.1.

[116] With the exception of the Tobit model.
[117] The base group is services and primary goods.
[118] Country dummies are not reported in the main text but can be found in the corresponding tables in the appendix section.

Following the discussion presented in section 6.3 on the issue of missing values, as a robustness check the full sample model has been estimated through the use of multiple imputation.[119] The estimated results from the imputed baseline model are generally consistent with those of non-imputed model with very few exceptions (see imputed results in Tables A6.3.7 A6.4.6, A6.5.6 in the appendix section). The estimate of the on-the-job training dummy *(emp_trng)* becomes significant at 5% in the imputed Tobit model, while the share of educated workforce in Fractional Logit and Poisson models loses its 10% level of statistical significance. However, an issue of major concern to our empirical analysis has been the inability to include some potential determinants of export intensity (such as, the share of skilled employees, the education level of the top manager, technological progress, etc.) in the main model due to very high fractions of missing data. In order to be able to examine the impact of these variables on a firm's international competitiveness, assisted by the multiple imputation technique, an additional – augmented[120] regression model has been developed.

As discussed in the previous section, there is no strict agreement on the number of imputations to be used. While, there are studies that have used 20 imputations even for higher fractions of missing data, other researchers have suggested using higher number of imputations when the share of missing information is high (e.g. equal to the rate of missingness). Since the rate of missingness for these additional variables is very high, to assess the consistency of the results, we have applied different numbers of imputation, i.e. 45 and 95. Overall, the results are consistent in terms of the sign, while the magnitude and level of statistical significance of estimates appear to slightly change when the number of imputations is increased. For instance, from the additional human capital variables, the education level of the top manager *(manager_edu_dummy)* appears to have a positive and significant (at 10% significance level) impact across the three estimators, when 45 imputations are used, while its statistical significance vanishes in Fractional Logit and Poisson when the number of imputations is increased to 95. The share of skilled workers in a firm's total workforce *(skilled_emp),* the technological position compared to the main competitor *(tech)* and participation in a business

[119] Given the relatively low share of missing data in the baseline model, the number of imputations used was 22.
[120] In addition to the baseline model regressors, it also includes: the share of skilled production employees, the level of formal education of the top manager, a relative measure of technology, participation in a business association and the share of foreign material inputs.

association *(bus_assoc)* appear to have no significant impact on a firm's export intensity. The parameter estimate of the share of imported input materials *(f_inputs)*, on the other hand, turned out to be highly significant and with an expected sign. The results from the augmented imputed model are presented in Tables A6.3.8, A6.3.9, A6.4.7, A6.4.8, A6.5.7 and A6.5.8 in the appendix section. Acknowledging that multiple imputation when the share of missing data is high is likely to be more problematic, these results will be interpreted with caution.

Since one of the main objectives of this thesis is to assess the international competitiveness of European transition economies, the actual sample has been split into two country groups, European transition economies (CEECs) and Euro-Asian transition economies (CIS and, Turkey). Again, the estimated results (marginal effects) of Tobit, Fractional Logit and Poisson will be interpreted jointly in order to assess the robustness of our findings (see Table 6.5). Based on the estimated results produced by the Tobit model, the share of employees with higher education appears to have a positive and highly significant impact on the export intensity of firms from both groups of countries. The unconditional marginal effects reveal that, holding everything else constant, an increase of 10 percentage points on firm's share of workforce with higher education *(emp_edu)*, increases its export intensity by 0.3 percentage points if operating in CEECs and 0.1 in CIS . It is important to note that these marginal effects, in economic terms, are not very large. Namely, a 10 percentage points increase in the mean value of *emp_edu*, in CEECs (i.e. from 20% to 30%) increases the export intensity mean *(exp_int)* from 10.01% to 10.31%. When the marginal effect is applied in the latter set of countries (CIS), its economic impact is slightly smaller, i.e. a 10 percentage point increase in the mean value of *emp_edu* (from 41% to 51%) raises the mean value of export intensity *(exp_int)* from 4.25% to 4.35%.

Note that, the significance level of this variable disappears when the other two alternative estimation methods are adopted. The training dummy, on the other hand, i.e. if a firm has introduced formal training programmes for its employees *(emp_trng)*, seems to have a positive impact on CIS firms' export intensity, while its impact is statistically insignificant for firms operating in CEECs. The results suggest that a discrete change of this variable from 0 to 1 (i.e. having provided trainings) increases the export intensity of CIS firms by 0.6-0.8 percentage points. The years of experience of the top manager in a particular sector *(manager_exp)* turned out to be insignificant across the three estimators (sign varies). When average labour cost *(lnavrg_tlc)* is used to proxy human capital, its estimated coefficient is positive and significant in both sub-samples, however, this result is supported only by the Tobit estimator.

Table 6.5 Estimated results (marginal effects) by country group

	Tobit		**Fractional logit**		**Poisson**	
	CEECs	CIS	CEECs	CIS	CEECs	CIS
VARIABLES	exp_int,	exp_int,	exp_int,	exp_int,	exp_int,	exp_int,
emp_edu	0.000352***	0.000141***	0.000136	0.000111	0.000168	0.000101
	(0.000113)	(3.35e-05)	(0.000165)	(6.85e-05)	(0.000174)	(7.27e-05)
emp_trng	-0.00648	0.00559***	-0.0112	0.00795**	-0.0110	0.00770**
	(0.00524)	(0.00193)	(0.00703)	(0.00341)	(0.00716)	(0.00350)
manager_exp	0.000122	8.20e-06	-1.88e-05	-9.68e-06	-5.61e-05	-8.56e-06
	(0.000250)	(8.21e-05)	(0.000324)	(0.000153)	(0.000315)	(0.000150)
new_org_str	0.0183***	0.00118	0.0142*	0.00345	0.0141*	0.00383
	(0.00697)	(0.00223)	(0.00840)	(0.00389)	(0.00812)	(0.00377)
new_prod_serv	0.00626	0.00503**	-0.00832	-0.00276	-0.00834	-0.00204
	(0.00596)	(0.00234)	(0.00771)	(0.00411)	(0.00754)	(0.00410)
new_methods	0.0137*	-0.00118	0.0122	0.00170	0.0117	0.00181
	(0.00718)	(0.00225)	(0.00875)	(0.00448)	(0.00846)	(0.00446)
location	-0.00112	-0.00551**	-0.0154*	-0.0142***	-0.0125	-0.0140***
	(0.00585)	(0.00219)	(0.00788)	(0.00489)	(0.00803)	(0.00519)
lnsize	0.0558***	0.0102***	0.0619***	0.0163***	0.0722***	0.0198***
	(0.00864)	(0.00266)	(0.0115)	(0.00535)	(0.0125)	(0.00551)
lnsize_sqr	-0.00437***	-9.85e-05	-0.00429***	-0.000458	-0.00553***	-0.000885
	(0.00113)	(0.000322)	(0.00142)	(0.000594)	(0.00148)	(0.000588)
lnage	0.00486	0.00188	-0.00637	0.0101	-0.0117	0.0105
	(0.0166)	(0.00434)	(0.0206)	(0.00817)	(0.0204)	(0.00848)
lnage_sqr	-0.00314	-0.000493	-0.00262	-0.00242	-0.00173	-0.00252
	(0.00312)	(0.000861)	(0.00389)	(0.00161)	(0.00378)	(0.00164)
foreign_dummy	0.102***	0.0420***	0.0784***	0.0387***	0.0670***	0.0361***
	(0.0160)	(0.0103)	(0.0101)	(0.00651)	(0.00890)	(0.00594)
state_dummy	-0.0407**	-0.00718*	-0.192***	-0.0224*	-0.230***	-0.0219*
	(0.0205)	(0.00418)	(0.0418)	(0.0119)	(0.0574)	(0.0125)
credit	0.0200***	0.00782***	0.0126*	0.00712**	0.0135**	0.00700**
	(0.00523)	(0.00198)	(0.00674)	(0.00313)	(0.00672)	(0.00318)
low_mlow_tech	0.117***	0.0193***	0.109***	0.0250***	0.120***	0.0277***
	(0.00796)	(0.00264)	(0.00680)	(0.00400)	(0.00811)	(0.00444)
mhigh_tech	0.188***	0.0497***	0.129***	0.0377***	0.136***	0.0398***
	(0.0179)	(0.00635)	(0.00986)	(0.00471)	(0.0102)	(0.00506)
high_tech	0.203***	0.0551***	0.152***	0.0375***	0.156***	0.0409***
	(0.0421)	(0.0122)	(0.0182)	(0.00789)	(0.0160)	(0.00824)
RD_exp	0.0360***	0.00900***	0.0262***	0.00473	0.0243***	0.00476
	(0.00821)	(0.00310)	(0.00817)	(0.00428)	(0.00778)	(0.00414)
lnavrg_tlc	0.00554*	0.00183**	0.00312	0.000762	0.00351	0.000818

	(0.00329)	(0.000847)	(0.00400)	(0.00147)	(0.00403)	(0.00148)
Observations	4,836	9,190	4,836	9,190	4,836	9,190

Notes: (1) Country dummies included but not reported

(2) RD_exp and lnavrg_tlc are estimated separately from other innovation and human capital measures, respectively

(3) *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses

(4) CIS subsample also covers Turkey

From the set of innovation measures, the introduction of new organisational, management practices or structures *(new_org_str)* appears to exert a positive and significant impact on the export intensity of firms in CEECs only. Little[121] empirical evidence is found for the importance of new products and/or services *(new_prod_serv)* and new methods (*(new_methods)* on export intensity in either set of countries. R&D expenditure *(RD_exp)*, on the hand, as a measure of input innovation, appears to have a positive and significant impact on the export intensity of firms located in CEECs, but an insignificant impact for those operating in CIS (with the exception of the Tobit model).

The sign of the location estimate *(location)* remains negative, even after splitting the sample in two, though its significance level is not consistent across the estimators. The coefficient on the size of firms *(lnsize)* for both groups of countries remains positive up to a certain threshold point and after that it becomes negative *(lnsize_sqr)*. This is consistent across the three models, though the sign of the quadratic term is insignificant for CIS. The parameter estimates of business experience *(lnage)* and its squared term *(lnage_sqr)* are insignificant in both sub-samples. The hypothesized importance of ownership structure to firms' participation in international markets, is also confirmed when CEECs and CIS are estimated separately. As we can see from the results in Table 6.5, foreign ownership *(foreign_dummy)* has a highly significant impact on firm's export intensity, irrespective of the country group it belongs, while state ownership *(state_dummy)* is negative and significant, with the expectation of the Tobit parameter estimate. The expected positive impact of a firm's access to external finance *(credit)* on its exporting extent is re-established in both sets of countries. Being involved in a manufacturing industry, other things kept unchanged, has a positive impact on a firm's export intensity in all transition countries. Again, the effect is larger for firms that are involved in manufacturing more

[121] The coefficient of the former measure of innovation is significant for N-ETEs, only in the Tobit, while the parameter of the latter measure is again significant in ETEs only in the Tobit model.

technology-intensive goods as reflected by the larger parameters of medium-high *(mhigh_tech)* and high-tech *(high_tech)* dummies.

Consistent with the full sample estimations, three interaction terms between human capital measures of technology intensity industries have been included in the model(s). While the signs of the interaction parameters are generally consistent, their statistical significance is rather mixed (see Table 6.6). While, in the CEECs sub-sample, the share of workforce with higher education appears to exert a lower impact on the manufacturing industries (i.e. *int_edu_lowmlow, and int_edu_mhightech*) compared to services and primary goods, the evidence is slightly weaker for CIS. In the latter set of countries, a highly educated workforce exerts a lower impact on the export intensity of low and medium-low tech firms *(int_edu_lowmlow)* only. On the hypothesis as to whether offering formal training programmes is of more use for manufacturing firm's export intensity, across the two country groups, evidence is again mixed. The only significant interaction term revealed in the CEECs sub-sample is *int_trng_mhigh*, which suggests that firms operating in medium-high tech industries benefit more from training programmes compared to non-manufacturing industries. Insufficient evidence is found for the role of on-the-training across different industries in the CIS. The evidence for the impact of top manager's experience on a firm's extent of exporting appears to be scarce as well. While the signs of the interaction terms between manager's experience and tech intensive industries (*int_mngexp_lowmlow, int_mngexp_mhigh, and int_mngexp_high*) are positive, their estimated parameters are insignificant, with the exception of Tobit estimates in the CIS sub-sample. The final results for these two groups of countries are also reported in Tables A6.3.2-A6.3.5, A6.4.2-A6.4.5, and A6.5.2-A6.5.5.

Table 6.6 Industry estimated results (marginal effects) by country group

	Tobit		**Fractional logit**		**Poisson**	
	CEECs	CIS	CEECs	CIS	CEECs	CIS
VARIABLES	exp_int,	exp_int,	exp_int,	exp_int,	exp_int,	exp_int,
emp_edu	0.000621***	0.000225***	0.000618***	0.000271**	0.000719***	0.000277**
	(0.000132)	(4.95e-05)	(0.000212)	(0.000117)	(0.000245)	(0.000132)
emp_trng	-0.0103	0.00132	-0.0212*	0.000791	-0.0174	0.00184
	(0.00713)	(0.00309)	(0.0116)	(0.00700)	(0.0135)	(0.00781)

manager_exp	-9.50e-05	-0.000293*	-0.000467	-0.000447	-0.000761	-0.000471
	(0.000365)	(0.000166)	(0.000569)	(0.000377)	(0.000676)	(0.000422)
int_edu_lowmlow	-0.00116***	-0.000225***	-0.00158***	-0.000395**	-0.00169***	-0.000422**
	(0.000248)	(6.95e-05)	(0.000345)	(0.000154)	(0.000379)	(0.000169)
int_edu_mhightech	-0.000672*	-6.49e-05	-0.000947*	-3.90e-05	-0.000915*	-3.78e-05
	(0.000344)	(8.35e-05)	(0.000492)	(0.000172)	(0.000482)	(0.000185)
int_edu_hightech	0.000120	-0.000225	0.000474	-0.000257	0.000336	-0.000258
	(0.000577)	(0.000141)	(0.000567)	(0.000249)	(0.000473)	(0.000271)
int_trng_lowmlow	0.00695	0.00856*	0.0126	0.00885	0.00719	0.00723
	(0.0110)	(0.00491)	(0.0140)	(0.00785)	(0.0153)	(0.00857)
int_trng_mhigh	0.0412*	0.00451	0.0479**	0.0117	0.0351*	0.00860
	(0.0216)	(0.00565)	(0.0201)	(0.00944)	(0.0192)	(0.0100)
int_trng_high	-0.0328	0.00442	-0.0284	0.0143	-0.0261	0.0134
	(0.0203)	(0.00983)	(0.0347)	(0.0157)	(0.0298)	(0.0168)
int_mngexp_lowmlow	0.000532	0.000378**	0.000774	0.000442	0.00103	0.000466
	(0.000519)	(0.000193)	(0.000708)	(0.000412)	(0.000779)	(0.000450)
int_mngexp_mhigh	0.000286	0.000374*	0.000479	0.000657	0.000750	0.000638
	(0.000798)	(0.000227)	(0.00105)	(0.000458)	(0.000968)	(0.000487)
int_mngexp_high	7.94e-05	0.000844**	0.000534	0.00123	0.00121	0.00120
	(0.00165)	(0.000378)	(0.00174)	(0.000821)	(0.00151)	(0.000846)
Observations	4,836	9,190	4,836	9,190	4,836	9,190

Notes: (1) Control variables and country dummies included but not reported

(2) RD_exp and lnavrg_tlc are estimated separately from other innovation and human capital measures, respectively

(3) *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parenthese

(4) CIS subsample also covers Turkey

6.4.2 Export market share

This section reports and comments on the estimated results when an alternative measure of international competitiveness is adopted. In line with the previous country and industry level empirical analyses, an export market share measure has been used to capture the international competitiveness of firms in the sample. In the actual analysis, four different specifications of the dependent variable have been constructed. The first two specifications refer to the share of a firm's exports over the exports of EU-28 and EU-28+/EA40[122] in a particular industry[123], while, the second two specifications constructed use more aggregated data, i.e. the total rather than industry level exports of EU-28 and EU-28 +. The marginal effects and standard errors from the former two model specifications (i.e. exp_share_industryEU28 and exp_share_industryEA40) are reported in Table 6.7 while, the final results from the latter two models (i.e.

[122] This refers EU-28 + Albania, Belarus, Georgia, Macedonia FYR, Moldova, Montenegro, Serbia, Bosnia-Herzegovina, Kazakhstan, Russia, Turkey, and Ukraine.
[123] Manufacturing, Services and Primary goods industries.

exp_share_totalEU28 and exp_share_totalEA40) are presented in Tables A6.7.6-A6.7.7, A6.8.6-A6.8.7, and A6.9.6-A6.9.7. While in principle the estimators used in the previous analysis, i.e. Tobit, Fractional Logit and Poisson, seem to also be econometrically suitable for the new dependent variables, given that the share values are very small the latter two approaches might be slightly more sensitive than Tobit. As previously argued, Papke and Wooldride (1996) have introduced the Fractional Logit approach to model data that are bounded 0 and 1 (100%) . In the actual analysis, this is less of a problem as we have no higher bounds restrictions - the majority of the values are close to zero. However, having many zeros and almost zero values seems to exacerbate the issue of overdispersion in both models (i.e. Fractional logit and Poisson). In this section, the marginal effects from the three estimation methods will be reported but only the Tobit results will be commented upon. Note that, partially due to high share of zero and very small values, non-normality is likely to be violated in the Tobit model. The presence of some outlier observations[124] seems to exacerbate this even further. We are aware of the potential consequences of these on this estimations; hence the final estimates will be interpreted with great caution. For complete Tobit estimate results see Tables A6.7, A6.7.3, whereas for the Fractional Logit and Poisson estimates check Tables, A6.8, A6.8.3, A6.9 and A6.9.3 in the appendix section.

Table 6.7 Full sample estimated results (marginal effects)

	Tobit		**Fractional logit**[125]		**Poisson**	
VARIABLES	exp_share_industryEU28	exp_share_industryEA40	exp_share_industryEU28	exp_share_industryEA40	exp_share_industryEU28	exp_share_industryEA40
emp_edu	1.72e-05***	2.02e-05***	1.29e-07	2.40e-07	1.29e-07	2.41e-07
	(3.63e-06)	(4.17e-06)	(1.32e-07)	(1.47e-07)	(1.33e-07)	(1.48e-07)
emp_trng	0.000293**	0.000298	-2.34e-06	-3.30e-06	-2.35e-06	-3.30e-06
	(0.000146)	(0.000184)	(2.79e-06)	(6.01e-06)	(2.80e-06)	(6.02e-06)

[124] Cook (1977) has introduced a tool for detecting influencing observations in linear regression. Cook's distance is a measure of "the change in the regression coefficients that would occur if this case was omitted, thus revealing which cases are most influential in affecting the regression equation" (Stevens, 1984, p.341). Note that, if Cook's distance is revealed to be greater than 4/sample size (N), the observation is perceived to have a high influence, whereas, if the distance is greater than 1, the observation is considered to be a big outlier. In our analysis, according to **Cook's distance measure**, there seem to be quite a few influencing observations, but there is just one big outlier in each model specification. The big outlier observations were initially excluded from the estimations but given that the changes in the ultimate results were negligible, the full sample estimates are reported in this section.

[125] The dependent variable in Tobit is in percentages while, in Fractional Logit and Poisson, we have used proportion data mainly because the former approach does not support values greater than 1. Note that latter becomes an issue due to some outlier observations as otherwise, the share values are very small.

manager_exp	-7.49e-06	-7.81e-06	-3.55e-07	-3.48e-07	-3.56e-07	-3.48e-07
	(8.24e-06)	(9.29e-06)	(3.33e-07)	(3.21e-07)	(3.36e-07)	(3.22e-07)
new_org_str	0.000552***	0.000418	1.06e-05**	5.88e-06	1.07e-05**	5.88e-06
	(0.000211)	(0.000263)	(4.99e-06)	(6.71e-06)	(5.02e-06)	(6.72e-06)
new_prod_serv	0.000827***	0.000925***	-2.86e-06	-5.46e-07	-2.90e-06	-5.59e-07
	(0.000221)	(0.000235)	(4.64e-06)	(5.60e-06)	(4.67e-06)	(5.61e-06)
new_methods	-0.000144	-1.28e-05	-3.75e-06	1.68e-06	-3.75e-06	1.69e-06
	(0.000192)	(0.000280)	(4.85e-06)	(7.47e-06)	(4.87e-06)	(7.47e-06)
location	0.000502**	0.000573**	7.89e-06	1.03e-05	7.93e-06	1.03e-05
	(0.000227)	(0.000271)	(1.06e-05)	(7.58e-06)	(1.07e-05)	(7.59e-06)
lnsize	0.000762**	0.00104**	-1.84e-06	8.03e-06	-1.84e-06	8.06e-06
	(0.000315)	(0.000448)	(6.74e-06)	(8.07e-06)	(6.77e-06)	(8.09e-06)
lnsize_sqr	4.11e-05	2.27e-05	5.85e-07	-2.19e-07	5.86e-07	-2.21e-07
	(4.16e-05)	(5.75e-05)	(6.35e-07)	(6.54e-07)	(6.37e-07)	(6.54e-07)
lnage	0.000328	0.000393	4.06e-06	-7.58e-06	4.11e-06	-7.58e-06
	(0.000447)	(0.000486)	(1.06e-05)	(1.01e-05)	(1.07e-05)	(1.01e-05)
lnage_sqr	-5.15e-05	-6.98e-05	-6.67e-07	1.81e-06	-6.82e-07	1.81e-06
	(8.84e-05)	(9.82e-05)	(1.84e-06)	(1.77e-06)	(1.85e-06)	(1.77e-06)
foreign_dummy	0.00191***	0.00226***	-4.69e-06	-5.89e-06	-4.70e-06	-5.89e-06
	(0.000405)	(0.000540)	(7.17e-06)	(6.22e-06)	(7.20e-06)	(6.22e-06)
state_dummy	-0.000766	-0.000803	-1.05e-05	-2.11e-05*	-1.05e-05	-2.11e-05*
	(0.000511)	(0.000567)	(9.11e-06)	(1.10e-05)	(9.18e-06)	(1.10e-05)
credit	0.00120***	0.00132***	1.22e-05*	1.36e-05**	1.23e-05*	1.36e-05**
	(0.000184)	(0.000203)	(6.56e-06)	(6.26e-06)	(6.58e-06)	(6.27e-06)
low_mlow_tech	0.00274***	0.00279***	-2.27e-05***	-3.07e-05***	-2.28e-05***	-3.07e-05***
	(0.000213)	(0.000246)	(5.66e-06)	(9.93e-06)	(5.71e-06)	(9.96e-06)
mhigh_tech	0.00584***	0.00599***	-1.94e-05***	-2.68e-05**	-1.95e-05***	-2.68e-05**
	(0.000527)	(0.000571)	(5.15e-06)	(1.26e-05)	(5.19e-06)	(1.26e-05)
high_tech	0.00612***	0.00610***	-2.58e-05***	-4.95e-05***	-2.58e-05***	-4.95e-05***
	(0.00103)	(0.00110)	(7.70e-06)	(1.64e-05)	(7.74e-06)	(1.65e-05)
RD_exp	0.00141***	0.00172***	4.54e-06	9.37e-06	4.54e-06	9.38e-06
	(0.000277)	(0.000339)	(4.40e-06)	(6.30e-06)	(4.41e-06)	(6.31e-06)
lnavrg_tlc	0.000363***	0.000373***	7.82e-07	1.50e-06	7.89e-07	1.51e-06
	(7.75e-05)	(7.60e-05)	(2.33e-06)	(1.05e-06)	(2.35e-06)	(1.06e-06)
No. of observations: 13,711						

Notes: (1) Country dummies included but not reported

(2) RD_exp and lnavrg_tlc are estimated separately from other innovation and human capital measures, respectively

(3) *** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses

The unconditional marginal effects of the Tobit suggest that having a higher share of graduate employees is likely to have a positive impact on a firm's export market share. Holding everything else constant, an increase of 10 percentage points in the share of employees with higher education, *(emp_edu)* increases the share of exports of a firm by 0.000172 and 0.000202 percentage points, respectively. If these effects are applied at the mean values of the measures, the results reveal that, a 10 percentage points increases in *emp_edu* (i.e. from 34% to 44%) is reflected in a 23.5% (i.e. from 0.00073% to 0.00090%) and 19.3% (i.e. from 0.00104% to 0.00124%) increase in the mean values of *exp_share_industryEU28* and *exp_share_industryEA40*, respectively. Offering on-the-job training programmes to employees appears to have a positive and significant impact on a firm's share of exports in the EU-28, but not when EA40 is used as a reference group of countries. Ceteris paribus, a discrete change from 0 to 1 *in emp_trng* increases the export market share of firms with reference to EU-28 by 0.000293. The estimate parameter of manager's years of experience *(manager_exp)* is not statistically different from zero, implying that there is no evidence that export market share of the firm is determined by the experience of top manager's experience (see columns 1 and 2 of Table 6.7).

The introduction of new products and/or services over the period of three years *(new_prod_serv)* appears to have a highly significant impact on export market share, while, the parameter estimate of new organisational/ management practices or structures *(new_org_str)* turned out to be positive and significant only when the first specification of export market share is used (i.e. EU-28). While, the introduction of new methods *(new_methods)* turned out statistically insignificant across all model specifications. When, R&D expenditure is estimated separately, its coefficient *(RD_exp)* seems to have a positive and highly statistically significant on export market share regardless of the dependent variable specification used. From the set of control variables, in line with expectations, location *(location)* in the capital city exerts a positive impact on a firm's export market share and so does the size of the firm *(lnsize)*. No empirical evidence is found for its squared term *(lnsize_sqr)*, though, implying that the absence of non-linearities in the impact of firm's size on market share. The hypothesis that a firm's business experience *(lnage and lnage_sqr)* has a significant impact on firm's export market share is not supported empirically. As expected, foreign ownership *(foreign_dummy)* turned out to have a positive and highly significant impact on a firm's export market share, while the evidence for state ownership *(state_dummy)* is mostly insignificant (negative sign). The parameter estimate for *credit* suggests that having a line of credit or a loan from a financial institution has a positive and significant impact on a firm's share of exports.

Firms engaged in manufacturing industries *(low_mlow_tech, mhigh_tech, and high_tech)* are found to have larger export market shares, on average, compared to those in services and primary goods; and this difference is particularly strong for more technological intensive goods. The generally significant coefficient estimates of the country dummies show that economic, institutional, cultural and other specific country conditions are highly likely to influence a firm's export market share. After distinguishing between European (CEECs) and Euro-Asian transition economies (CIS), the parameter estimate of the share of employees with higher education *(emp_edu)* remains highly significant in both sub-samples, however, the parameter estimate of on-the-job training *(emp_trng)* is positive and significant only in the CIS sub-sample. Top manager's years of experience in a particular sector remains statistically insignificant across the two sub-samples of countries. See Tables A6.7.1, A6.7.2, A6.7.4 and A6.7.5 for Tobit sub-sample estimates, and A6.8.1/ A6.9.1, A6.8.2/ A6.9.2, A6.8.4/ A6.9.4 and A6.8.5/ A6.9.5 for Fractional Logit and Poisson.

6.5 Conclusions

In this chapter we have examined the impact of human capital endowments on international competitiveness, using a large sample of approximately 16,000[126] firms from 30 transition economies (and Turkey). To assess empirically the above outlined relationship, various estimation methods have been employed: a Tobit model, an innovative approach introduced by Papke and Woolridge (Fractional Logit), and a Poisson regression model. The international competitiveness of firms in the present empirical investigation is represented by their export intensity and export market share.

In line with theoretical underpinnings and existing empirical research, the full sample estimated results suggest that having a more qualified workforce exerts a positive and statistically significant impact on export intensity of firms. No supporting evidence is found for the significance of on-the-job training programmes and years of experience of the top manager. Once industry groups are distinguished, the share of workforce with higher education is revealed to have a lower marginal effect on the export engagement of firms in manufacturing industries

[126] Note that due to missing data, the number of firms utilized in the baseline model estimations is 14,026.

compared to those operating in services and primary goods sectors. However, this difference gets smaller when the differences between services and primary goods and more technology-intensive manufacturing goods are considered. On the other hand, on-the-job training programmes and years of experience of the top manager in the sector where the firm operates tend to have an overall stronger impact on a firm's export intensity of manufacturing goods. The country group differentiation shows that, according to the Tobit's final estimates, the share of workforce with higher education has a positive impact on a firm's share of international sales, in both European (CEECs) and Euro-Asian (CIS) transition economies (and Turkey). Offering formal training programmes to employees turned out to have a positive and significant effect on the export intensity of firms in the CIS sub-sample. Although we have raised the issue of potential endogeneity in this relationship, the robustness checks conducted in above, have shown little evidence of its presence in the model. When interaction terms between technological intensity dummies and human capital measures are introduced to the estimations, the empirical evidence for the two sub-samples of countries becomes mixed.

To check the robustness of the empirical findings, multiple imputation has been employed to fill in the gaps in the dataset due to missing information. The overall estimated results from the imputed models are consistent with those from the non-imputed models with a few exceptions (i.e. the parameter estimate of on-the-job training becomes significant in Tobit model, while the share of educated workforce in Fractional Logit and Poisson models loses its 10% level of statistical significance). Furthermore, the adoption of this approach allowed us to develop an augmented model, which, in addition to the main set of explanatory variables, has included the share of skilled employees, the education level of the top manager, the establishment's technological level compared to its competitors, and other potential determinants of export intensity. From the added set of human capital measures, some supporting empirical evidence is found for the importance of the education level of the top manager on export intensity.

When export market share is used to proxy the international competitiveness of firms, supporting evidence is found for the positive impact of the share of employees with a university degree. In the same vein, the positive parameter on the measure of on-the-job training in the model reveals that having provided formal training programmes tends to exert a positive and statistically significant impact on a firm's export market share. The impact of the share of employees with higher education remains positive and significant when CEECs and CIS are estimated separately, whereas, on-the-job training appears to exert a positive and significant impact only on the CIS sub-sample.

The main conclusions on the impact of human capital endowments on international competitiveness from both macro and micro level empirical analyses will be summarized and synthesised in the next chapter. In addition, the final chapter will identify and discuss the key contributions to knowledge of this research project, its limitations and assess the policy implications of the key findings with particular reference to transition economies.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

Contents

7.1 Introduction

The effect of human capital endowments on enhancing international competitiveness, with special reference to transition economies, has been assessed in this thesis using macro and micro level data. The transformation from centrally planned economies to market economies has resulted in increased openness and fuller integration of these countries into the global economy. The importance of fully participating in international markets for a country's economic development has become part of a growing economic debate. In a rapidly changing globalized economy, maintaining and increasing their international competitiveness is a major challenge for most countries, particularly for developing and transition economies. The overall export performance of these countries has improved significantly since the beginning of transition, indicating an increasing level of competitiveness. This transition and integration process has also involved significant shifts in the composition of exports, with some of these countries having managed to switch their focus from low skill and technology goods to more a sophisticated basket of exports.

Once the rationale for assessing international competitiveness, its impact on the transition process, and the key research questions were established at the start of this thesis, a discussion on the complex and ambiguous nature of international competitiveness has followed. The multidimensional concept of international competitiveness has been elaborated from micro and macro perspectives, and a critical analysis of the main measurement approaches followed by a comprehensive review of empirical studies was presented in this investigation. Human capital endowments as the main dimension of interest were also assessed in light of the theoretical and empirical literature. The key sources of human capital accumulation, with particular focus on education and training, were thoroughly elaborated followed by a discussion of the underlying mechanisms through which human capital influences labour productivity, economic growth and international competitiveness. The pre-estimation stage was further complemented by an extensive review of empirical studies assessing the link between human capital and international competitiveness at different levels of aggregation and across various countries. Once the theoretical framework was developed, various estimation approaches were adopted to address the three key research questions:

1. Do human capital endowments have an impact on the international competitiveness of EU countries, with special reference to transition economies?
2. Do human capital endowments have an impact on the relative importance of technology intensive exports of EU countries, with special reference to transition economies?
3. Do a firm's human capital resources have an impact on its export intensity and export market share in transition economies?

While the key focus of this thesis is placed on European transition economies, in order to be able to compare and contrast the findings; the main sample of ETEs has been further extended by covering an additional 17 European countries and 13 Euro-Asian[127] transition economies. To assess the robustness of our findings, both macro and micro level data extracted from various sources have been employed. Econometric analyses, at both macro and micro levels, were undertaken to assess the consistency of our results and thus allow us to draw a more conclusive inference. To carry out the hypothesis testing various proxy measures of international competiveness and human capital were adopted, augmented by a number of relevant control variables. Particular attention has been paid to choosing and applying appropriate econometric methods, given the sensitivity of the data and other issues faced during the estimations.

The aim of this concluding chapter is to provide a synthesis of the key findings of the research; establish the contribution to knowledge of these findings; examine their policy implications; identify the main limitations of the research and provide recommendations for future research work. The remaining parts of this chapter are organized as follows: section 7.2 summarises and discusses the main findings of the thesis with particular emphasis on the key research questions. Section 7.3 provides a discussion of the main contributions to knowledge of this research project. Section 7.4 develops the main policy implications emerging from this research and suggests a range of human capital based policy interventions to enhance international competitiveness. Section 7.5 points out the main limitations that have arisen while conducting the empirical analyses and provides recommendations for further research in the future.

[127] Including Turkey.

7.2 Empirical findings

To examine whether human capital endowments have an impact on the international competitiveness of EU countries with special reference to selected transition economies, a macro level investigation using both country and industry level panel data for the period 1995-2010 was conducted in Chapter 4. In order to assess the robustness of our results, two proxy measures of international competitiveness were used: export market share and a measure of relative export advantage. The choice of these proxy measures of competiveness was based on their better established theoretical underpinnings and the availability of data. Human capital as the key component of interest in this investigation was proxied by measures of the quantity of education (i.e. education attainment), quality of education, and participation in vocational training. Data on the share of population 15 and over who have attained secondary and tertiary education as their highest level, respectively, provided by Barro and Lee (2014), were used in this empirical analysis. In addition, data on the average years of schooling of the population 15 and over, and students' achievements on internationally comparable tests were employed to complement the initial human capital measures.

The choice of the stock measures for education attainment rather than flow measures stems from their relative superiority in capturing the actual human capital of the labour force. As previously discussed in Chapter 3, school enrolment rates, despite being frequently employed in the research literature, represent the level of schooling and human capital of the future rather than current workforce and, furthermore, they can be distorted by differences in dropout rates, emigration, health, unemployment, and so on. The average student test score measure has been constructed by Hanushek and Woessmann (2009), and although it is not a direct measure of the quality of education of the labour force, to the best of our knowledge, it represents the best proxy measure available. Note that International Adult Literacy surveys have been also introduced in the literature, but that data are limited in terms of both time span and country coverage. Even though the chosen measure represents the test scores of students in mathematics and science, the authors have averaged the data over a period of 40 years in order to better capturethe quality of education of the labour force. Vocational training is another important dimension of human capital development assessed in Chapter 4, though the lack of more detailed information precludes a full investigation. Data on the percentage of employees participating in continuing vocational training (CVT) and training enterprises as a percentage of all enterprises were used in this macro level analysis. The survey was conducted by Eurostat in 1999, 2005, and 2010 and in order to obtain the values in the years between, a linear interpolation approach has been adopted.

The choice of measures for the stock of human capital in this analysis is derived from the human capital theories discussed in Chapter 3. According to the conventional human capital theory, education and on-the-job-training are the key sources of human capital development and investing in these activities will boost labour productivity and employee earnings (Becker, 1964). To empirically test the impact of human capital on international competitiveness, several estimation techniques were adopted, controlling for different sources of potential estimate inconsistency. Among the wide range of approaches employed in this analysis, an instrumental variable method was used to account for potential endogeneity, and various techniques (e.g. fixed effects vector decomposition (FEVD), Hausman and Taylor, and Hsiao's two stage estimators) were employed to estimate the coefficients of the time invariant variables. The empirical evidence obtained from this macro analysis suggests that, in line with theoretical expectations, the level of education attainment exerts a positive and significant impact on the export market share, at both country and industry level, though this effect is not replicated when the relative export advantage index is taken as a measure of international competitiveness.

While both measures of education attainment, i.e. the share of the population with secondary and tertiary education, are found to have a positive and significant impact on the export market share of EU-27, the effect of the latter is relatively stronger. The relative importance of highly educated individuals has been further reinforced by an assessment of the impact of average years of schooling on export market share. For levels up to 10.7 years of schooling, the marginal effect of this variable on export market share turned out negative, while, for higher levels of schooling it exerted a positive impact. The empirical evidence on the importance of vocational training is limited, whereas no supporting evidence is found for the hypothesised positive role of the quality of education. While the importance of the quality dimension of education has been strongly highlighted, particularly in the growth literature, its insignificance in these estimations might be attributed to the limitations of this measure of education quality. As previously discussed, the quality of education was represented by a standardised index of students' test scores. The lack of variation over time has introduced new challenges to the main estimation methodology. In order to be able to assess the importance of this dimension, alternative approaches that allow for time invariant variables had to be adopted (e.g. FEVD, Hausman and Taylor, and Hsiao's two stage estimator), despite the acknowledged limitations of these methods. However, in spite of the different assumptions these approaches make, overall they seem to tell a consistent story.

Since measurement errors are quite common when constructing stock estimate data, in order to assess the accuracy and reliability of our results, comparative analysis using two versions of education attainment data (i.e. an older and an updated version of Barro and Lee's dataset) was conducted. The results obtained for these two datasets differ, highlighting the importance of being particularly cautious when interpreting estimation results. As discussed above, the results obtained from the most recent version of the data suggest that the share of population with higher education has a relatively stronger impact on the export market share of EU-27 compared to the share of population with secondary education. On the other hand, the older version of the data suggests that the share of population who have attained secondary education is the only education based determinant of export market share. Slight differences in the results were also identified when the average years of schooling was used as a proxy for human capital. To be able to compare the empirical findings for transition and non-transition economies, the human capital-international competitiveness nexus was estimated separately for these two sets of countries. In the former group, both the share of population 15 and over who have attained secondary and tertiary education as their highest level of education were found to exert a positive and significant impact, though the effect of secondary education appears to be stronger. The relative importance of the latter might have been due to the potentially low share of high skill and technologically-intensive goods exported by these countries. In the non-transition set of countries, on the other hand, the only education based indictor remaining statistically significant was the share of population with tertiary education, implying that higher levels of education are the only human capital based source of international competeviness in the EU-17. Again, this result is likely to be a reflection of the different levels of economic development and structure of exports of these countries. In line with several strands of research (e.g. Rosenzweig, 1995, 1996 and Acemoglu and Autor, 2012), it was argued that higher levels of education are more likely to boost labour productivity when more advanced activities are to be performed and completed. Furthermore, more skilled and competent individuals are more likely to induce and stimulate innovation activities compared to their counterparts (see Section 3.2.2 for a more detailed discussion on human capital, innovation and productivity). Hence, a higher proportion of highly skilled and qualified individuals are required if countries aim to engage in skill and technology intensive exports.

With the purpose of modelling and testing the relative importance of human capital endowments on technology intensive exports of EU countries (the second research question), an industry level analysis using medium and high technology goods export data for the period 1995-2010 was conducted in Chapter 5. This particular dimension of competiveness has been represented by the share of a country's exports in medium and high technology industries over the exports of EU-28 in the corresponding industries, an export specialization measure (RXA) and an export sophistication index (EXPY). RXA was defined as the ratio of a country's exports of industry k relative to its total exports and to the corresponding exports of EU-28, whereas EXPY represents the sophistication of a country's export basket and, according to Hausmann et al. (2007), it captures the productivity level associated with a country's export portfolio. Constrained by the lack of more disaggregated data, human capital endowments are captured by the education attainment and student test scores (i.e. quality of education) measured at the country level. The results, drawn from the various estimation methods employed, suggest that the share of population who have attained tertiary education exerts a positive impact on the share of medium and high tech exports in the exports of the EU-27, the impact being relatively stronger for the high tech category. This finding further reinforces the importance of highly educated individuals when countries are involved in exporting more technology-intensive manufacturing goods. However, no supporting evidence for this link is found when either transition or non-transition economies are assessed separately or when the export specialization measure (RXA) is used to capture international competitiveness. The latter results might be attributed to some extent to the questionable quality of this competitiveness index per se. As discussed in Chapter 2 and Chapter 4, despite its widespread use, the export specialization or relative export advantage index has been criticised by many researchers on several theoretical and statistical grounds. Its statistical shortcomings were evident in our analysis (such as asymmetric distribution, some very high values, inconsistency and instability), though some of these were overcome and/or accounted for by performing adjustments to correct for non-normality and also estimating the models excluding the (extremely high) outlier observations.

When a more innovative measure of competitiveness was used in the analysis, i.e. the export sophistication index introduced by Hausmann et al. (2007), the results appeared to be inconclusive. The full sample estimates reveal no supporting evidence for the key hypothesis, whereas the separate sample estimations suggest that the share of the population who have attained tertiary education has a positive impact on the export sophistication of non-transition economies only (i.e. EU-17). Again, these particular results might be attributed to the more sophisticated composition of exports in these countries compared to their transition counterparts. No supporting evidence is found for the influence of the quality of education in this analysis, irrespective of the international competiveness measure used.

To provide further insights into the link between human capital and international competiveness, the investigation went one step further by adopting a micro level perspective. Using a micro approach enabled us to delve deeper into this relationship and assess how the human capital of their employees influences a firm's international competitiveness. The link between the two can be more directly observed and examined when firms are used as units of analysis. The aim of this investigation is to answer the third research question: whether human capital resources have an impact on the export intensity and export market share of approximately 16,000 firms in 30 transition economies, with particular focus on European transition countries. The human capital dimension is represented by the share of a firm's employees with a university degree, the provision of on-the-job training programmes by the firm, and the level of education and years of experience of the firm's 'top' manager. The importance of on-the-job training was captured by a dummy variable showing whether or not the firm has provided formal training programmes for its employees. A dummy variable was also used for the education level of the top manager indicating whether or not they have completed a degree in higher education. For comparison purposes and as a robustness check, a labour cost measure, defined as the total cost of labour, including wages, salaries and benefits divided by the total number of employees, was used to proxy human capital in an alternative model specification. Furthermore, to assess the robustness of our results several estimation methods were used and the issue of potential endogeneity and missing values was taken into account. The former issue was addressed by performing various robustness checks and also providing theoretical explanations on why reverse causation is not likely to be present in our analysis. The latter involved conducting additional regression analyses after using multiple imputation to fill in the missing information. Overall, the share of missing observations for the majority of variables used in the estimations is fairly low, though there were some potentially relevant variables that suffered from a higher rate of missingness. In order to be able to model and assess the predictive power of these variables, a multiple imputation approach introduced by Rubin (1987) was employed to fill in the missing observations.

Consistent with the theoretical framework and existing empirical research, the full sample estimates suggest that having a more educated workforce is associated with higher export intensity and export market share of firms in all transition economies. The evidence on the importance of training programmes and year of experience of the top managers was limited. When multiple imputation was adopted to fill in the gaps in the baseline dataset the results appeared to be generally consistent. However, the empirical results from the imputed augmented model revealed some supporting evidence for the role of the education level of the top manager on export intensity. Note that, due to a very high share of missing data, this dimension of human capital was not assessed in the baseline model specification.

To examine the relative importance of human capital endowments on the share of firms' international sales, classification by industry group was introduced into the modelling strategy. The industry level results reveal that highly educated employees have a stronger impact on the export intensity of firms engaged in the services and primary goods sectors compared to manufacturing, though this differences appear to vanish for more technology-intensive goods. As reflected by the interaction terms between industry dummies and education, the relative importance of more educated employees for services and primary goods becomes smaller when compared to more technology-intensive manufacturing goods. A potential explanation for this counterintuitive finding is that the manufacturing firms in this sample are mainly engaged in exporting low and medium-low technology goods where the formal qualifications of the workforce might not be of great importance. In line with theoretical considerations, highly educated employees are likely to be less productive if they are engaged in performing simpler tasks, i.e. producing less skilled and technology intensive goods. On-the-job training programmes and years of experience of the top manager appear to, generally, have stronger influences on firm's international sales in the manufacturing industry compared to firms engaged in services and primary goods. Some supporting evidence[128] is found for the role of highly educated employees on the export intensity and export market share of firms in European and Euro-Asian transition economies, when the two sub-samples are examined separately. It is worth noting that the economic impact of the share of employees with higher education is slightly higher in the former group of countries, though the effect is not very large in magnitude in either set of countries. Firms that offer training programmes to their employees appear to have, on average, higher international sales and export market shares only in Euro-Asian firms, though the economic effect is not very large in magnitude. The years of experience of the top manager are not found to have any economic or statistical impact in any of the country groups.

The overall findings of this research project reveal that, in line with theoretical expectations, human capital endowments appear to exert a positive and significant impact on export market share at both country and industry levels, though this effect is not obtained when the relative export advantage index is used as the measure of international competitiveness. The share of the population who have attained tertiary education turned out to exert a positive impact on the share of medium and high tech manufactures exported by EU-27, the impact being relatively stronger for the high tech category. No supporting evidence is found for the influence of the quality of education, irrespective of the international competiveness measure used. As previously argued, this finding might be attributed to the limitations of the proxy itself, i.e. it measures the performance of current students (up to the age of 15) rather than the quality of education of the workforce. In the export sophistication sub-analysis, the estimated results suggest that the share of population who have attained tertiary education has a positive impact on the export sophistication only of non-transition economies. Consistent with the macro analysis, the firm level estimated results suggest that having a more educated workforce exerts a positive and statistically significant impact on the export intensity and export market share of firms in the 30 transition economies.

[128] While the tobit estimates seem to support the hypothesized link between the two, this was not found to be the case in the alternative estimation approaches.

7.3 Contributions to knowledge

While the concept of international competitiveness per se has been elaborated quite extensively in the literature, its potential determinants have received less significant attention, both at a theoretical and empirical level. The impact of human capital endowments, in particular, has been under-researched, especially at more aggregated levels of investigation. The vast majority of research studies investigating the concept of international competitiveness at the macro level have focused on constructing and developing competitiveness indicators and indices with the purpose of ranking and comparing trends across sectors or countries. Research papers examining the determinants of competitiveness, on the other hand, seem to have usually employed only a limited set of influencing factors. Whilst micro level studies have more frequently assessed the importance of human capital endowments in their analyses, they rarely make any reference to international competitiveness and where they do the choice of measures for the latter is usually very restricted. Hence, through addressing the under-theorised and under-researched link between human capital endowments and international competitiveness, this research project aimed at filling these gaps in the research literature, with particular reference to transition economies.

The contributions of this research range from elaborating the theoretical framework that has informed and guided the empirical investigation, to developing models that explain the impact of human capital endowments on international competitiveness and estimating these models using macro and micro level data. The empirical investigation presented in this thesis makes use of various human capital and international competitiveness measures which allows the drawing of more comprehensive inferences. Initially, the discussion on international competitiveness shed new light on the complexity of defining and measuring this concept by reviewing different measures of competitiveness and examining how these have been assessed in the research literature. In this investigation, the choice of measures was determined based on their theoretical considerations as well as the availability of data. To help establish the basis for the modelling stage, the underlying mechanisms through which human capital endowments are likely to influence the international competitiveness of firms and countries have been elaborated in depth. The main approaches to defining human capital and its measurement approaches have also received great attention in this research project. A review of the most commonly used measures in the literature; their theoretical rationale and the availability of the data have determined the choice of measures for this dimension. Furthermore, this empirical investigation has controlled for a range of potential competitiveness-enhancing factors derived from different macro and micro strands of literature. To highlight the importance of having accurate measures for the variables of interest, a comparative analysis using two versions of education stock data was conducted. The outcome from this particular analysis highlighted the sensitivity of the findings of research studies when stock estimate data are used. Recent research on human capital accumulation has highlighted the importance of focusing on the quality as well as the quantity of education (see Hanushek and Woessmann, 2009); accordingly a measure of the former dimension was also integrated into the regression analysis. No other research study has assessed its potential impact in the field of international competitiveness.

While the main focus of this investigation was placed on European transition economies, the hypothesis testing was expanded by covering additional country groups, i.e. EU-17 and Euro-Asian transition economies (and Turkey). In the firm level analysis, the large cross-country dataset (BEEPS) made available by the World Bank and EBRD, rarely utilized in this area of study, was employed. The extended country coverage has enabled the investigation of the hypothesized differences between each set of countries. Furthermore, in the micro level analysis, the relative importance of human capital endowments for different industries was empirically examined. The human capital dimension was further expanded by including on-the-job training programmes offered by the firm and years of experience of the top manager. In alternative model specifications, the level of education of the top manager and average wages of the employees were also assessed. Note that whilst these potential source of human capital development have been emphasized in the theoretical literature, they have less frequently been examined in the empirical research.

To assess the robustness of the empirical results, a diversified modelling strategy was employed. Furthermore, various estimation approaches to account for potential endogeneity and handle the issue of missing data were adopted. The use of various estimation methods has helped ensure that the findings are consistent and unbiased and hence the inference drawn from these results is more reliable. It is worth noting that very few studies in this field of research have adopted such a wide range of estimation techniques. By providing empirical evidence on the contribution of the key components of human capital on international competitiveness, this investigation can assist policy-makers in designing effective policies that facilitate and promote human capital accumulation and in turn enhance the international competitiveness of this sample of countries. The policy implications derived from this research project and their relationship to the current policy agenda in transition economies will be presented and discussed in the following section.

7.4 Policy implications

The empirical evidence obtained in this investigation has potential useful policy implications for European and Euro-Asian countries seeking to sustain and/or increase their international competitiveness. Since competitiveness enhancement in international markets is a key objective of transition economies, the results presented in this thesis can help the policy-making in these countries with respect to human capital development. The macro level evidence obtained in this investigation suggests that increasing the stock of highly educated individuals has important implications for the enhancement of international competitiveness of the EU-27, as proxied by their export market share. Although, the impact of higher levels of education (i.e. tertiary) remains significant when transition and non-transition economies are assessed separately, its effect in the former set of countries is surpassed by that of secondary education. Given the high and rising share of the population who have attained secondary education in transition countries, promoting and raising post-secondary attainment[129] seems more appropriate as it would assist them in the process of catching-up with their non-transition counterparts. Policy interventions in raising the school leaving age in some developed countries were found to have a positive impact also on post-compulsory education participation (see Meghir and Palme, 2004, and Oreopoulos, 2005). The current school leaving age, in transition economies varies from 14 to 16 years, with the exception of few countries that have made school attendance mandatory up to the age of 18. Government action in this regard would, therefore, be likely to increase not only the share of individuals with secondary education, but also those who complete post-secondary education.

It is worth noting that the empirical findings of this research programme are in accordance with a priori expectations given the current stage of development and the relatively lower levels of export sophistication in these countries. Hence, in policy terms, these countries should also try to

[129] The tertiary level education attainment appears to be, on average, lower in the European transition economies, compared to their non-transition counterparts; although, it has grown rapidly in many of these countries.

focus on changing their current structure of exports to more knowledge and technology-intensive based goods. The lack of evidence on the role of the quality of education and vocational training, on the other hand, makes it more difficult to suggest any policy recommendations, though it can be argued that the absence of clear findings might have been driven to a large extent by the poor quality of data. The need to improve the quality of data and, more generally, quality assurance mechanisms, both internal and external, is part of the current educational policy debates in transition economies, especially in countries that are struggling to achieve higher quality schooling. According to a World Bank report, many of transition countries are still focused on the measurement of inputs into education rather than on the outputs; hence, policy agendas should try to switch that focus into paying more attention to how much students are learning and if their acquired knowledge and skills are meeting the labour market's demands (Murthi and Sondergaard, 2012).

Since the importance of specializing in high skill and technology intensive goods for economic growth has been elaborated extensively in the recent literature (see, Rodrik, 2006, Hausmann et al., 2007, Jarreau and Poncet, 2012, Anand et al., 2012), public policies in these countries should redirect their focus towards high profile skilled individuals. The positive impact of the share of population with tertiary education on the share of medium-high and high technology goods exported by EU-27 emphasizes the relative importance of higher levels of education for these sectors and in turn, suggests specific policy interventions. Policy makers are advised to place more emphasis on promoting higher education attainment in subjects relevant to their profile of exports, particularly if these countries aim at maintaining and enhancing their competitive positions in more technology-intensive goods. Potential interventions might involve expanding the expenditure on more technology-related study programmes rather than on generic ones. This finding might also have implications for attracting highly-qualified employees from other countries, or in the context of transition economies, attracting back students and emigrants who have undertaken higher education abroad. The large and increasing student flows from many European transition economies to more developed countries have also increased the size and costs of the brain drain. According to Adnett (2010), the provision of educational assistance for students (e.g. scholarship programmes) has contributed significantly to this problem, hence, the financial support should be redirected towards domestic higher education institutions rather than student mobility. Encouraging the mobility of high-quality study programmes and institutions, rather than of students, via franchising and other forms of delivery is another potential way of minimising the size of the brain drain (OECD and World Bank, 2007). International emigration rates are relatively high in many transition economies, with a substantial number of the emigrants being highly-skilled workers (EBRD, 2013, Arias et al., 2014). Hence, to prevent the loss of actual and potential highly-qualified workers, policy makers in these countries should place more focus on creating the economic conditions that help retain and/or attract back this group. Transition countries should therefore continue the process of reforming their public sectors and labour markets; foster employment through promoting entrepreneurship as key source of job creation; designing adequate integration programmes for migrants to assist and facilitate their incorporation into labour markets; and improve the business climate to encourage returning emigrants to invest.

The absence of supporting evidence for the role of education attainment of the population on the export sophistication of European transition economies makes it more difficult to give any suggestions on potential policy actions. Above it was argued that this lack of evidence might be due to their generally less sophisticated export baskets; hence, policy interventions that encourage these countries to switch to producing and exporting more sophisticated goods might be recommended. Potential policy actions involve encouraging entrepreneurs to engage in more skilled and technology-based goods via subsidizing their investments in the latter activities, supporting technological transfer and accumulation, and attracting foreign direct investment. Human capital development and "tax-favoured" high technology zones, according to Wang and Wei (2008), turned out to be main contributors to the increasing export sophistication of China. Even though the structure of exports in some transition countries has changed significantly in recent years, greater investment in human capital accumulation might still be warranted to help them catch up with their non-transition counterparts.

The micro level evidence provides further evidence in favour of the key sources of human capital development and their impact on firms' engagement in international markets. As the focus of the analysis was placed strictly on transition economies, both European and Euro-Asian, the main findings aimed to shed new light on how policy makers can intervene to promote international competitiveness in these particular groups of countries. The empirical findings could help design human capital development policies which, in turn, would boost labour productivity and drive the international competitiveness of firms in transition economies. Firms' investments in enhancing their labour productivity through attracting and hiring more skilled and qualified employees can be further supported and facilitated by suitable policy interventions. Implementing policies that encourage and support higher education might have positive implications for firms that aim to enter, remain and increase their export share in international markets. Not only would exporting firms become more productive by hiring more skilled and competent workers, but also raising the supply of tertiary educated individuals would, other things being equal, lower their relative costs and in turn improve the international competitiveness of firms. The absence of robust empirical evidence on the role of on-the-job training programmes and top manager's level of education and years of experience suggests that pursuing policies that focus solely on these dimensions might not be sufficient to improve the international competitiveness of firms. However, it is worth noting that this lack of evidence might be attributed to the lack of more superior measures (e.g. the quality, frequency and duration of training) and the high share of missing data on the level of education of the top manager.

A recent World Bank report on the human capital in transition economies shows that in spite of the relatively high rates of education attainment and satisfactory quality in the early years of schooling, in many of these countries employers have continued to complain about workers lacking suitable skills and competencies (e.g. behavioural skills, socio-emotional skills and similar) (Arias et al., 2014). The system of education and training in these countries appears to be lagging behind in delivering appropriate knowledge and skills in accordance with the market needs (Murthi and Sondergaard, 2012). Hence, the World Bank report emphasizes the need to manage tertiary education expansion by improving the quality assurance system; improving the link between tertiary education curricula and labour market needs; creating stronger harmonization between government, training providers and the business sector; incentivizing firms into offering high-quality on-the-job training programmes for their employees; paying attention to the education and training of the adult labour force, particularly in 'aging countries'; and finally, investing in lifelong learning development (Arias et al., 2014).

It is worth noting that when the industry dimension was accounted for, the role of workforce with a university degree turned out to a have a lower impact on the export intensity of manufacturing firms compared to those operating in services and primary goods sectors. However, as the link between the two appears to vanish when more technology-intensive manufacture goods are observed and estimated, hence again policy actions directed towards supporting technology-related goods are recommended. The key roles of the provision of on-the-job training programmes and top manager's years of experience on export intensity appear to be stronger in the manufacturing sector. Nevertheless, this does not preclude the importance of human capital in raising the export intensity of firms engaged in services. As services are becoming increasingly tradable, fostering this sector should also be part of the policy making agendas in transition economies.

Given that the economic impact of human capital endowments revealed in this investigation is not very large in magnitude in transition economies, policies focusing merely on this source of competitiveness are unlikely to be sufficient; hence they should be complemented by additional complementary, competiveness-enhancing interventions). The latter would include improving the business climate, encouraging entrepreneurship, business start-up, attracting foreign investors promoting R&D and innovation, facilitating technological diffusion, targeting return migrants, and exploiting links with diaspora. Note that the above outlined actions have been the subject of considerable debate amongst researchers and policy-makers. The "behind the border[130]" reforms have been also highlighted as key interventions for transition countries in order to enhance their international competitiveness. Business environment reforms entailing stronger competition, improved governance and increased investment in knowledge, skills and infrastructure are regarded as key requirement to a greater international integration (Mitra, 2008). To induce deeper integration and stronger international competitiveness, Damijan et al. (2008) suggest that transition countries should pay particular attention to their supply capacities, whereas for the less integrated countries (CIS and EU candidate countries), institutional changes, structural reforms and FDI accumulation should be prioritized in their policy agendas.

7.5 Limitations and recommendations for future research

The aim of this section is to highlight the key limitations of this investigation and how these can be addressed in future research work. As previously argued, international competiveness is an

[130] This term refers to "domestic structural and institutional reforms" (Broadman, 2005, p. 57).

ambiguous and multidimensional concept, therefore various measuring approaches have been proposed in the literature with no agreement on which is superior. While, the focus of this analysis has been placed on assessing export-based indicators, exploring other competitiveness indicators is recommended for future research work. Concerning the international competitiveness measures used in our analysis, a key limitation is their static nature. A dynamic proxy measure capturing changes over time rather than the current international competitiveness would be worth assessing in the future.

The scarcity of data on the stock of human capital at the macro level is another shortcoming of our research project. Data on education attainment provided by Barro and Lee (2014) are the most comprehensive available, but are still restricted in terms of the time span (no data are available after 2010) and are constructed at 5-year intervals rather than annually. Furthermore, the actual dataset does not distinguish between different types of education acquired. The lack of such information did not allow to control for qualification mismatch, or potential shortages in high profile professions (e.g. science, engineering) in the sample of countries. Limitations stemming from measurement errors in data when constructing stock estimates should be also noted. Given the lack of more direct information on the quality dimension of education, this investigation has made use of students' achievements in different international tests. At the time of the writing, this is the best available proxy measure, though it covers a limited time span and unchanging nature (i.e. lack of variation over time). The impact of the training dimension at the macro level of investigation has also not been fully assessed and that is principally due to data restrictions.

Due to missing information for the main variable of interest, the macro level analyses was constrained in both time span and country coverage. In terms of the former, data on education were not available in the most recent years (i.e. after 2010), while with regard to country coverage some transition economies had to be excluded from the empirical estimations. Although the potential to overcome these constraints is currently rather limited, this can be listed in the agenda for future work. Another limitation concerning the variables of interest is the lack of disaggregated data at the industry level. In the absence of such data, the research question was addressed using information on human capital measured and reported at more aggregated levels (i.e. country level). Again, such a limitation opens up opportunities for further research once more disaggregated data become available. The main limitation of the micro level analysis, on the other hand, is its cross sectional nature. Note that, recently BEEPS has introduced a longitudinal dataset, but due to the small fraction of participating firms and the short time span, currently only the cross section component is suitable for analysis of the determinants of competitiveness. Apart from the data being collected at a single point in time, which does not allow an assessment of the relationship between human capital and international competitiveness overtime, it also makes it more difficult to control for potential reverse causation. A dataset extension, i.e. a panel covering a larger time span, is required to address this limitation and allow researchers to draw more comprehensive inference from the data. The lack of information on the type and quality of education and on-the-job training is another shortcoming of the micro level analysis. While firms in the sample have reported whether they have offered on-the-job training programmes for their employees, no information on their content/relevance, duration, frequency or quality has been provided. Information on the level of education of the top manager is missing for a large share of firms, whereas there is no measure of the quality of education of the workforce. Although, such information is rarely available in cross country surveys, accounting for these important components, in the future, could provide further insights into the human capital – international competiveness nexus.

8. References

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Appendix - A4

Contents

Table A4.1 Model 1 - Fixed effects estimated results

```
xtreg lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.7141                         Obs per group: min =         5
       between = 0.2692                                        avg =      13.6
       overall = 0.2043                                        max =        16

                                                F(25,314)          =     31.38
corr(u_i, Xb)  = -0.9233                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .2278381   .1265099     1.80   0.073    -.0210761    .4767523
     lntedut |   .5918861   .1272115     4.65   0.000     .3415915    .8421807
     cskills |  (omitted)
   lnpatappr |   .0557272   .0277064     2.01   0.045     .0012136    .1102408
       lnfdi |  -.0042827   .0052079    -0.82   0.412    -.0145294     .005964
      lngdpc |   1.223514   .1357031     9.02   0.000     .9565112    1.490516
       lnpop |  -1.921913   .3773957    -5.09   0.000    -2.664457   -1.179369
        unem |   .0039765   .0008909     4.46   0.000     .0022237    .0057293
   lnecofree |  -.0586927   .1780905    -0.33   0.742    -.4090943    .2917088
      lnrulc |  -.4617832   .1959859    -2.36   0.019    -.8473949   -.0761716
        serv |  -.0070245   .0038653    -1.82   0.070    -.0146297    .0005808
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0036437   .0460969     0.08   0.937    -.0870542    .0943416
    year1997 |  -.0374412   .0471993    -0.79   0.428    -.1303081    .0554257
    year1998 |  -.0658051   .0484716    -1.36   0.176    -.1611753    .0295651
    year1999 |  -.0985383    .051051    -1.93   0.054    -.1989835    .0019069
    year2000 |  -.1153523    .051616    -2.23   0.026    -.2169092   -.0137954
    year2001 |  -.1413013   .0535384    -2.64   0.009    -.2466406    -.035962
    year2002 |  -.1694559   .0571088    -2.97   0.003    -.2818202   -.0570916
    year2003 |  -.1953327   .0600268    -3.25   0.001    -.3134383   -.0772271
    year2004 |  -.2446844   .0630965    -3.88   0.000    -.3688297   -.1205391
    year2005 |   -.258355   .0675741    -3.82   0.000    -.3913103   -.1253997
    year2006 |  -.3265143   .0710035    -4.60   0.000     -.466217   -.1868116
    year2007 |  -.3612019   .0738698    -4.89   0.000    -.5065442   -.2158595
    year2008 |  -.3272289   .0760833    -4.30   0.000    -.4769265   -.1775312
    year2009 |  -.2355773   .0777604    -3.03   0.003    -.3885746   -.0825799
    year2010 |  -.2733546   .0791745    -3.45   0.001    -.4291342   -.1175751
       _cons |   5.727365   4.460174     1.28   0.200    -3.048241    14.50297
-------------+----------------------------------------------------------------
     sigma_u |  3.7994624
     sigma_e |  .12173099
         rho |  .99897455   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(26, 314) =    54.68             Prob > F = 0.0000
```

Table A4.1.1 Model 1 - Random effects estimated results

```
xtreg lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, re

Random-effects GLS regression                   Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.6589                         Obs per group: min =         5
       between = 0.9505                                        avg =      13.6
       overall = 0.9396                                        max =        16

                                                Wald chi2(28)      =   1280.84
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .3441857   .1295316     2.66   0.008     .0903083     .598063
     lntedut |   .3270771   .1184489     2.76   0.006     .0949216    .5592326
     cskills |   .3950799    .395629     1.00   0.318    -.3803387    1.170499
   lnpatappr |   .0749434   .0291072     2.57   0.010     .0178943    .1319925
       lnfdi |  -.0113765   .0056464    -2.01   0.044    -.0224432   -.0003097
      lngdpc |   1.606786    .112462    14.29   0.000     1.386364    1.827208
       lnpop |   .8760211   .0619248    14.15   0.000     .7546507    .9973915
        unem |   .0053651   .0009695     5.53   0.000      .003465    .0072653
   lnecofree |    .276913   .1905637     1.45   0.146    -.0965849    .6504109
      lnrulc |   -.527893   .2156944    -2.45   0.014    -.9506462   -.1051398
        serv |  -.0110863    .004056    -2.73   0.006    -.0190359   -.0031368
        dist |  -.0002422   .0001267    -1.91   0.056    -.0004905    6.01e-06
  transdummy |   1.204635   .2045135     5.89   0.000     .8037962    1.605475
    year1996 |   .0325913   .0513396     0.63   0.526    -.0680325    .1332152
    year1997 |  -.0201704   .0524968    -0.38   0.701    -.1230622    .0827214
    year1998 |  -.0426018   .0536586    -0.79   0.427    -.1477708    .0625672
    year1999 |  -.0828063   .0560612    -1.48   0.140    -.1926842    .0270716
    year2000 |  -.1178102    .056196    -2.10   0.036    -.2279524   -.0076679
    year2001 |  -.1606278   .0578137    -2.78   0.005    -.2739406    -.047315
    year2002 |  -.1963685   .0611303    -3.21   0.001    -.3161816   -.0765553
    year2003 |  -.2249339   .0639232    -3.52   0.000     -.350221   -.0996467
    year2004 |  -.2987946   .0661558    -4.52   0.000    -.4284576   -.1691316
    year2005 |  -.3293725   .0698847    -4.71   0.000     -.466344   -.1924011
    year2006 |  -.4220311   .0723107    -5.84   0.000    -.5637575   -.2803048
    year2007 |  -.4697669   .0743196    -6.32   0.000    -.6154306   -.3241031
    year2008 |  -.4370662   .0762374    -5.73   0.000    -.5864888   -.2876436
    year2009 |  -.2971298   .0798667    -3.72   0.000    -.4536655    -.140594
    year2010 |  -.3507957   .0807714    -4.34   0.000    -.5091047   -.1924867
       _cons |  -26.29119   2.592463   -10.14   0.000    -31.37232   -21.21005
-------------+----------------------------------------------------------------
     sigma_u |  .27328966
     sigma_e |  .12173099
         rho |  .83444141   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Table A4.1.2 Model 1 - Fixed effects versus Random effects

```
hausman FE RE, sigmamore
Note: the rank of the differenced variance matrix (17) does not equal the number of
coefficients being tested (25); be sure
         this is what you expect, or there may be problems computing the test.  Examine
the output of your estimators for
```

```
        anything unexpected and possibly consider scaling your variables so that the
coefficients are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
     lnsedut |    .2278381     .3441857       -.1163476        .0568188
     lntedut |    .5918861     .3270771         .264809        .0787351
   lnpatappr |    .0557272     .0749434       -.0192162        .0106003
       lnfdi |   -.0042827    -.0113765        .0070938        .0014219
      lngdpc |    1.223514     1.606786       -.3832724        .1018454
       lnpop |   -1.921913     .8760211       -2.797934        .4173818
        unem |    .0039765     .0053651       -.0013886        .0002285
   lnecofree |   -.0586927      .276913       -.3356057         .057728
      lnrulc |   -.4617832     -.527893        .0661097        .0386154
        serv |   -.0070245    -.0110863        .0040619         .001492
    year1996 |    .0036437     .0325913       -.0289477        .0045296
    year1997 |   -.0374412    -.0201704       -.0172708        .0053786
    year1998 |   -.0658051    -.0426018       -.0232034        .0075995
    year1999 |   -.0985383    -.0828063        -.015732        .0107256
    year2000 |   -.1153523    -.1178102        .0024579        .0131305
    year2001 |   -.1413013    -.1606278        .0193265        .0155138
    year2002 |   -.1694559    -.1963685        .0269126        .0184401
    year2003 |   -.1953327    -.2249339        .0296012        .0204462
    year2004 |   -.2446844    -.2987946        .0541102        .0244966
    year2005 |    -.258355    -.3293725        .0710176         .028709
    year2006 |   -.3265143    -.4220311        .0955169        .0327614
    year2007 |   -.3612019    -.4697669         .108565        .0360254
    year2008 |   -.3272289    -.4370662        .1098373        .0377362
    year2009 |   -.2355773    -.2971298        .0615525        .0343512
    year2010 |   -.2733546    -.3507957        .0774411        .0362226
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(17) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       81.69
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table A4.1.3 Model 1- Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (27)  =    1583.88
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
   F(  1,      26) =     62.329
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 66.572906
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 3.372e-16
LM5= 8.1592221
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 2.220e-16

Test for significance of fixed effects
F= 54.684067
Probability>F= 1.84e-100
Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                         ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |    366      0.0001         0.0000        58.08         0.0000
```

Table A4.1.4 Model 1 - Driscoll-Kraay estimated results

```
xtscc lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       366
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 28,     26)    = 158584.82
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7141


------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .2278381   .1088336     2.09   0.046     .0041274    .4515488
     lntedut |   .5918861   .1166649     5.07   0.000      .352078    .8316942
     cskills |  (omitted)
   lnpatappr |   .0557272   .0254298     2.19   0.038     .0034554     .107999
       lnfdi |  -.0042827   .0046884    -0.91   0.369    -.0139198    .0053544
      lngdpc |   1.223514   .1221395    10.02   0.000     .9724522    1.474575
       lnpop |  -1.921913   .1450437   -13.25   0.000    -2.220055   -1.623771
        unem |   .0039765    .001135     3.50   0.002     .0016436    .0063094
   lnecofree |  -.0586927   .1618869    -0.36   0.720    -.3914559    .2740705
      lnrulc |  -.4617832   .2744321    -1.68   0.104    -1.025886    .1023199
        serv |  -.0070245    .005997    -1.17   0.252    -.0193515    .0053026
        dist |     .00553   .0021728     2.55   0.017     .0010638    .0099961
  transdummy |  (omitted)
    year1996 |   .0036437   .0166121     0.22   0.828    -.0305029    .0377902
    year1997 |  -.0374412   .0145314    -2.58   0.016     -.067311   -.0075714
    year1998 |  -.0658051   .0217187    -3.03   0.005    -.1104486   -.0211617
    year1999 |  -.0985383   .0280971    -3.51   0.002    -.1562928   -.0407838
    year2000 |  -.1153523   .0295056    -3.91   0.001     -.176002   -.0547026
    year2001 |  -.1413013   .0330164    -4.28   0.000    -.2091675   -.0734351
    year2002 |  -.1694559   .0380976    -4.45   0.000    -.2477667   -.0911451
```

```
    year2003 |  -.1953327   .0432281    -4.52   0.000    -.2841894    -.106476
    year2004 |  -.2446844   .0473835    -5.16   0.000    -.3420825   -.1472863
    year2005 |   -.258355   .0525528    -4.92   0.000    -.3663789   -.1503311
    year2006 |  -.3265143   .0596868    -5.47   0.000    -.4492023   -.2038263
    year2007 |  -.3612019   .0633378    -5.70   0.000    -.4913946   -.2310091
    year2008 |  -.3272289   .0647013    -5.06   0.000    -.4602244   -.1942333
    year2009 |  -.2355773    .063774    -3.69   0.001    -.3666665    -.104488
    year2010 |  -.2733546   .0681064    -4.01   0.000    -.4133493   -.1333599
       _cons |  (omitted)
```

Table A4.1.4.1 Model 1 - Driscoll-Kraay estimated results

```
xtscc lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy emplcvt year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010 if year>=1999, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       261
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 25,     26)    =  17330.34
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7693

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.0001417   .1212394    -0.00   0.999    -.2493529    .2490694
     lntedut |   .4874158   .1448727     3.36   0.002     .1896257    .7852058
     cskills |  (omitted)
   lnpatappr |   .0675709   .0246628     2.74   0.011     .0168758     .118266
       lnfdi |  -.0042138   .0042458    -0.99   0.330    -.0129412    .0045135
      lngdpc |   1.052187   .1547232     6.80   0.000     .7341488    1.370225
       lnpop |  -2.505562   .4119352    -6.08   0.000    -3.352307   -1.658817
        unem |    .000228   .0005474     0.42   0.680    -.0008973    .0013533
   lnecofree |  -.2121704     .09718    -2.18   0.038    -.4119267   -.0124141
      lnrulc |  -.7199074   .3481213    -2.07   0.049    -1.435481   -.0043338
        serv |  -.0090782   .0098606    -0.92   0.366    -.0293471    .0111906
        dist |    .014422   .0040647     3.55   0.002     .0060669    .0227771
  transdummy |  (omitted)
     emplcvt |   .0054245   .0017876     3.03   0.005     .0017501     .009099
    year2000 |  -.0104548    .008113    -1.29   0.209    -.0271314    .0062218
    year2001 |  -.0213074   .0119484    -1.78   0.086    -.0458678    .0032529
    year2002 |  -.0339452   .0243696    -1.39   0.175    -.0840377    .0161473
    year2003 |   -.042481   .0304751    -1.39   0.175    -.1051233    .0201614
    year2004 |  -.0814902   .0386084    -2.11   0.045    -.1608509   -.0021295
    year2005 |  -.0888033    .047552    -1.87   0.073    -.1865479    .0089414
    year2006 |  -.1498734   .0571763    -2.62   0.014    -.2674009   -.0323459
    year2007 |  -.1877568   .0613344    -3.06   0.005    -.3138314   -.0616822
    year2008 |   -.165777   .0633924    -2.62   0.015     -.296082   -.0354719
    year2009 |  -.0989989   .0650548    -1.52   0.140     -.232721    .0347232
    year2010 |  -.1085966    .068193    -1.59   0.123    -.2487694    .0315762
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.1.4.2 Model 1 - Driscoll-Kraay estimated results

```
xtscc lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy trngent year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       271
Method: Fixed-effects regression                 Number of groups  =        27
```

```
Group variable (i): country                         F( 25,     26)     =  54935.03
maximum lag: 2                                      Prob > F           =    0.0000
                                                    within R-squared   =    0.7652

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.0226812   .1197222    -0.19   0.851    -.2687738    .2234114
     lntedut |   .4869711   .1511451     3.22   0.003      .176288    .7976542
     cskills |  (omitted)
   lnpatappr |   .0771079   .0199564     3.86   0.001     .0360869    .1181289
       lnfdi |  -.0001828   .0037157    -0.05   0.961    -.0078205     .007455
      lngdpc |   1.205036   .1556221     7.74   0.000       .88515    1.524922
       lnpop |   -2.54841   .4470838    -5.70   0.000    -3.467403   -1.629416
        unem |   .0003372   .0005965     0.57   0.577     -.000889    .0015634
   lnecofree |  -.3083823   .0922264    -3.34   0.003    -.4979563   -.1188083
      lnrulc |  -.9417257    .434806    -2.17   0.040    -1.835482   -.0479693
        serv |  -.0110808   .0108595    -1.02   0.317    -.0334028    .0112412
        dist |   .0156204   .0046311     3.37   0.002     .0061011    .0251397
  transdummy |  (omitted)
     trngent |   .0037935   .0009122     4.16   0.000     .0019185    .0056685
    year2000 |  -.0322841   .0090107    -3.58   0.001    -.0508058   -.0137624
    year2001 |  -.0405786   .0153211    -2.65   0.014    -.0720715   -.0090858
    year2002 |  -.0511925   .0236809    -2.16   0.040    -.0998693   -.0025157
    year2003 |  -.0658759   .0305714    -2.15   0.041    -.1287163   -.0030356
    year2004 |  -.1094283   .0374161    -2.92   0.007    -.1863382   -.0325184
    year2005 |  -.1281449   .0467443    -2.74   0.011    -.2242291   -.0320607
    year2006 |  -.1935653   .0584784    -3.31   0.003    -.3137693   -.0733612
    year2007 |  -.2361966   .0631359    -3.74   0.001    -.3659742   -.1064189
    year2008 |  -.2072109   .0637127    -3.25   0.003    -.3381742   -.0762476
    year2009 |  -.1161116   .0646503    -1.80   0.084    -.2490022     .016779
    year2010 |  -.1339737   .0715373    -1.87   0.072    -.2810207    .0130733
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.1.5 Model 1 - FEVD estimated results (STATA ado file)

```
 xtfevd lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant (cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd     =       311            number of obs        =       366
mean squared error          = .0127131             F( 30, 311)          = 3.860252
root mean squared error     = .1127523             Prob > F             = 1.84e-09
Residual Sum of Squares     = 4.652988             R-squared            = .9945998
Total Sum of Squares        = 861.6282             adj. R-squared       = .9936621
Estimation Sum of Squares   = 856.9752

------------------------------------------------------------------------------
             |                fevd
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |    .227838     7.1843     0.03   0.975    -13.90814    14.36382
     lntedut |   .5918861   6.513698     0.09   0.928     -12.2246    13.40838
   lnpatappr |   .0557272   1.449755     0.04   0.969    -2.796841    2.908295
       lnfdi |  -.0042827   .1037668    -0.04   0.967    -.2084564     .199891
      lngdpc |   1.223514   10.12053     0.12   0.904    -18.68985    21.13688
       lnpop |  -1.921913   3.697784    -0.52   0.604    -9.197751    5.353926
```

```
        unem |   .0039765   .0209349     0.19   0.849    -.0372154    .0451684
   lnecofree |  -.0586931   6.536864    -0.01   0.993    -12.92077    12.80338
     lnrulc |  -.4617832   4.341907    -0.11   0.915    -9.005011    8.081444
        serv |  -.0070245   .1210407    -0.06   0.954    -.2451866    .2311377
    year1996 |   .0036437   .9742373     0.00   0.997    -1.913286    1.920574
    year1997 |  -.0374412   1.368525    -0.03   0.978     -2.73018    2.655297
    year1998 |  -.0658051   1.511183    -0.04   0.965    -3.039241    2.907631
    year1999 |  -.0985383    1.54311    -0.06   0.949    -3.134794    2.937718
    year2000 |  -.1153523   1.621689    -0.07   0.943    -3.306223    3.075518
    year2001 |  -.1413013   1.814489    -0.08   0.938    -3.711529    3.428926
    year2002 |  -.1694559    1.95121    -0.09   0.931    -4.008699    3.669787
    year2003 |  -.1953327   2.230428    -0.09   0.930    -4.583969    4.193304
    year2004 |  -.2446844   2.291952    -0.11   0.915    -4.754377    4.265008
    year2005 |   -.258355   2.506411    -0.10   0.918    -5.190022    4.673312
    year2006 |  -.3265143   2.427469    -0.13   0.893    -5.102853    4.449824
    year2007 |  -.3612018    2.86382    -0.13   0.900    -5.996115    5.273712
    year2008 |  -.3272288   2.945501    -0.11   0.912    -6.122859    5.468401
    year2009 |  -.2355773    2.74702    -0.09   0.932    -5.640672    5.169518
    year2010 |  -.2733546    2.72262    -0.10   0.920    -5.630439     5.08373
     cskills |   .4322903   5.456129     0.08   0.937     -10.3033    11.16789
        dist |  -.0011707   .0043279    -0.27   0.787    -.0096863     .007345
  transdummy |  -.7400727   13.40416    -0.06   0.956    -27.11439    25.63425
         eta |   .9999999          .        .       .            .           .
       _cons |   5.095233   113.8573     0.04   0.964    -218.9328    229.1233
```

Table A4.1.5.1 Model 1- FEVD estimated results (three stage procedure)

```
regress lnemsh lnsedut lntedut cskills  lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy res1 year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010

      Source |       SS       df       MS              Number of obs =     366
-------------+------------------------------           F( 29,   336) = 2118.71
       Model |     856.942    29  29.5497241           Prob > F      =  0.0000
    Residual |  4.68619351   336  .013947004           R-squared     =  0.9946
-------------+------------------------------           Adj R-squared =  0.9941
       Total |  861.628194   365  2.36062519           Root MSE      =   .1181


------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .2071703   .0436335     4.75   0.000     .1213411    .2929995
     lntedut |   .5554104   .0306641    18.11   0.000     .4950926    .6157281
     cskills |   .3878305   .0514466     7.54   0.000     .2866325    .4890285
   lnpatappr |   .0736929   .0104674     7.04   0.000     .0531031    .0942828
       lnfdi |  -.0030968   .0043417    -0.71   0.476    -.0116373    .0054436
      lngdpc |    1.25244   .0345189    36.28   0.000      1.18454    1.320341
       lnpop |   -1.85638   .0683355   -27.17   0.000    -1.990799   -1.721961
        unem |   .0035821   .0006194     5.78   0.000     .0023636    .0048006
   lnecofree |  -.0318772   .0872249    -0.37   0.715    -.2034529    .1396986
      lnrulc |  -.4294586   .1540345    -2.79   0.006    -.7324521   -.1264652
        serv |  -.0105273   .0013637    -7.72   0.000    -.0132098   -.0078447
        dist |  -.0011424   .0000251   -45.44   0.000    -.0011919   -.0010929
  transdummy |  -.6593765   .0554173   -11.90   0.000    -.7683849    -.550368
        res1 |   .9980148   .0256981    38.84   0.000     .9474653    1.048564
    year1996 |    .011923   .0435878     0.27   0.785    -.0738163    .0976622
    year1997 |  -.0291207   .0441826    -0.66   0.510      -.11603    .0577887
    year1998 |  -.0544739   .0439682    -1.24   0.216    -.1409615    .0320137
    year1999 |  -.0832359   .0441412    -1.89   0.060    -.1700638    .0035921
    year2000 |  -.1022648   .0434881    -2.35   0.019    -.1878081   -.0167215
    year2001 |  -.1278523   .0440573    -2.90   0.004    -.2145151   -.0411894
    year2002 |  -.1532446   .0450221    -3.40   0.001    -.2418053   -.0646839
    year2003 |  -.1753686   .0455765    -3.85   0.000    -.2650198   -.0857174
```

```
    year2004 |  -.2249091   .0460832    -4.88   0.000     -.315557   -.1342612
    year2005 |   -.237147   .0467276    -5.08   0.000    -.3290625   -.1452316
    year2006 |  -.3066745   .0477151    -6.43   0.000    -.4005324   -.2128166
    year2007 |  -.3432312   .0479909    -7.15   0.000    -.4376315   -.2488308
    year2008 |  -.3119111   .0479121    -6.51   0.000    -.4061566   -.2176656
    year2009 |  -.2138779   .0485361    -4.41   0.000    -.3093509   -.1184049
    year2010 |  -.2490618   .0486258    -5.12   0.000    -.3447111   -.1534124
       _cons |   4.407886   1.116067     3.95   0.000     2.212528    6.603245
------------------------------------------------------------------------------------
```

Table A4.1.6 Model 1 - Hausman and Taylor estimated results

```
xthtaylor lnemsh lnsedut lntedut cskills lnpatappr  lnfdi lngdpc  lnpop unem  dist
lnecofree lnrulc serv transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
endog (lnsedut lntedut cskills)

Hausman-Taylor estimation                       Number of obs      =       366
Group variable: country                         Number of groups   =        27

                                                Obs per group: min =         5
                                                               avg =      13.6
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    786.95
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.       z     P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |   .0631056    .027384     2.30   0.021     .0094338    .1167773
       lnfdi |  -.0065782   .0051293    -1.28   0.200    -.0166314    .0034749
      lngdpc |   1.385903   .1283267    10.80   0.000     1.134387    1.637418
       lnpop |  -1.105387   .3164936    -3.49   0.000    -1.725703    -.485071
        unem |   .0042882   .0008794     4.88   0.000     .0025646    .0060117
   lnecofree |  -.0074174   .1759922    -0.04   0.966    -.3523558    .3375211
      lnrulc |  -.4952554   .1939962    -2.55   0.011     -.875481   -.1150299
        serv |  -.0073103   .0038279    -1.91   0.056    -.0148129    .0001922
    year1996 |   .0076572   .0456625     0.17   0.867    -.0818397    .0971541
    year1997 |  -.0385679   .0467632    -0.82   0.410    -.1302221    .0530863
    year1998 |  -.0675467   .0480213    -1.41   0.160    -.1616666    .0265732
    year1999 |  -.1057184   .0505448    -2.09   0.036    -.2047844   -.0066525
    year2000 |  -.1293869   .0510169    -2.54   0.011    -.2293782   -.0293956
    year2001 |  -.1606703   .0528233    -3.04   0.002    -.2642021   -.0571384
    year2002 |  -.1930174   .0562756    -3.43   0.001    -.3033155   -.0827194
    year2003 |  -.2213432   .0591173    -3.74   0.000    -.3372111   -.1054754
    year2004 |  -.2796166   .0619099    -4.52   0.000    -.4009578   -.1582754
    year2005 |  -.3007994   .0661188    -4.55   0.000    -.4303899    -.171209
    year2006 |  -.3777091   .0692003    -5.46   0.000    -.5133391    -.242079
    year2007 |  -.4184051   .0718101    -5.83   0.000    -.5591503     -.27766
    year2008 |  -.3856482   .0739841    -5.21   0.000    -.5306544    -.240642
    year2009 |  -.2787041   .0762871    -3.65   0.000     -.428224   -.1291842
    year2010 |   -.321286   .0775318    -4.14   0.000    -.4732455   -.1693265
TVendogenous |
     lnsedut |    .291828   .1243184     2.35   0.019     .0481684    .5354876
     lntedut |   .5139196   .1245018     4.13   0.000     .2699006    .7579385
TIexogenous  |
        dist |  -.0013921   .0014657    -0.95   0.342    -.0042648    .0014807
  transdummy |   .2096076   1.600302     0.13   0.896    -2.926926    3.346142
TIendogenous |
     cskills |   -.085789   5.220704    -0.02   0.987    -10.31818     10.1466
```

```
             |
       _cons |  -1.573235   26.79117    -0.06   0.953    -54.08297     50.9365
-------------+----------------------------------------------------------------
     sigma_u |  3.6341621
     sigma_e |  .11715643
         rho |  .99896182   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A4.1.6.1 Model 1 - Fixed effects versus Hausman and Taylor

```
hausman FE HT
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           HT         Difference          S.E.
-------------+----------------------------------------------------------------
     lnsedut |    .2278381      .291828       -.0639899        .0234452
     lntedut |    .5918861     .5139196        .0779665        .0261165
   lnpatappr |    .0557272     .0631056       -.0073784        .0042138
       lnfdi |   -.0042827    -.0065782        .0022955        .0009015
      lngdpc |    1.223514     1.385903        -.162389        .0441316
       lnpop |   -1.921913    -1.105387       -.8165259        .2055707
        unem |    .0039765     .0042882       -.0003117        .0001427
   lnecofree |   -.0586927    -.0074174       -.0512753        .0272572
      lnrulc |   -.4617832    -.4952554        .0334722        .0278561
        serv |   -.0070245    -.0073103        .0002859        .0005367
    year1996 |    .0036437     .0076572       -.0040135        .0063136
    year1997 |   -.0374412    -.0385679        .0011267        .0064015
    year1998 |   -.0658051    -.0675467        .0017416        .0065921
    year1999 |   -.0985383    -.1057184        .0071801        .0071711
    year2000 |   -.1153523    -.1293869        .0140346         .007841
    year2001 |   -.1413013    -.1606703        .0193689        .0087208
    year2002 |   -.1694559    -.1930174        .0235615        .0097198
    year2003 |   -.1953327    -.2213432        .0260106        .0104095
    year2004 |   -.2446844    -.2796166        .0349322        .0121789
    year2005 |    -.258355    -.3007994        .0424445        .0139487
    year2006 |   -.3265143    -.3777091        .0511948        .0159002
    year2007 |   -.3612019    -.4184051        .0572033        .0173222
    year2008 |   -.3272289    -.3856482        .0584194         .017749
    year2009 |   -.2355773    -.2787041        .0431268        .0150654
    year2010 |   -.2733546     -.321286        .0479314        .0160443
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xthtaylor

    Test:  Ho:  difference in coefficients not systematic

                  chi2(25) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                           =       15.80
                Prob>chi2 =      0.9206
```

Table A4.1.7 Model 1 - Hsiao 2 step procedure

Step 1

```
xtreg lnemsh lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
```

```
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.7141                         Obs per group: min =         5
       between = 0.2692                                        avg =      13.6
       overall = 0.2043                                        max =        16

                                                F(25,314)          =     31.38
corr(u_i, Xb)  = -0.9233                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .2278381   .1265099     1.80   0.073    -.0210761    .4767523
     lntedut |   .5918861   .1272115     4.65   0.000     .3415915    .8421807
     cskills |  (omitted)
   lnpatappr |   .0557272   .0277064     2.01   0.045     .0012136    .1102408
       lnfdi |  -.0042827   .0052079    -0.82   0.412    -.0145294     .005964
      lngdpc |   1.223514   .1357031     9.02   0.000     .9565112    1.490516
       lnpop |  -1.921913   .3773957    -5.09   0.000    -2.664457   -1.179369
        unem |   .0039765   .0008909     4.46   0.000     .0022237    .0057293
   lnecofree |  -.0586927   .1780905    -0.33   0.742    -.4090943    .2917088
      lnrulc |  -.4617832   .1959859    -2.36   0.019    -.8473949   -.0761716
        serv |  -.0070245   .0038653    -1.82   0.070    -.0146297    .0005808
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0036437   .0460969     0.08   0.937    -.0870542    .0943416
    year1997 |  -.0374412   .0471993    -0.79   0.428    -.1303081    .0554257
    year1998 |  -.0658051   .0484716    -1.36   0.176    -.1611753    .0295651
    year1999 |  -.0985383    .051051    -1.93   0.054    -.1989835    .0019069
    year2000 |  -.1153523    .051616    -2.23   0.026    -.2169092   -.0137954
    year2001 |  -.1413013   .0535384    -2.64   0.009    -.2466406    -.035962
    year2002 |  -.1694559   .0571088    -2.97   0.003    -.2818202   -.0570916
    year2003 |  -.1953327   .0600268    -3.25   0.001    -.3134383   -.0772271
    year2004 |  -.2446844   .0630965    -3.88   0.000    -.3688297   -.1205391
    year2005 |   -.258355   .0675741    -3.82   0.000    -.3913103   -.1253997
    year2006 |  -.3265143   .0710035    -4.60   0.000     -.466217   -.1868116
    year2007 |  -.3612019   .0738698    -4.89   0.000    -.5065442   -.2158595
    year2008 |  -.3272289   .0760833    -4.30   0.000    -.4769265   -.1775312
    year2009 |  -.2355773   .0777604    -3.03   0.003    -.3885746   -.0825799
    year2010 |  -.2733546   .0791745    -3.45   0.001    -.4291342   -.1175751
       _cons |   5.727365   4.460174     1.28   0.200    -3.048241    14.50297
-------------+----------------------------------------------------------------
     sigma_u |  3.7994624
     sigma_e |  .12173099
         rho |  .99897455   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(26, 314) =    54.68             Prob > F = 0.0000
```

Step 2.

```
. xtreg residfe cskills dist transdummy, be
Between regression (regression on group means)  Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  =      .                         Obs per group: min =         5
       between = 0.1082                                        avg =      13.6
       overall = 0.0606                                        max =        16

                                                F(3,23)            =      0.93
sd(u_i + avg(e_i.))=    3.8149                  Prob > F           =    0.4421

------------------------------------------------------------------------------
     residfe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
     cskills |   .1157208   4.721369     0.02   0.981    -9.651175    9.882616
        dist |  -.0018337   .0014197    -1.29   0.209    -.0047707    .0011032
  transdummy |  -.3347728   1.594482    -0.21   0.836    -3.633209    2.963664
       _cons |   1.520285   23.93124     0.06   0.950    -47.98525    51.02582
------------------------------------------------------------------------------------
```

Table A4.1.8 Model 1 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi  = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1), fe endog (lnsedut lntedut
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        27                   Obs per group: min =          3
                                                              avg =       12.9
                                                              max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      349
                                                      F( 24,   298) =    20.26
                                                      Prob > F      =   0.0000
Total (centered) SS     =  14.63220443                Centered R2   =   0.7260
Total (uncentered) SS   =  14.63220443                Uncentered R2 =   0.7260
Residual SS             =  4.009426721                Root MSE      =     .116

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .3424256   .1872516     1.83   0.068    -.0260774    .7109286
     lntedut |   .6733095   .2179679     3.09   0.002     .2443581    1.102261
   lnpatappr |   .0610218   .0532667     1.15   0.253    -.0438048    .1658485
       lnfdi |  -.0059936   .0059154    -1.01   0.312    -.0176348    .0056476
      lngdpc |   1.197576   .1997254     6.00   0.000     .8045254    1.590627
       lnpop |  -2.016415   .5715912    -3.53   0.000    -3.141281    -.891548
        unem |   .0032295   .0015005     2.15   0.032     .0002766    .0061823
   lnecofree |   -.247174   .2410619    -1.03   0.306    -.7215733    .2272253
        serv |  -.0072541   .0088983    -0.82   0.416    -.0247656    .0102574
      lnrulc |  -.5650038    .320498    -1.76   0.079     -1.19573    .0657222
    year1996 |   .0413185   .0413735     1.00   0.319    -.0401028    .1227398
    year1998 |  -.0275463    .028259    -0.97   0.330    -.0831588    .0280663
    year1999 |  -.0637151   .0368149    -1.73   0.085    -.1361653     .008735
    year2000 |  -.0807552   .0452444    -1.78   0.075    -.1697942    .0082837
    year2001 |  -.1060222   .0474109    -2.24   0.026    -.1993249   -.0127195
    year2002 |  -.1346071   .0528127    -2.55   0.011    -.2385403    -.030674
    year2003 |  -.1565867    .055701    -2.81   0.005    -.2662039   -.0469695
    year2004 |  -.2146719   .0619406    -3.47   0.001    -.3365683   -.0927756
    year2005 |  -.2315709   .0666623    -3.47   0.001    -.3627594   -.1003824
    year2006 |  -.2965732   .0712968    -4.16   0.000    -.4368822   -.1562643
```

```
    year2007 |  -.3355562     .07638    -4.39   0.000    -.4858688   -.1852436
    year2008 |  -.3020992   .0833971    -3.62   0.000     -.466221   -.1379774
    year2009 |  -.2113287   .0943561    -2.24   0.026    -.3970174   -.0256401
    year2010 |  -.2487715   .0924033    -2.69   0.007    -.4306171   -.0669258
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             15.718
                                                   Chi-sq(1) P-val =    0.0001
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               63.507
                         (Kleibergen-Paap rk Wald F statistic):         15.880
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               5.551
                                                   Chi-sq(4) P-val =    0.2353
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A4.1.8.1 Model 1 - IV estimated results (ETEs)

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindN year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi  = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        10                    Obs per group: min =         7
                                                               avg =      13.4
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      134
                                                      F( 25,    99) =    46.34
                                                      Prob > F      =   0.0000
Total (centered) SS     =  12.71853745                Centered R2   =   0.8988
Total (uncentered) SS   =  12.71853745                Uncentered R2 =   0.8988
Residual SS             =  1.286640963                Root MSE      =     .114

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
     lnsedut |   1.164194   .4304078     2.70   0.008     .3101716    2.018216
     lntedut |   .5152809   .2828284     1.82   0.071    -.0459121    1.076474
   lnpatappr |   .1603175   .1053727     1.52   0.131    -.0487648    .3693998
       lnfdi |   .0553047   .0830858     0.67   0.507    -.1095555    .2201649
      lngdpc |   .9404404   .2837797     3.31   0.001       .37736    1.503521
       lnpop |    5.42684   1.669529     3.25   0.002     2.114132    8.739547
        unem |  -.0030287   .0020472    -1.48   0.142    -.0070909    .0010334
   lnecofree |  -.9639629   .3522358    -2.74   0.007    -1.662875   -.2650505
        serv |   .0167495   .0114201     1.47   0.146    -.0059104    .0394095
      lnrulc |  -.7353934   .4065713    -1.81   0.074    -1.542119    .0713324
   transindN |   .2737753   .4697199     0.58   0.561    -.6582508    1.205801
    year1996 |    -.003413   .0596975    -0.06   0.955    -.1218658    .1150397
    year1998 |  -.0003758    .054672    -0.01   0.995    -.1088569    .1081053
    year1999 |  -.1015828     .08178    -1.24   0.217    -.2638521    .0606865
    year2000 |  -.0531393    .094359    -0.56   0.575    -.2403681    .1340894
    year2001 |  -.0324937   .1117421    -0.29   0.772    -.2542142    .1892268
    year2002 |  -.0731176   .1579314    -0.46   0.644    -.3864878    .2402525
    year2003 |  -.0527558   .1686321    -0.31   0.755    -.3873585    .2818469
    year2004 |  -.0422034   .1970161    -0.21   0.831     -.433126    .3487193
    year2005 |   -.018774    .216989    -0.09   0.931    -.4493273    .4117793
    year2006 |  -.0391536   .2364381    -0.17   0.869     -.508298    .4299909
    year2007 |  -.0540033   .2546519    -0.21   0.832    -.5592879    .4512813
    year2008 |  -.0126152   .2614469    -0.05   0.962    -.5313825    .5061521
    year2009 |  -.0361056   .2709823    -0.13   0.894    -.5737933    .5015821
    year2010 |   .0936595   .2549561     0.37   0.714    -.4122287    .5995477
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.033
                                                   Chi-sq(1) P-val =    0.0003
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               13.582
                         (Kleibergen-Paap rk Wald F statistic):         11.159
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              11.502
                                                   Chi-sq(4) P-val =    0.0215
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindN year1996
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A4.1.8.2 Model 1 - IV estimated results (N-ETEs)

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
```

```
Number of groups =        17                    Obs per group: min =         3
                                                               avg =      12.6
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      215
                                                      F( 24,    174) =   12.74
                                                      Prob > F      =   0.0000
Total (centered) SS     =  1.913666985                Centered R2   =   0.6394
Total (uncentered) SS   =  1.913666985                Uncentered R2 =   0.6394
Residual SS             =  .6901324152                Root MSE      =   .06298

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0542098   .1768283     0.31   0.760    -.2947946    .4032142
     lntedut |   .2900513    .153847     1.89   0.061    -.0135952    .5936978
   lnpatappr |   .1458985   .0565263     2.58   0.011     .0343331    .2574639
       lnfdi |   .0064967   .0047006     1.38   0.169    -.0027807    .0157742
      lngdpc |   .0497715   .2443512     0.20   0.839    -.4325025    .5320454
       lnpop |  -.1153604    .418653    -0.28   0.783    -.9416522    .7109314
        unem |   .0007031   .0008257     0.85   0.396    -.0009266    .0023329
   lnecofree |   -.138552   .2254544    -0.61   0.540    -.5835295    .3064255
        serv |  -.0363652    .005077    -7.16   0.000    -.0463856   -.0263447
      lnrulc |  -.5557825   .2887582    -1.92   0.056    -1.125702     .014137
    year1996 |   .0225266   .0223163     1.01   0.314    -.0215189    .0665721
    year1998 |  -.0119614    .019957    -0.60   0.550    -.0513503    .0274274
    year1999 |   .0168608   .0295942     0.57   0.570     -.041549    .0752705
    year2000 |  -.0149168   .0408226    -0.37   0.715    -.0954881    .0656545
    year2001 |  -.0025398   .0439587    -0.06   0.954    -.0893007     .084221
    year2002 |   .0113951   .0458121     0.25   0.804    -.0790239    .1018141
    year2003 |   .0257112   .0471422     0.55   0.586     -.067333    .1187554
    year2004 |   .0007732   .0544692     0.01   0.989    -.1067322    .1082785
    year2005 |  -.0009511    .059345    -0.02   0.987    -.1180798    .1161775
    year2006 |  -.0472057    .067034    -0.70   0.482    -.1795102    .0850988
    year2007 |  -.0581055   .0704246    -0.83   0.410    -.1971019    .0808908
    year2008 |  -.0439293   .0744593    -0.59   0.556     -.190889    .1030303
    year2009 |   .0366275   .0739494     0.50   0.621    -.1093258    .1825808
    year2010 |  -.0227341   .0751072    -0.30   0.762    -.1709725    .1255044
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             10.068
                                                Chi-sq(1) P-val =    0.0015
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               26.140
                         (Kleibergen-Paap rk Wald F statistic):          6.543
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               6.698
                                                Chi-sq(4) P-val =    0.1527
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
```

```
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A4.1.8.3 Model 1 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree lnrulc dist transdummy serv
year2000 year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008
year2009 year2010  (lnsedut lntedut lnpatappr lnfdi emplcvt = lnsedutlag1 lntedutlag1
lnpatapprlag1 lnfdilag1 emplcvtlag1), fe endog (lnsedut lntedut lnpatappr lnfdi
emplcvt) small robust bw(3)
Warning - singleton groups detected.  1 observation(s) not used.
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2000

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       24                    Obs per group: min =         4
                                                              avg =       9.8
                                                              max =        11

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      235
                                                      F( 21,    190) =    32.26
                                                      Prob > F      =   0.0000
Total (centered) SS     =  6.433845401                Centered R2   =   0.7520
Total (uncentered) SS   =  6.433845401                Uncentered R2 =   0.7520
Residual SS             =  1.595568495                Root MSE      =   .09164

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0041323      .22372     0.02   0.985    -.4371617    .4454264
     lntedut |   .7064749    .1975416     3.58   0.000     .3168185    1.096131
   lnpatappr |    .064873    .0633813     1.02   0.307    -.0601483    .1898944
       lnfdi |  -.0115761    .0087805    -1.32   0.189    -.0288959    .0057437
     emplcvt |   .0062403     .003979     1.57   0.118    -.0016083     .014089
      lngdpc |   .8719175    .2177042     4.01   0.000     .4424899    1.301345
       lnpop |  -2.607213     .764153    -3.41   0.001    -4.114526     -1.0999
        unem |  -.0004969    .0011179    -0.44   0.657    -.0027019    .0017082
   lnecofree |  -.1552381    .2861278    -0.54   0.588    -.7196332     .409157
      lnrulc |  -.7457831    .3855491    -1.93   0.055     -1.50629    .0147234
        serv |   -.003039    .0125194    -0.24   0.808    -.0277337    .0216558
    year2001 |  -.0182529    .0244279    -0.75   0.456    -.0664376    .0299318
    year2002 |  -.0312823    .0439965    -0.71   0.478    -.1180666    .0555019
    year2003 |  -.0441282    .0497434    -0.89   0.376    -.1422485    .0539921
    year2004 |  -.0793621    .0650195    -1.22   0.224    -.2076149    .0488907
    year2005 |  -.0877043    .0753256    -1.16   0.246    -.2362862    .0608775
    year2006 |  -.1479297    .0820927    -1.80   0.073    -.3098598    .0140004
```

```
    year2007 |  -.1847118   .0896442    -2.06   0.041    -.3615374   -.0078861
    year2008 |  -.1700239   .0935857    -1.82   0.071    -.3546244    .0145766
    year2009 |  -.1401614   .0968861    -1.45   0.150     -.331272    .0509492
    year2010 |  -.1422623   .0900442    -1.58   0.116    -.3198771    .0353525
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             11.836
                                                   Chi-sq(1) P-val =    0.0006
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               19.557
                         (Kleibergen-Paap rk Wald F statistic):          4.253
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              11.212
                                                   Chi-sq(5) P-val =    0.0473
Regressors tested:    lnsedut lntedut lnpatappr lnfdi emplcvt
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi emplcvt
Included instruments: lngdpc lnpop unem lnecofree lnrulc serv year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
                      emplcvtlag1
Dropped collinear:    cskills dist transdummy year2000
------------------------------------------------------------------------------
```

Table A4.1.8.4 Model 1 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree lnrulc dist transdummy serv
year2000 year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008
year2009 year2010  (lnsedut lntedut lnpatappr lnfdi trngent = lnsedutlag1 lntedutlag1
lnpatapprlag1 lnfdilag1 trngentlag1), fe endog (lnsedut lntedut lnpatappr lnfdi
trngent) small robust bw(3)
Warning - singleton groups detected.  1 observation(s) not used.
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2000

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        26                    Obs per group: min =         3
                                                               avg =       9.4
                                                               max =        11

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      245
                                                      F( 21,   198) =    27.22
                                                      Prob > F      =   0.0000
Total (centered) SS     =   5.84702702                Centered R2   =   0.7390
Total (uncentered) SS   =   5.84702702                Uncentered R2 =   0.7390
Residual SS             =  1.526256904                Root MSE      =    .0878

------------------------------------------------------------------------------
             |               Robust
```

```
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |    .038942   .2458555     0.16   0.874    -.4458894    .5237734
     lntedut |   .7287337   .1855638     3.93   0.000     .3627987    1.094669
   lnpatappr |   .0805568   .0529975     1.52   0.130    -.0239552    .1850688
       lnfdi |  -.0063252   .0084588    -0.75   0.455    -.0230062    .0103558
     trngent |   .0038247   .0020429     1.87   0.063     -.000204    .0078534
      lngdpc |   1.015105   .2310175     4.39   0.000     .5595341    1.470675
       lnpop |  -2.710436   .6179533    -4.39   0.000     -3.92905   -1.491821
        unem |  -.0004413   .0011823    -0.37   0.709    -.0027727    .0018902
   lnecofree |  -.4056694   .2610385    -1.55   0.122    -.9204418     .109103
      lnrulc |  -.9715607    .653951    -1.49   0.139    -2.261164    .3180422
        serv |  -.0076349   .0153137    -0.50   0.619    -.0378339    .0225641
    year2001 |   -.009719   .0255515    -0.38   0.704    -.0601071    .0406691
    year2002 |  -.0192922   .0396138    -0.49   0.627    -.0974114     .058827
    year2003 |  -.0374682   .0468478    -0.80   0.425    -.1298529    .0549166
    year2004 |  -.0792914   .0568401    -1.39   0.165     -.191381    .0327983
    year2005 |  -.1002742   .0659989    -1.52   0.130    -.2304253    .0298768
    year2006 |  -.1633208   .0758433    -2.15   0.032     -.312885   -.0137565
    year2007 |  -.2057542   .0824314    -2.50   0.013    -.3683104    -.043198
    year2008 |  -.1787355   .0846388    -2.11   0.036    -.3456447   -.0118263
    year2009 |  -.1212402   .0907268    -1.34   0.183    -.3001551    .0576747
    year2010 |  -.1361013     .08405    -1.62   0.107    -.3018494    .0296467
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             14.951
                                                   Chi-sq(1) P-val =    0.0001
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               26.381
                         (Kleibergen-Paap rk Wald F statistic):          5.995
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.291
                                                   Chi-sq(5) P-val =    0.6553
Regressors tested:    lnsedut lntedut lnpatappr lnfdi trngent
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi trngent
Included instruments: lngdpc lnpop unem lnecofree lnrulc serv year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
                      trngentlag1
Dropped collinear:    cskills dist transdummy year2000
------------------------------------------------------------------------------
```

Table A4.2 Model 2 - Fixed effects estimated results

```
xtreg lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.7227                         Obs per group: min =         5
       between = 0.1824                                        avg =      13.6
       overall = 0.1238                                        max =        16
```

```
                                                F(25,314)         =     32.74
corr(u_i, Xb)  = -0.8914                        Prob > F          =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -1.080913   .1899696    -5.69   0.000    -1.454688    -.707139
     sqravyrs |    .049501   .0088414     5.60   0.000      .032105    .0668969
     cskills |  (omitted)
   lnpatappr |   .0520743   .0273091     1.91   0.057    -.0016577    .1058062
       lnfdi |   .0052473   .0051033     1.03   0.305    -.0047936    .0152882
      lngdpc |   1.435969    .114614    12.53   0.000      1.21046    1.661477
       lnpop |  -1.627357   .3371254    -4.83   0.000    -2.290667   -.9640471
        unem |   .0027774   .0009256     3.00   0.003     .0009563    .0045985
   lnecofree |  -.0661197   .1742631    -0.38   0.705    -.4089908    .2767513
      lnrulc |  -.7721936   .1953689    -3.95   0.000    -1.156591   -.3877959
        serv |  -.0023586   .0038857    -0.61   0.544     -.010004    .0052867
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |    .027878   .0451139     0.62   0.537    -.0608857    .1166418
    year1997 |   .0037678   .0459997     0.08   0.935    -.0867388    .0942745
    year1998 |  -.0090401   .0466186    -0.19   0.846    -.1007643    .0826842
    year1999 |  -.0435811   .0485319    -0.90   0.370    -.1390699    .0519077
    year2000 |  -.0603345   .0485849    -1.24   0.215    -.1559276    .0352586
    year2001 |  -.0579877   .0499644    -1.16   0.247     -.156295    .0403196
    year2002 |  -.0755238    .052998    -1.43   0.155    -.1797998    .0287522
    year2003 |  -.0853357   .0552017    -1.55   0.123    -.1939476    .0232762
    year2004 |  -.1256662   .0581086    -2.16   0.031    -.2399976   -.0113347
    year2005 |  -.1277923   .0621234    -2.06   0.041    -.2500231   -.0055616
    year2006 |  -.1856784   .0658082    -2.82   0.005    -.3151592   -.0561977
    year2007 |   -.216428   .0682483    -3.17   0.002    -.3507098   -.0821462
    year2008 |  -.1621321   .0694706    -2.33   0.020    -.2988189   -.0254453
    year2009 |   -.051436   .0687749    -0.75   0.455     -.186754    .0838819
    year2010 |  -.0729625   .0711878    -1.02   0.306    -.2130279     .067103
       _cons |   10.47527   4.159338     2.52   0.012     2.291572    18.65896
-------------+----------------------------------------------------------------
     sigma_u |  3.3868244
     sigma_e |  .11988634
         rho |  .99874856   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that
 all u_i=0:     F(26, 314) =    54.87              Prob > F = 0.0000
```

Table A4.2.1 Model 2 - Random effects estimated results

```
 xtreg lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, re

Random-effects GLS regression                   Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.6714                         Obs per group: min =         5
       between = 0.9552                                        avg =      13.6
       overall = 0.9420                                        max =        16

                                                Wald chi2(28)      =   1295.23
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

avyrs	-.9914933	.1972637	-5.03	0.000	-1.378123	-.6048635
sqravyrs	.0444612	.0092536	4.80	0.000	.0263245	.0625979
cskills	.7907957	.4022904	1.97	0.049	.002321	1.579271
lnpatappr	.0861025	.0285853	3.01	0.003	.0300764	.1421287
lnfdi	-.0041766	.0053651	-0.78	0.436	-.014692	.0063387
lngdpc	1.685165	.1050948	16.03	0.000	1.479183	1.891147
lnpop	.8401194	.0627301	13.39	0.000	.7171707	.9630681
unem	.003811	.0010001	3.81	0.000	.0018508	.0057711
lnecofree	.3034713	.183776	1.65	0.099	-.056723	.6636656
lnrulc	-.8209565	.2117368	-3.88	0.000	-1.235953	-.4059599
serv	-.0075803	.0040364	-1.88	0.060	-.0154914	.0003309
dist	-.0002765	.0001276	-2.17	0.030	-.0005265	-.0000264
transdummy	1.453597	.2040162	7.12	0.000	1.053733	1.853461
year1996	.0620547	.0496083	1.25	0.211	-.0351759	.1592853
year1997	.0267563	.050603	0.53	0.597	-.0724237	.1259363
year1998	.022597	.0511335	0.44	0.659	-.0776229	.1228169
year1999	-.0143912	.0530314	-0.27	0.786	-.1183308	.0895485
year2000	-.0431238	.05291	-0.82	0.415	-.1468255	.0605779
year2001	-.0613037	.0541036	-1.13	0.257	-.1673449	.0447374
year2002	-.085015	.0570435	-1.49	0.136	-.1968183	.0267882
year2003	-.0962515	.0591477	-1.63	0.104	-.2121788	.0196758
year2004	-.1587686	.0614396	-2.58	0.010	-.279188	-.0383491
year2005	-.1747637	.0648842	-2.69	0.007	-.3019344	-.047593
year2006	-.25754	.0676374	-3.81	0.000	-.3901069	-.124973
year2007	-.3011292	.0692934	-4.35	0.000	-.4369418	-.1653166
year2008	-.2566167	.0700356	-3.66	0.000	-.3938841	-.1193494
year2009	-.1116414	.0712873	-1.57	0.117	-.2513618	.0280791
year2010	-.1491276	.073015	-2.04	0.041	-.2922345	-.0060208
_cons	-20.1145	2.8937	-6.95	0.000	-25.78605	-14.44295
sigma_u	.28379644					
sigma_e	.11988634					
rho	.84856961	(fraction of variance due to u_i)				

Table A4.2.2 Model 2 - Fixed effects versus Random effects

```
 hausman FE RE, sigmamore

Note: the rank of the differenced variance matrix (17) does not equal the number of
coefficients being tested (25); be sure this is what you expect, or there may be
problems computing the test.  Examine the output of your estimators for
        anything unexpected and possibly consider scaling your variables so that the
coefficients are on a similar scale.
```

	---- Coefficients ---- (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
avyrs	-1.080913	-.9914933	-.08942	.0714703
sqravyrs	.049501	.0444612	.0050398	.0031184
lnpatappr	.0520743	.0861025	-.0340283	.0096228
lnfdi	.0052473	-.0041766	.0094239	.0017274
lngdpc	1.435969	1.685165	-.2491961	.0705616
lnpop	-1.627357	.8401194	-2.467477	.3670156
unem	.0027774	.003811	-.0010335	.0002118
lnecofree	-.0661197	.3034713	-.369591	.057176
lnrulc	-.7721936	-.8209565	.0487629	.04155
serv	-.0023586	-.0075803	.0052216	.0014579
year1996	.027878	.0620547	-.0341767	.0046524
year1997	.0037678	.0267563	-.0229885	.0045192
year1998	-.0090401	.022597	-.0316371	.0060299
year1999	-.0435811	-.0143912	-.02919	.0077935
year2000	-.0603345	-.0431238	-.0172107	.0089376

```
    year2001 |   -.0579877    -.0613037         .003316        .0108616
    year2002 |   -.0755238     -.085015        .0094912        .0131231
    year2003 |   -.0853357    -.0962515        .0109158        .0147845
    year2004 |   -.1256662    -.1587686        .0331024        .0185469
    year2005 |   -.1277923    -.1747637        .0469714        .0223085
    year2006 |   -.1856784      -.25754        .0718615        .0266049
    year2007 |    -.216428    -.3011292        .0847012        .0296662
    year2008 |   -.1621321    -.2566167        .0944847         .031337
    year2009 |    -.051436    -.1116414        .0602054        .0262262
    year2010 |   -.0729625    -.1491276        .0761652        .0291622
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(17) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       75.27
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table A4.2.2.1 Models 1& 2 - Fixed effects versus Random effects

Hausman test	χ^2	p-value	Null Hypothesis	Decision	Estimate
Model 1	81.69	0.0000	Difference in coefficients not systematic	Reject	Fixed effects
Model 2	75.27	0.0000	Difference in coefficients not systematic	Reject	Fixed effects

Table A4.2.3 Model 2 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (27)  =    4430.56
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
. xtserial lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      26) =     74.686
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 71.975981
which is asy. distributed as chisq(1) under null, so:
```

```
Probability of value greater than LM is 2.178e-17
LM5= 8.4838659
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0
Test for significance of fixed effects
F= 54.867683
Probability>F= 1.21e-100
Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                         ------- joint ------
    Variable |     Obs    Pr(Skewness)    Pr(Kurtosis)  adj chi2(2)     Prob>chi2
-------------+---------------------------------------------------------------
     __00000B |     366       0.0000         0.0000         65.01          0.0000
```

Table A4.2.3.1 Models 1&2 - Diagnostic tests

	Test statistic (Models 1 & 2)	p-value	Null Hypothesis	Decision
Groupwise heteroskedasticity	2428.06 & 4430.56	0.0000	Homoskedasticity	Reject
Autocorrelation in panel data	68.172 & 74.686	0.0000	No first order autocorrelation	Reject
Normality of residuals	54.23 & 65.01	0.0000	Residuals normally distributed	Reject

Table A4.2.4 Model 2 - Driscoll-Kraay estimated results

```
. xtscc lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       366
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 28,     26)    =   8007.38
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7227

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -1.080913   .3278661    -3.30   0.003    -1.754852   -.4069749
    sqravyrs |    .049501   .0147577     3.35   0.002     .0191662    .0798358
     cskills |  (omitted)
   lnpatappr |   .0520743   .0217595     2.39   0.024      .007347    .0968015
       lnfdi |   .0052473   .0022308     2.35   0.027     .0006619    .0098327
      lngdpc |   1.435969   .1769305     8.12   0.000     1.072283    1.799655
       lnpop |  -1.627357   .3206984    -5.07   0.000    -2.286562   -.9681523
        unem |   .0027774    .000661     4.20   0.000     .0014188    .0041361
   lnecofree |  -.0661197   .1340637    -0.49   0.626    -.3416915    .2094521
      lnrulc |  -.7721936   .2917213    -2.65   0.014    -1.371835   -.1725519
        serv |  -.0023586   .0076249    -0.31   0.760    -.0180319    .0133147
        dist |   .0101142      .0054     1.87   0.072    -.0009857    .0212142
  transdummy |  (omitted)
    year1996 |    .027878   .0134806     2.07   0.049     .0001683    .0555877
    year1997 |   .0037678   .0133087     0.28   0.779    -.0235887    .0311243
    year1998 |  -.0090401   .0171144    -0.53   0.602    -.0442193    .0261391
    year1999 |  -.0435811   .0252326    -1.73   0.096    -.0954474    .0082851
```

```
    year2000 |  -.0603345   .0312892    -1.93   0.065    -.1246504    .0039814
    year2001 |  -.0579877   .0324698    -1.79   0.086    -.1247304     .008755
    year2002 |  -.0755238   .0381843    -1.98   0.059    -.1540128    .0029652
    year2003 |  -.0853357   .0407983    -2.09   0.046    -.1691978   -.0014737
    year2004 |  -.1256662   .0471177    -2.67   0.013    -.2225181   -.0288143
    year2005 |  -.1277923   .0542486    -2.36   0.026    -.2393019   -.0162828
    year2006 |  -.1856784   .0630953    -2.94   0.007    -.3153727   -.0559842
    year2007 |   -.216428   .0683356    -3.17   0.004    -.3568939   -.0759621
    year2008 |  -.1621321   .0692881    -2.34   0.027    -.3045558   -.0197084
    year2009 |   -.051436   .0592759    -0.87   0.393    -.1732794    .0704074
    year2010 |  -.0729625   .0619239    -1.18   0.249    -.2002488    .0543239
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.2.4.1 Model 2 - Driscoll-Kraay estimated results

```
xtscc lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy emplcvt year2000 year2001 year2002 year2003 year2004 year2005
year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       261
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 25,    26)     =  28610.48
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7539

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.1091938   .1650686    -0.66   0.514    -.4484971    .2301096
    sqravyrs |   .0043597   .0075474     0.58   0.568    -.0111543    .0198737
     cskills |  (omitted)
   lnpatappr |   .0508035   .0376878     1.35   0.189    -.0266649    .1282718
       lnfdi |   .0010466   .0029138     0.36   0.722    -.0049428     .007036
      lngdpc |   1.368132   .1924679     7.11   0.000     .9725087    1.763755
       lnpop |  -1.920067    .393501    -4.88   0.000     -2.72892   -1.111214
        unem |   .0005136   .0006747     0.76   0.453    -.0008733    .0019004
   lnecofree |  -.2914959   .1112297    -2.62   0.014    -.5201318   -.0628599
      lnrulc |  -.7267018   .3523537    -2.06   0.049    -1.450975   -.0024285
        serv |  -.0085993   .0111456    -0.77   0.447    -.0315095    .0143109
        dist |   .0089111   .0046604     1.91   0.067    -.0006684    .0184906
  transdummy |  (omitted)
     emplcvt |   .0053224   .0019968     2.67   0.013     .0012179    .0094269
    year2000 |  -.0155423   .0114992    -1.35   0.188    -.0391792    .0080947
    year2001 |  -.0136744   .0128546    -1.06   0.297    -.0400974    .0127485
    year2002 |  -.0221831   .0290177    -0.76   0.451    -.0818298    .0374636
    year2003 |  -.0257974   .0348675    -0.74   0.466    -.0974687    .0458739
    year2004 |  -.0625157   .0444105    -1.41   0.171    -.1538027    .0287714
    year2005 |  -.0682145   .0557052    -1.22   0.232    -.1827182    .0462891
    year2006 |  -.1274935   .0633694    -2.01   0.055    -.2577512    .0027641
    year2007 |  -.1659385   .0689101    -2.41   0.023    -.3075852   -.0242918
    year2008 |   -.127027   .0713717    -1.78   0.087    -.2737335    .0196796
    year2009 |  -.0258184   .0724126    -0.36   0.724    -.1746645    .1230277
    year2010 |  -.0278897   .0734327    -0.38   0.707    -.1788328    .1230534
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.2.4.2 Model 2 - Driscoll-Kraay estimated results

```
 xtscc lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy trngent year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010 , fe
Regression with Driscoll-Kraay standard errors   Number of obs     =       271
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 25,     26)    =   4523.15
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.7496


------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.2194707    .177504    -1.24   0.227    -.5843354     .145394
    sqravyrs |   .0096823   .0081556     1.19   0.246    -.0070817    .0264464
     cskills |  (omitted)
   lnpatappr |   .0648301   .0319264     2.03   0.053    -.0007955    .1304557
       lnfdi |   .0052982   .0024287     2.18   0.038      .000306    .0102905
      lngdpc |   1.541499   .1907944     8.08   0.000     1.149315    1.933682
       lnpop |  -1.897898   .4483206    -4.23   0.000    -2.819434   -.9763613
        unem |   .0006527   .0006814     0.96   0.347    -.0007479    .0020533
   lnecofree |  -.3432416   .0842891    -4.07   0.000    -.5165004   -.1699828
      lnrulc |   -1.01032   .4184818    -2.41   0.023    -1.870522   -.1501184
        serv |  -.0090949   .0119118    -0.76   0.452    -.0335799    .0153901
        dist |   .0094917   .0053851     1.76   0.090    -.0015775    .0205609
  transdummy |  (omitted)
     trngent |   .0035154   .0007499     4.69   0.000     .0019739    .0050568
    year2000 |  -.0384295   .0117839    -3.26   0.003    -.0626517   -.0142074
    year2001 |  -.0386158   .0169544    -2.28   0.031    -.0734661   -.0037656
    year2002 |   -.048629   .0285709    -1.70   0.101    -.1073574    .0100994
    year2003 |  -.0602386   .0357699    -1.68   0.104    -.1337646    .0132874
    year2004 |  -.1038608   .0438171    -2.37   0.025    -.1939282   -.0137934
    year2005 |  -.1210933    .054921    -2.20   0.037    -.2339849   -.0082016
    year2006 |  -.1860541   .0653044    -2.85   0.008    -.3202893    -.051819
    year2007 |  -.2304448   .0713404    -3.23   0.003    -.3770872   -.0838025
    year2008 |  -.1853523   .0722031    -2.57   0.016    -.3337679   -.0369367
    year2009 |  -.0609674   .0732318    -0.83   0.413    -.2114975    .0895628
    year2010 |  -.0737697   .0782099    -0.94   0.354    -.2345324    .0869929
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.2.5 Model 2 - FEVD estimated results (STATA ado file)

```
xtfevd lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant (cskills dist transdummy)
panel fixed effects regression with vector decomposition

degrees of freedom fevd     =       311           number of obs        =       366
mean squared error          = .0123307            F( 30, 311)          = 1.916721
root mean squared error     = .1110437            Prob > F             = .0043369
Residual Sum of Squares     = 4.513039            R-squared            = .9947622
Total Sum of Squares        = 861.6282            adj. R-squared       = .9938527
Estimation Sum of Squares   = 857.1152

------------------------------------------------------------------------------
             |                fevd
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
       avyrs |  -1.080913    7.32284    -0.15   0.883    -15.48949    13.32766
    sqravyrs |    .049501   .3433536     0.14   0.885    -.6260888    .7250908
   lnpatappr |   .0520743   .9192366     0.06   0.955    -1.756635    1.860784
       lnfdi |   .0052473   .1039506     0.05   0.960     -.199288    .2097826
      lngdpc |   1.435969   5.551273     0.26   0.796    -9.486834    12.35877
       lnpop |  -1.627357   3.000251    -0.54   0.588    -7.530715       4.276
        unem |   .0027774   .0181445     0.15   0.878    -.0329241     .038479
   lnecofree |  -.0661196   5.673922    -0.01   0.991    -11.23025    11.09801
      lnrulc |  -.7721935   4.638977    -0.17   0.868    -9.899943    8.355556
        serv |  -.0023586   .1043572    -0.02   0.982    -.2076941    .2029768
    year1996 |    .027878    .946997     0.03   0.977    -1.835453    1.891209
    year1997 |   .0037678   1.250233     0.00   0.998    -2.456218    2.463753
    year1998 |  -.0090401   1.267724    -0.01   0.994    -2.503441    2.485361
    year1999 |  -.0435812   1.133639    -0.04   0.969    -2.274152     2.18699
    year2000 |  -.0603345   1.085334    -0.06   0.956     -2.19586    2.075191
    year2001 |  -.0579877   1.215693    -0.05   0.962     -2.45001    2.334035
    year2002 |  -.0755238   1.237765    -0.06   0.951    -2.510976    2.359929
    year2003 |  -.0853358   1.451805    -0.06   0.953    -2.941938    2.771266
    year2004 |  -.1256662   1.542291    -0.08   0.935     -3.16031    2.908977
    year2005 |  -.1277924   1.759571    -0.07   0.942    -3.589962    3.334377
    year2006 |  -.1856785   1.795801    -0.10   0.918    -3.719135    3.347778
    year2007 |  -.2164281   2.118943    -0.10   0.919    -4.385705    3.952849
    year2008 |  -.1621322   2.149305    -0.08   0.940    -4.391149    4.066885
    year2009 |  -.0514361   1.898269    -0.03   0.978     -3.78651    3.683637
    year2010 |  -.0729626   1.923868    -0.04   0.970    -3.858405     3.71248
     cskills |   .9437148   3.991406     0.24   0.813    -6.909859    8.797289
        dist |  -.0010556   .0028443    -0.37   0.711    -.0066521    .0045409
  transdummy |  -.2740663    8.45568    -0.03   0.974    -16.91164    16.36351
         eta |          1          .        .       .            .           .
       _cons |   7.028601   74.89124     0.09   0.925     -140.329    154.3862
------------------------------------------------------------------------------
```

Table A4.2.5.1 Model 2 - FEVD estimated results (Three stage procedure)

```
. regress lnemsh avyrs sqravyrs cskills  lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy res1 year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010

      Source |       SS       df       MS              Number of obs =     366
-------------+------------------------------           F( 29,   336) = 2189.62
       Model |  857.092946    29  29.5549292           Prob > F      =  0.0000
    Residual |  4.53524822   336  .013497763           R-squared     =  0.9947
-------------+------------------------------           Adj R-squared =  0.9943
       Total |  861.628194   365  2.36062519           Root MSE      =  .11618

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -1.110924   .0686678   -16.18   0.000    -1.245996   -.9758507
    sqravyrs |   .0509864   .0034117    14.94   0.000     .0442753    .0576974
     cskills |   .8907606   .0484429    18.39   0.000     .7954711    .9860502
   lnpatappr |   .0676452   .0107093     6.32   0.000     .0465794     .088711
       lnfdi |   .0062892   .0041998     1.50   0.135    -.0019719    .0145504
      lngdpc |   1.441092   .0388593    37.08   0.000     1.364654     1.51753
       lnpop |   -1.59816   .0606314   -26.36   0.000    -1.717425   -1.478895
        unem |   .0023633   .0006191     3.82   0.000     .0011455    .0035811
   lnecofree |  -.0504342   .0857356    -0.59   0.557    -.2190802    .1182119
      lnrulc |  -.7429245   .1522684    -4.88   0.000    -1.042444   -.4434051
        serv |  -.0051168   .0014251    -3.59   0.000      -.00792   -.0023136
        dist |  -.0010461    .000023   -45.51   0.000    -.0010913   -.0010009
  transdummy |  -.2404452    .055581    -4.33   0.000    -.3497758   -.1311146
```

```
         res1 |   .9976891   .0256122    38.95   0.000     .9473087     1.04807
     year1996 |    .033311   .0428003     0.78   0.437    -.0508794    .1175014
     year1997 |   .0089998   .0433315     0.21   0.836    -.0762354     .094235
     year1998 |  -.0018857   .0430688    -0.04   0.965    -.0866042    .0828328
     year1999 |  -.0336484   .0431863    -0.78   0.436     -.118598    .0513012
     year2000 |  -.0524368   .0424717    -1.23   0.218    -.1359808    .0311072
     year2001 |  -.0505214   .0428856    -1.18   0.240    -.1348794    .0338366
     year2002 |  -.0665169    .043755    -1.52   0.129    -.1525852    .0195513
     year2003 |  -.0740781    .044117    -1.68   0.094    -.1608583    .0127022
     year2004 |  -.1148623   .0444593    -2.58   0.010    -.2023158   -.0274087
     year2005 |  -.1164443   .0449142    -2.59   0.010    -.2047926   -.0280959
     year2006 |  -.1755587   .0457345    -3.84   0.000    -.2655208   -.0855966
     year2007 |  -.2081536   .0459151    -4.53   0.000    -.2984708   -.1178363
     year2008 |  -.1574952   .0457141    -3.45   0.001    -.2474171   -.0675732
     year2009 |  -.0445535    .046506    -0.96   0.339    -.1360331    .0469261
     year2010 |  -.0639115   .0463097    -1.38   0.168    -.1550049     .027182
        _cons |   6.982916   1.219102     5.73   0.000     4.584883    9.380949
--------------------------------------------------------------------------------------
```

Table A4.2.6 Model 2 - Hausman and Taylor estimated results

```
 xthtaylor lnemsh avyrs sqravyrs cskills lnpatappr  lnfdi lngdpc  lnpop unem  dist
lnecofree lnrulc serv transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,endog
(avyrs sqravyrs cskills)

Hausman-Taylor estimation                       Number of obs      =       366
Group variable: country                         Number of groups   =        27

                                                Obs per group: min =         5
                                                               avg =      13.6
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    823.27
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |   .0622833   .0269314     2.31   0.021     .0094987    .1150679
       lnfdi |   .0020501    .004994     0.41   0.681     -.007738    .0118382
      lngdpc |   1.551464   .1098438    14.12   0.000     1.336174    1.766754
       lnpop |  -.9008545   .2827201    -3.19   0.001    -1.454976   -.3467332
        unem |   .0030139    .000915     3.29   0.001     .0012205    .0048074
   lnecofree |    .003472   .1717828     0.02   0.984    -.3332161      .34016
      lnrulc |  -.8091059   .1933035    -4.19   0.000    -1.187974   -.4302379
        serv |  -.0031934   .0038426    -0.83   0.406    -.0107247     .004338
    year1996 |   .0348935   .0446596     0.78   0.435    -.0526376    .1224247
    year1997 |   .0061083   .0455654     0.13   0.893    -.0831982    .0954148
    year1998 |  -.0054072   .0461729    -0.12   0.907    -.0959044    .0850899
    year1999 |  -.0433342   .0480743    -0.90   0.367    -.1375581    .0508898
    year2000 |  -.0645864   .0481132    -1.34   0.179    -.1588865    .0297138
    year2001 |  -.0684398   .0494221    -1.38   0.166    -.1653053    .0284257
    year2002 |  -.0892914   .0523821    -1.70   0.088    -.1919584    .0133756
    year2003 |  -.1010051    .054536    -1.85   0.064    -.2078937    .0058834
    year2004 |  -.1494594   .0572492    -2.61   0.009    -.2616658    -.037253
    year2005 |   -.157931   .0610715    -2.59   0.010    -.2776289   -.0382331
    year2006 |  -.2246655   .0644567    -3.49   0.000    -.3509984   -.0983327
    year2007 |  -.2611275    .066679    -3.92   0.000    -.3918159    -.130439
    year2008 |  -.2100643   .0677713    -3.10   0.002    -.3428935    -.077235
    year2009 |  -.0877591   .0675169    -1.30   0.194    -.2200898    .0445716
```

```
    year2010 |  -.1147225   .0697404    -1.64   0.100    -.2514112    .0219662
TVendogenous |
       avyrs |  -1.057891   .1880327    -5.63   0.000    -1.426428   -.6893534
    sqravyrs |   .0482889   .0087508     5.52   0.000     .0311375    .0654402
TIexogenous  |
        dist |  -.0012541   .0013075    -0.96   0.337    -.0038168    .0013086
  transdummy |   .5717101   1.429772     0.40   0.689    -2.230592    3.374012
TIendogenous |
     cskills |   .4497035   4.660743     0.10   0.923    -8.685184    9.584591
             |
       _cons |   1.427867   23.94151     0.06   0.952    -45.49662    48.35236
-------------+----------------------------------------------------------------
     sigma_u |  3.2447554
     sigma_e |   .1153811
         rho |  .99873714   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A4.2.6.1 Model 2 - Fixed effects versus Hausman and Taylor

```
hausman FE HT
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           HT         Difference          S.E.
-------------+----------------------------------------------------------------
       avyrs |   -1.080913    -1.057891       -.0230226        .0270586
    sqravyrs |     .049501     .0482889        .0012121        .0012624
   lnpatappr |    .0520743     .0622833        -.010209        .0045261
       lnfdi |    .0052473     .0020501        .0031972        .0010504
      lngdpc |    1.435969     1.551464       -.1154953        .0327219
       lnpop |   -1.627357    -.9008545       -.7265028        .1836378
        unem |    .0027774     .0030139       -.0002365        .0001393
   lnecofree |   -.0661197      .003472       -.0695917        .0292971
     lnrulc |   -.7721936    -.8091059        .0369123         .028333
        serv |   -.0023586    -.0031934        .0008348        .0005775
    year1996 |     .027878     .0348935       -.0070155        .0063865
    year1997 |    .0037678     .0061083       -.0023405        .0063066
    year1998 |   -.0090401    -.0054072       -.0036328         .006431
    year1999 |   -.0435811    -.0433342        -.000247        .0066484
    year2000 |   -.0603345    -.0645864        .0042519        .0067536
    year2001 |   -.0579877    -.0684398        .0104521        .0073414
    year2002 |   -.0755238    -.0892914        .0137676        .0080562
    year2003 |   -.0853357    -.1010051        .0156694         .008547
    year2004 |   -.1256662    -.1494594        .0237932        .0099568
    year2005 |   -.1277923     -.157931        .0301387        .0113838
    year2006 |   -.1856784    -.2246655        .0389871        .0132683
    year2007 |    -.216428    -.2611275        .0446995        .0145513
    year2008 |   -.1621321    -.2100643        .0479322        .0152716
    year2009 |    -.051436    -.0877591        .0363231        .0130943
    year2010 |   -.0729625    -.1147225          .04176        .0142822
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xthtaylor

    Test:  Ho:  difference in coefficients not systematic

                 chi2(25) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       15.68
                Prob>chi2 =      0.9240
```

Table A4.2.7 Model 2 - Hsiao 2 step procedure

Step 1

```
xtreg lnemsh avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.7227                         Obs per group: min =         5
       between = 0.1824                                        avg =      13.6
       overall = 0.1238                                        max =        16

                                                F(25,314)          =     32.74
corr(u_i, Xb)  = -0.8914                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -1.080913   .1899696    -5.69   0.000    -1.454688    -.707139
    sqravyrs |    .049501   .0088414     5.60   0.000      .032105    .0668969
     cskills |  (omitted)
   lnpatappr |   .0520743   .0273091     1.91   0.057    -.0016577    .1058062
       lnfdi |   .0052473   .0051033     1.03   0.305    -.0047936    .0152882
      lngdpc |   1.435969    .114614    12.53   0.000      1.21046    1.661477
       lnpop |  -1.627357   .3371254    -4.83   0.000    -2.290667   -.9640471
        unem |   .0027774   .0009256     3.00   0.003     .0009563    .0045985
   lnecofree |  -.0661197   .1742631    -0.38   0.705    -.4089908    .2767513
      lnrulc |  -.7721936   .1953689    -3.95   0.000    -1.156591   -.3877959
        serv |  -.0023586   .0038857    -0.61   0.544     -.010004    .0052867
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |    .027878   .0451139     0.62   0.537    -.0608857    .1166418
    year1997 |   .0037678   .0459997     0.08   0.935    -.0867388    .0942745
    year1998 |  -.0090401   .0466186    -0.19   0.846    -.1007643    .0826842
    year1999 |  -.0435811   .0485319    -0.90   0.370    -.1390699    .0519077
    year2000 |  -.0603345   .0485849    -1.24   0.215    -.1559276    .0352586
    year2001 |  -.0579877   .0499644    -1.16   0.247     -.156295    .0403196
    year2002 |  -.0755238    .052998    -1.43   0.155    -.1797998    .0287522
    year2003 |  -.0853357   .0552017    -1.55   0.123    -.1939476    .0232762
    year2004 |  -.1256662   .0581086    -2.16   0.031    -.2399976   -.0113347
    year2005 |  -.1277923   .0621234    -2.06   0.041    -.2500231   -.0055616
    year2006 |  -.1856784   .0658082    -2.82   0.005    -.3151592   -.0561977
    year2007 |   -.216428   .0682483    -3.17   0.002    -.3507098   -.0821462
    year2008 |  -.1621321   .0694706    -2.33   0.020    -.2988189   -.0254453
    year2009 |   -.051436   .0687749    -0.75   0.455     -.186754    .0838819
    year2010 |  -.0729625   .0711878    -1.02   0.306    -.2130279     .067103
       _cons |   10.47527   4.159338     2.52   0.012     2.291572    18.65896
-------------+----------------------------------------------------------------
     sigma_u |  3.3868244
     sigma_e |  .11988634
         rho |  .99874856   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(26, 314) =    54.87             Prob > F = 0.0000

Step 2.
. xtreg residfe2 cskills dist transdummy, be
Between regression (regression on group means)  Number of obs      =       366
Group variable: country                         Number of groups   =        27
```

```
R-sq:  within  = 0.0000                         Obs per group: min =         5
       between = 0.1104                                        avg =      13.6
       overall = 0.0547                                        max =        16

                                                F(3,23)            =      0.95
sd(u_i + avg(e_i.))=  3.396431                  Prob > F           =    0.4324

------------------------------------------------------------------------------
    residfe2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     cskills |   .6554133   4.203466     0.16   0.877    -8.040118    9.350945
        dist |  -.0016271    .001264    -1.29   0.211    -.0042419    .0009877
  transdummy |   .0847174   1.419577     0.06   0.953    -2.851902    3.021337
       _cons |  -1.508556   21.30614    -0.07   0.944    -45.58366    42.56654
---------------------------------------------------------------------------------
```

Table A4.2.8 Model 2 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
=avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs lnpatappr
lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       27                     Obs per group: min =         3
                                                               avg =      12.9
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      349
                                                      F( 24,    298) =   15.72
                                                      Prob > F      =   0.0000
Total (centered) SS     =  14.63220443                Centered R2   =   0.7241
Total (uncentered) SS   =  14.63220443                Uncentered R2 =   0.7241
Residual SS             =  4.036497757                Root MSE      =    .1164

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -1.031575   .2948954    -3.50   0.001    -1.611916   -.4512335
    sqravyrs |   .0482362    .013676     3.53   0.000     .0213225      .07515
   lnpatappr |   .0567323   .0545946     1.04   0.300    -.0507075     .164172
       lnfdi |   .0069452    .005033     1.38   0.169    -.0029595    .0168499
      lngdpc |   1.460736   .1528232     9.56   0.000     1.159987    1.761485
       lnpop |  -1.771418   .5034151    -3.52   0.001    -2.762118   -.7807194
        unem |    .002719   .0012378     2.20   0.029     .0002832    .0051549
   lnecofree |  -.1675852   .2264491    -0.74   0.460    -.6132272    .2780567
        serv |  -.0036182   .0090052    -0.40   0.688    -.0213402    .0141037
```

```
      lnrulc |  -.7975026   .3216266    -2.48   0.014     -1.43045   -.1645554
    year1996 |   .0295505   .0383195     0.77   0.441    -.0458607    .1049616
    year1998 |  -.0134661   .0273068    -0.49   0.622    -.0672048    .0402726
    year1999 |   -.044812   .0355406    -1.26   0.208    -.1147544    .0251304
    year2000 |  -.0695808   .0472118    -1.47   0.142    -.1624916    .0233299
    year2001 |   -.066127   .0486055    -1.36   0.175    -.1617805    .0295265
    year2002 |  -.0863375   .0521045    -1.66   0.099    -.1888769     .016202
    year2003 |  -.0930256   .0535988    -1.74   0.084    -.1985058    .0124545
    year2004 |  -.1421195   .0612433    -2.32   0.021    -.2626437   -.0215952
    year2005 |  -.1480621   .0684107    -2.16   0.031    -.2826914   -.0134328
    year2006 |  -.2065023   .0753484    -2.74   0.007    -.3547847   -.0582198
    year2007 |  -.2432144   .0818328    -2.97   0.003    -.4042577    -.082171
    year2008 |  -.1857263   .0870564    -2.13   0.034    -.3570495    -.014403
    year2009 |  -.0707786   .0862203    -0.82   0.412    -.2404564    .0988992
    year2010 |  -.0958456   .0867498    -1.10   0.270    -.2665655    .0748743
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.890
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               63.586
                         (Kleibergen-Paap rk Wald F statistic):         14.375
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.288
                                                   Chi-sq(4) P-val =    0.3684
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
```

Table A4.2.8.1 Model 2 - IV estimated results (ETEs)

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist transindN
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        10                    Obs per group: min =         7
                                                               avg =      13.4
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      134
                                                      F( 25,     99) =    57.06
```

```
                                                      Prob > F      =    0.0000
Total (centered) SS     =  12.71853745                Centered R2   =    0.9103
Total (uncentered) SS   =  12.71853745                Uncentered R2 =    0.9103
Residual SS             =  1.140768854                Root MSE      =     .1073

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.3052558   .8846765    -0.35   0.731    -2.060646    1.450134
    sqravyrs |   .0346494   .0352968     0.98   0.329     -.035387    .1046858
   lnpatappr |   .0713089   .1435895     0.50   0.621    -.2136038    .3562215
       lnfdi |   .0395134   .0730237     0.54   0.590    -.1053815    .1844083
      lngdpc |    .645078   .2519814     2.56   0.012     .1450922    1.145064
       lnpop |   5.147192   2.782861     1.85   0.067    -.3746081    10.66899
        unem |  -.0030045   .0019977    -1.50   0.136    -.0069684    .0009594
   lnecofree |  -.9577257   .3796993    -2.52   0.013    -1.711131   -.2043199
        serv |   .0156958   .0112817     1.39   0.167    -.0066896    .0380811
      lnrulc |   -.862894   .4321943    -2.00   0.049    -1.720461   -.0053267
   transindN |   .6528614   .5101366     1.28   0.204    -.3593603    1.665083
    year1996 |   .0176631   .0602031     0.29   0.770    -.1017929    .1371192
    year1998 |  -.0041615   .0535936    -0.08   0.938    -.1105027    .1021797
    year1999 |  -.1299999   .0809781    -1.61   0.112    -.2906781    .0306783
    year2000 |  -.0755349    .092034    -0.82   0.414    -.2581503    .1070806
    year2001 |  -.0359315   .1050194    -0.34   0.733    -.2443128    .1724498
    year2002 |  -.0701535   .1506527    -0.47   0.642    -.3690812    .2287743
    year2003 |  -.0589288   .1520536    -0.39   0.699    -.3606362    .2427785
    year2004 |  -.0418056   .1747348    -0.24   0.811    -.3885174    .3049061
    year2005 |   -.029688   .1901875    -0.16   0.876    -.4070612    .3476852
    year2006 |  -.0421618   .2052132    -0.21   0.838    -.4493493    .3650257
    year2007 |  -.0415037   .2187794    -0.19   0.850    -.4756095    .3926022
    year2008 |   .0053018   .2250431     0.02   0.981    -.4412324    .4518361
    year2009 |  -.0440012   .2413103    -0.18   0.856    -.5228131    .4348107
    year2010 |   .0716051   .2245842     0.32   0.751    -.3740187    .5172288
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.904
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               10.793
                         (Kleibergen-Paap rk Wald F statistic):          7.841
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              10.118
                                                   Chi-sq(4) P-val =    0.0385
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindN year1996
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist year1997
```

Table A4.2.8.2 Model 2 - IV estimated results (N-ETEs)

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree serv lnrulc dist year1996 year1997
year1998 year1999 year2000 year2001 year2002 year2003 year2004 year2005 year2006
year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi = avyrslag1
```

```
sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs sqravyrs
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        17                    Obs per group: min =         3
                                                               avg =      12.6
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      215
                                                      F( 24,    174) =    11.89
                                                      Prob > F      =   0.0000
Total (centered) SS     =  1.913666985                Centered R2   =   0.6429
Total (uncentered) SS   =  1.913666985                Uncentered R2 =   0.6429
Residual SS             =  .6833586415                Root MSE      =   .06267

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   -.208023   .1765125    -1.18   0.240    -.5564043    .1403582
    sqravyrs |   .0094988   .0087071     1.09   0.277    -.0076863    .0266839
   lnpatappr |   .1328604   .0547323     2.43   0.016     .0248358    .2408851
       lnfdi |   .0107908   .0044414     2.43   0.016     .0020248    .0195568
      lngdpc |    .097354   .2373415     0.41   0.682    -.3710848    .5657928
       lnpop |   .2600111   .3704091     0.70   0.484    -.4710621    .9910843
        unem |   .0007636   .0007947     0.96   0.338     -.000805    .0023322
   lnecofree |  -.2097773   .2300386    -0.91   0.363    -.6638025    .2442479
        serv |  -.0364731   .0049984    -7.30   0.000    -.0463383   -.0266079
      lnrulc |  -.5832545   .2811184    -2.07   0.039    -1.138096   -.0284136
    year1996 |   .0160154    .021723     0.74   0.462     -.026859    .0588898
    year1998 |  -.0042814   .0184336    -0.23   0.817    -.0406636    .0321008
    year1999 |   .0302899   .0270154     1.12   0.264    -.0230301    .0836099
    year2000 |   .0032514   .0390915     0.08   0.934    -.0739031    .0804059
    year2001 |     .02505    .040151     0.62   0.534    -.0541956    .1042956
    year2002 |   .0407288   .0408543     1.00   0.320     -.039905    .1213627
    year2003 |   .0581461   .0390808     1.49   0.139    -.0189874    .1352796
    year2004 |   .0356136   .0452288     0.79   0.432    -.0536542    .1248813
    year2005 |   .0348479   .0505001     0.69   0.491    -.0648237    .1345195
    year2006 |  -.0037839   .0572327    -0.07   0.947    -.1167436    .1091759
    year2007 |  -.0101578   .0598228    -0.17   0.865    -.1282297     .107914
    year2008 |   .0162896   .0619283     0.26   0.793    -.1059377    .1385168
    year2009 |   .1058635   .0587101     1.80   0.073    -.0100121    .2217391
    year2010 |   .0510753   .0601496     0.85   0.397    -.0676414     .169792
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):              9.188
                                                   Chi-sq(1) P-val =    0.0024
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               24.479
                         (Kleibergen-Paap rk Wald F statistic):          5.733
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
```

```
Hansen J statistic (overidentification test of all instruments):         0.000
                                                   (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                                4.448
                                                     Chi-sq(4) P-val =    0.3488
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist year1997
------------------------------------------------------------------------------
```

Table A4.2.8.3 Model 2 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree lnrulc dist transdummy serv
year2000 year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008
year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi emplcvt = avyrslag1 sqravyrslag1
lnpatapprlag1 lnfdilag1 emplcvtlag1), fe endog (avyrs sqravyrs lnpatappr lnfdi
emplcvt) small robust bw(3)
Warning - singleton groups detected.  1 observation(s) not used.
Warning - collinearities detected
Vars dropped:  cskills dist transdummy

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        24                    Obs per group: min =         4
                                                               avg =       9.8
                                                               max =        11

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      235
                                                      F( 21,    190) =    24.53
                                                      Prob > F      =   0.0000
Total (centered) SS     =  6.433845401                Centered R2   =   0.7331
Total (uncentered) SS   =  6.433845401                Uncentered R2 =   0.7331
Residual SS             =  1.717345961                Root MSE      =   .09507

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .2100002   .3363832     0.62   0.533    -.4535253    .8735256
    sqravyrs |  -.0097267   .0159883    -0.61   0.544     -.041264    .0218105
   lnpatappr |   .0326035   .0658534     0.50   0.621    -.0972942    .1625011
       lnfdi |  -.0021279   .0076413    -0.28   0.781    -.0172006    .0129449
     emplcvt |   .0071931   .0037966     1.89   0.060    -.0002959    .0146821
      lngdpc |   1.262157   .2413452     5.23   0.000     .7860963    1.738217
       lnpop |   -2.16032   .6562217    -3.29   0.001    -3.454736   -.8659043
        unem |   .0002655   .0012139     0.22   0.827     -.002129    .0026601
   lnecofree |  -.3205598   .2980319    -1.08   0.283    -.9084362    .2673166
      lnrulc |   -.698581   .3806397    -1.84   0.068    -1.449404    .0522416
```

```
        serv |  -.0038473   .0126986    -0.30   0.762    -.0288957    .0212011
    year2001 |   -.001364   .0237684    -0.06   0.954    -.0482478    .0455197
    year2002 |  -.0096716   .0390855    -0.25   0.805    -.0867688    .0674255
    year2003 |  -.0164771    .045483    -0.36   0.718    -.1061937    .0732395
    year2004 |  -.0477635   .0599382    -0.80   0.427    -.1659932    .0704663
    year2005 |  -.0533026   .0729129    -0.73   0.466    -.1971253    .0905202
    year2006 |  -.1110718   .0798245    -1.39   0.166     -.268528    .0463844
    year2007 |  -.1465777   .0878638    -1.67   0.097    -.3198914    .0267361
    year2008 |  -.1078058   .0884421    -1.22   0.224    -.2822604    .0666487
    year2009 |   -.029549   .0879184    -0.34   0.737    -.2029705    .1438725
    year2010 |  -.0251925   .0790725    -0.32   0.750    -.1811652    .1307803
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             11.639
                                                   Chi-sq(1) P-val =    0.0006
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               19.378
                         (Kleibergen-Paap rk Wald F statistic):          4.006
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              15.343
                                                   Chi-sq(5) P-val =    0.0090
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi emplcvt
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi emplcvt
Included instruments: lngdpc lnpop unem lnecofree lnrulc serv year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1 emplcvtlag1
Dropped collinear:    cskills dist transdummy
--------------------------------------------------------------------------------
```

Table A4.2.8.4 Model 2 - IV estimated results

```
xtivreg2 lnemsh cskills lngdpc lnpop unem lnecofree lnrulc dist transdummy serv
year2000 year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008
year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi trngent = avyrslag1 sqravyrslag1
lnpatapprlag1 lnfdilag1 trngentlag1), fe endog (avyrs sqravyrs lnpatappr lnfdi
trngent) small robust bw(3)
Warning - singleton groups detected.  1 observation(s) not used.
Warning - collinearities detected
Vars dropped:  cskills dist transdummy

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       26                   Obs per group: min =         3
                                                             avg =       9.4
                                                             max =        11

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      245
                                                      F( 21,   198) =    18.04
```

```
                                                      Prob > F      =    0.0000
Total (centered) SS     =    5.84702702               Centered R2   =    0.7152
Total (uncentered) SS   =    5.84702702               Uncentered R2 =    0.7152
Residual SS             =   1.665167772               Root MSE      =    .09171

------------------------------------------------------------------------------
             |               Robust
      lnemsh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .1402249   .3446741     0.41   0.685    -.5394785    .8199284
    sqravyrs |   -.005806    .016073    -0.36   0.718    -.0375022    .0258902
   lnpatappr |   .0689269   .0608204     1.13   0.258     -.051012    .1888658
       lnfdi |   .0040889   .0078644     0.52   0.604    -.0114198    .0195977
     trngent |   .0032168   .0020315     1.58   0.115    -.0007894    .0072229
      lngdpc |   1.482311   .2542142     5.83   0.000      .980996    1.983626
       lnpop |  -2.032036   .5385296    -3.77   0.000    -3.094026   -.9700463
        unem |   .0005673   .0012097     0.47   0.640    -.0018182    .0029528
   lnecofree |  -.4444192   .2923973    -1.52   0.130    -1.021032    .1321933
      lnrulc |   -1.04007   .6129938    -1.70   0.091    -2.248904    .1687648
        serv |  -.0061007   .0147592    -0.41   0.680    -.0352061    .0230047
    year2001 |  -.0010207   .0262829    -0.04   0.969    -.0528511    .0508097
    year2002 |  -.0139329   .0389911    -0.36   0.721    -.0908241    .0629582
    year2003 |  -.0280595   .0471727    -0.59   0.553    -.1210848    .0649659
    year2004 |   -.072281   .0582493    -1.24   0.216    -.1871496    .0425875
    year2005 |  -.0950734   .0704682    -1.35   0.179    -.2340378    .0438911
    year2006 |  -.1570947   .0812154    -1.93   0.055     -.317253    .0030635
    year2007 |  -.2007215   .0893234    -2.25   0.026    -.3768687   -.0245742
    year2008 |  -.1510465   .0892068    -1.69   0.092    -.3269639     .024871
    year2009 |  -.0420551    .088853    -0.47   0.637    -.2172748    .1331646
    year2010 |    -.05491   .0831786    -0.66   0.510    -.2189397    .1091196
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.928
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               26.245
                         (Kleibergen-Paap rk Wald F statistic):          5.553
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.380
                                                   Chi-sq(5) P-val =    0.4961
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi trngent
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi trngent
Included instruments: lngdpc lnpop unem lnecofree lnrulc serv year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1 trngentlag1
Dropped collinear:    cskills dist transdummy
------------------------------------------------------------------------------
```

Table A4.3 Descriptive statistics (Variables in levels)

						Quantiles		
Variable	**n**	**Mean**	**S.D.**	**Min**	**.25**	**Mdn**	**.75**	**Max**
emsh	464	4.02	6.66	0.03	0.36	1.54	3.84	36.60
sedut	464	58.85	12.95	24.67	48.99	59.77	66.10	88.99

tedut	464	17.64	6.01	7.05	12.46	17.72	22.40	40.09
avyrs	464	10.34	1.18	6.69	9.54	10.38	11.22	12.82
cskills	432	4.90	0.19	4.54	4.78	4.96	5.05	5.19
patappr	442	3883.05	9421.06	3.00	242.00	788.00	2274.00	51736.00
fdi	463	42.14	40.54	0.00	16.92	31.46	50.84	322.19
gdpc	464	24993.55	17580.37	2353.99	9766.65	21877.45	35600.00	87716.73
pop	464	17208.14	22010.91	376.89	3751.43	8168.71	16531.04	82504.55
unem	440	39.22	15.35	0.00	27.00	42.35	51.10	73.10
ecofree	453	66.00	7.56	42.90	61.20	66.20	70.80	82.60
rulc	431	101.85	4.72	91.90	99.20	100.70	103.80	129.10
serv	452	66.71	7.47	35.83	62.03	66.66	72.01	86.55
dist	464	1142.02	631.97	68.44	767.16	1129.98	1601.10	2904.98
transdummy	464	0.38	0.49	0.00	0.00	0.00	1.00	1.00
transind	153	3.62	0.30	2.60	3.40	3.60	3.90	4.10
emplcvt	293	31.95	12.86	8.00	19.20	33.00	41.00	61.00
trngent	299	60.92	20.43	11.00	44.00	68.00	76.00	96.00

Table A4.3.1 Correlation matrix

	lnsedut	lntedut	avyrs	cskills	lnpata~r	lnfdi	lngdpc	lnpop	unem	lnecof~e	lnrulc	serv
lnsedut	1.0000											
lntedut	-0.1898	1.0000										
avyrs	0.7791	0.2618	1.0000									
cskills	0.3873	0.2768	0.5145	1.0000								
lnpatappr	0.0129	0.0110	0.0814	0.2640	1.0000							
lnfdi	0.1000	0.2076	0.1876	0.2012	-0.0142	1.0000						
lngdpc	-0.3071	0.3748	-0.0579	0.1422	0.3725	-0.0887	1.0000					
lnpop	-0.0529	-0.1600	-0.0330	0.0578	0.8469	0.0859	0.0445	1.0000				
unem	0.1729	-0.3365	0.0465	-0.0613	-0.1863	0.0534	-0.5836	0.1064	1.0000			
lnecofree	-0.0699	0.5145	0.1859	0.3242	0.0295	0.0596	0.5584	-0.1503	-0.4274	1.0000		
lnrulc	0.0232	0.1993	0.0506	0.1189	0.0002	-0.0404	0.0665	-0.1168	-0.2238	0.0900	1.0000	
serv	-0.3474	0.3865	-0.2229	-0.1627	-0.0162	-0.0230	0.5457	-0.1276	-0.2590	0.4688	0.0413	1.0000
dist	-0.2377	-0.1341	-0.3058	-0.3781	-0.3444	-0.0031	-0.5491	-0.1562	0.1228	-0.3996	-0.1135	-0.3484
transdummy	0.6041	-0.3048	0.4061	0.0719	-0.4544	0.0797	-0.8622	-0.2724	0.4846	-0.3987	-0.0275	-0.5735
transindN	0.6126	-0.2843	0.4374	0.1075	-0.4520	0.0941	-0.8382	-0.2680	0.4818	-0.3497	-0.0287	-0.5616
emplcvt	0.0029	0.2191	0.2893	0.3706	0.2795	0.0738	0.6576	0.0005	-0.3365	0.3705	0.0504	0.1841
trngent	0.0707	0.3980	0.2836	0.5694	0.3368	0.0371	0.7259	-0.0454	-0.4934	0.6284	0.1329	0.2670

	dist	transd~y	transi~N	emplcvt	trngent
dist	1.0000				
transdummy	0.3101	1.0000			
transindN	0.2948	0.9944	1.0000		
emplcvt	-0.5515	-0.4186	-0.3912	1.0000	
trngent	-0.5781	-0.4991	-0.4742	0.7532	1.0000

Figure A4.4 Functional transformations for all explanatory variables

Figure A4.4.1 Functional transformation for *sedut*

Figure A4.4.2 Functional transformation for *tedut*

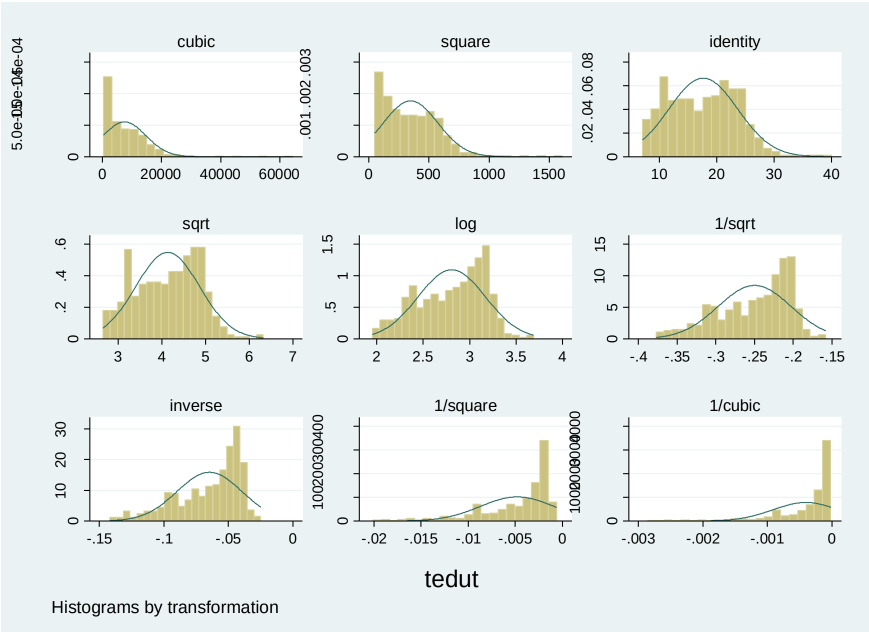


Figure A4.4.3 Functional transformation for *avyrs*

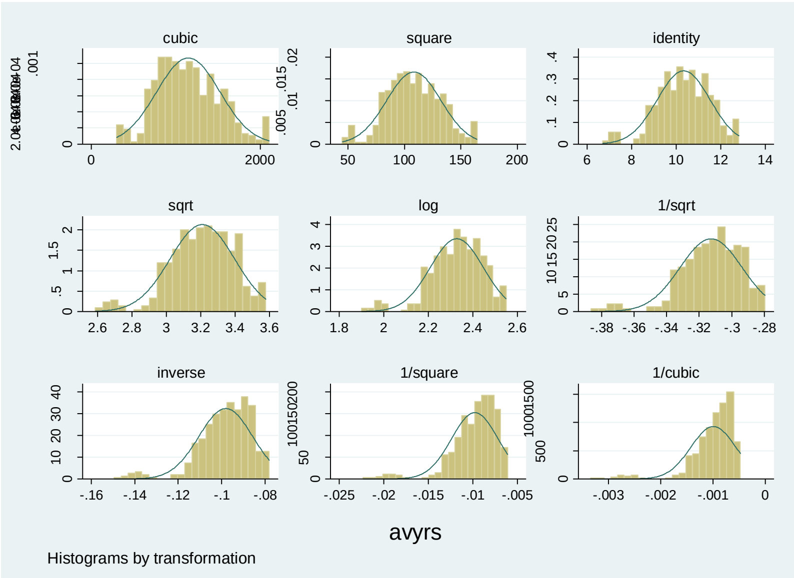


Figure A4.4.4 Functional transformation for *cskills*

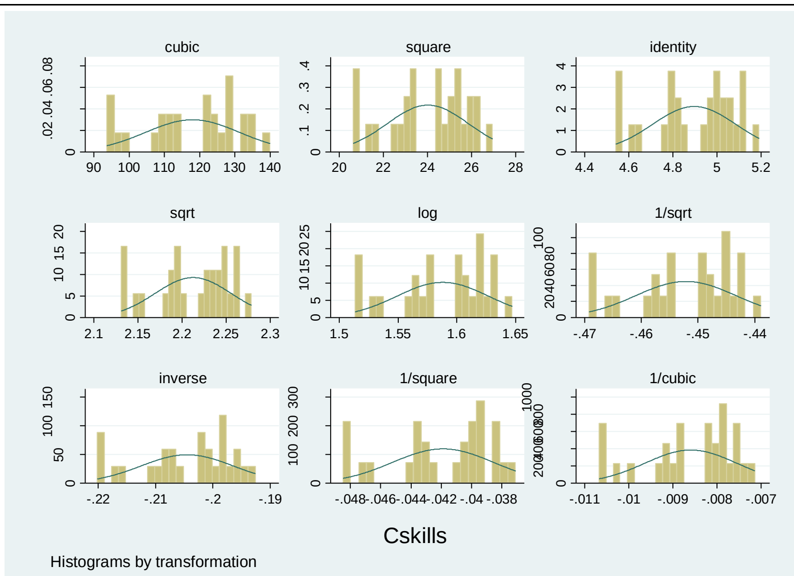


Figure A4.4.5 Functional transformation for *patappr*

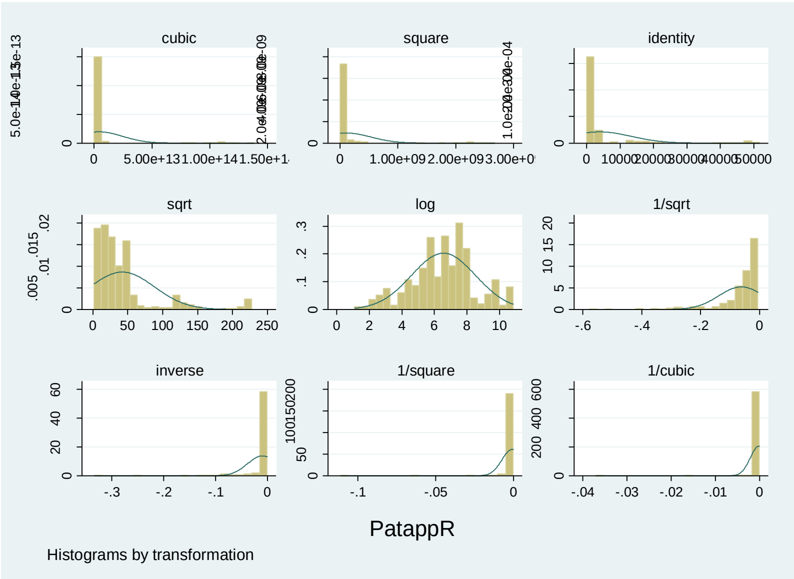


Figure A4.4.6 Functional transformation for *fdi*

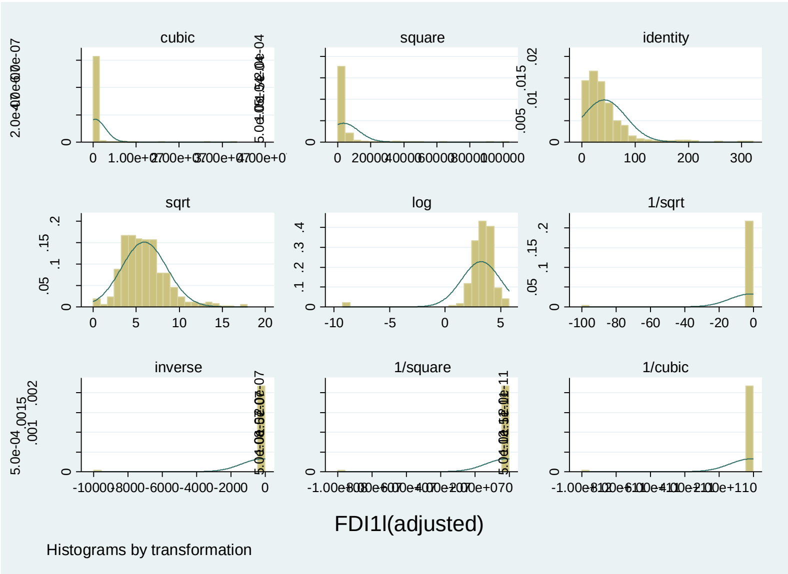


Figure A4.4.7 Functional transformation for *gdpc*

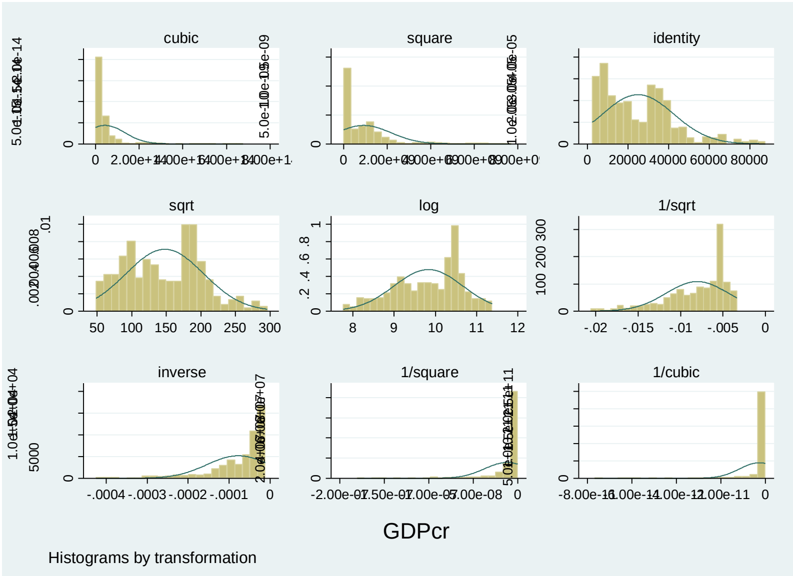


Figure A4.4.8 Functional transformation for *unem*

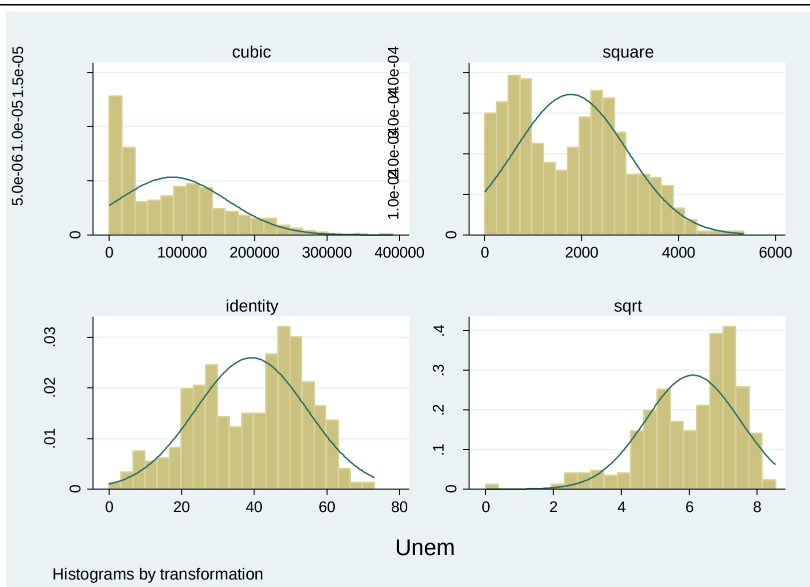


Figure A4.4.9 Functional transformation for *ecofree*

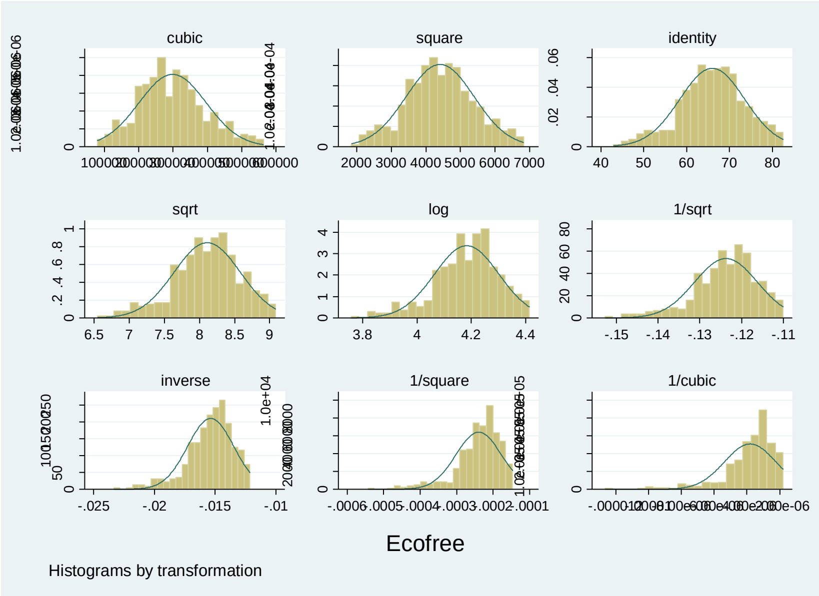


Figure A4.5.1 Functional transformation for *rulc*

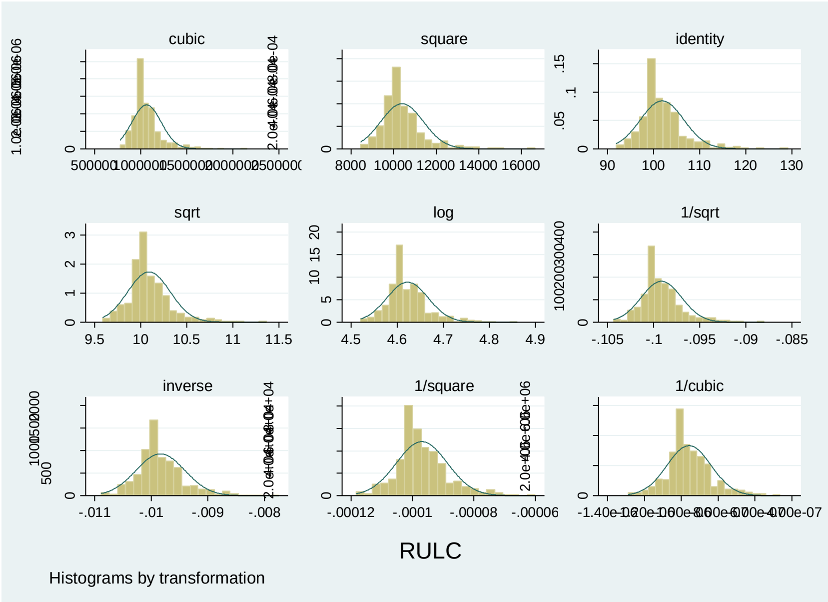


Figure A4.5.2 Functional transformation for *serv*

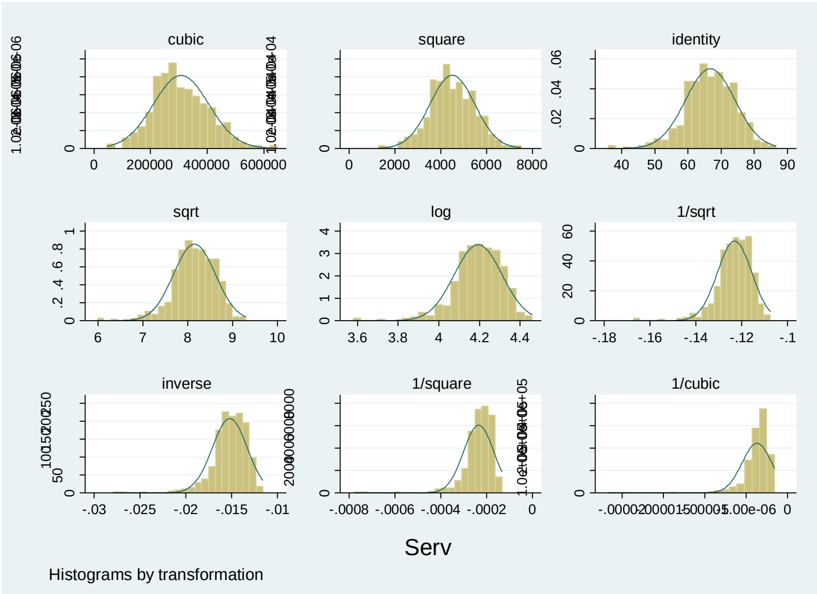


Figure A4.5.3 Functional transformation for *pop*

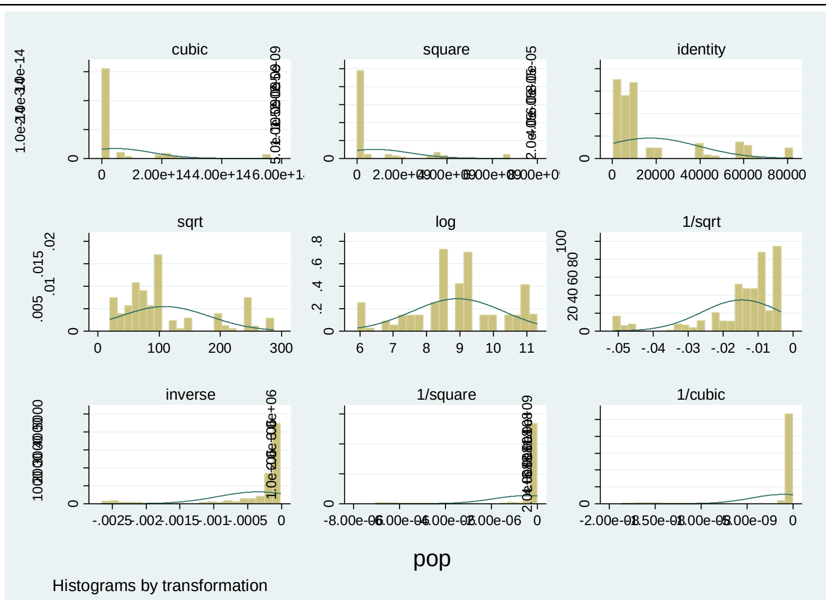


Figure A4.5.4 Functional transformation for *trandinN*

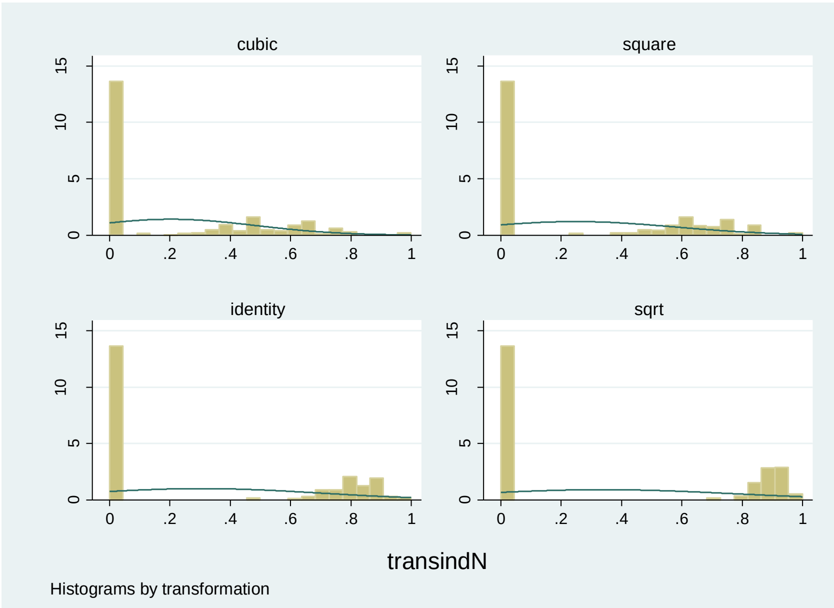


Figure A4.5.5 Functional transformation for *dist*

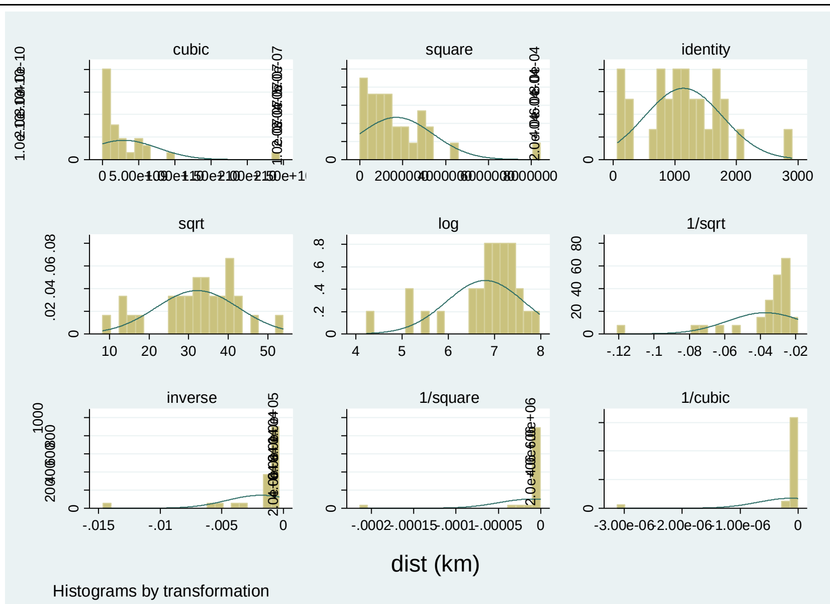


Figure A4.5.6 Functional transformation for *transdummy*

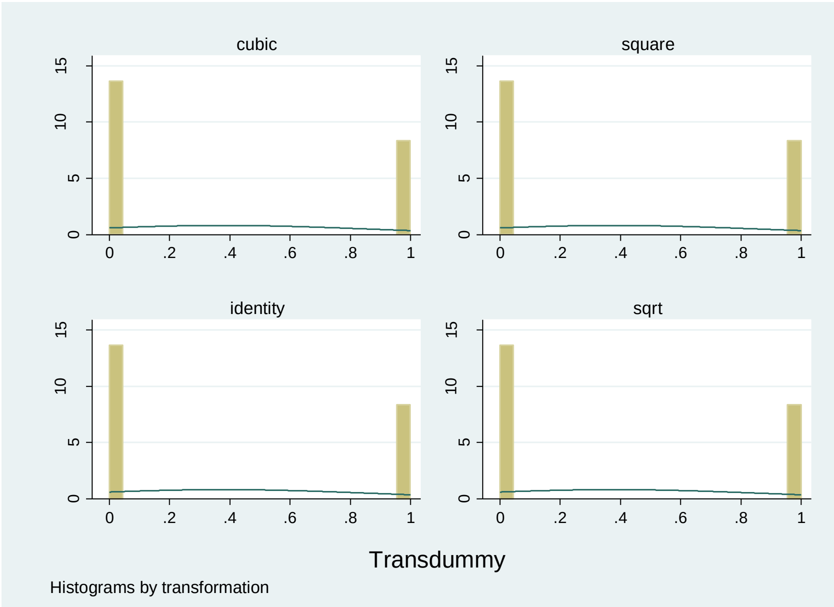


Figure A4.5.7 Functional transformation for *emplcvt*

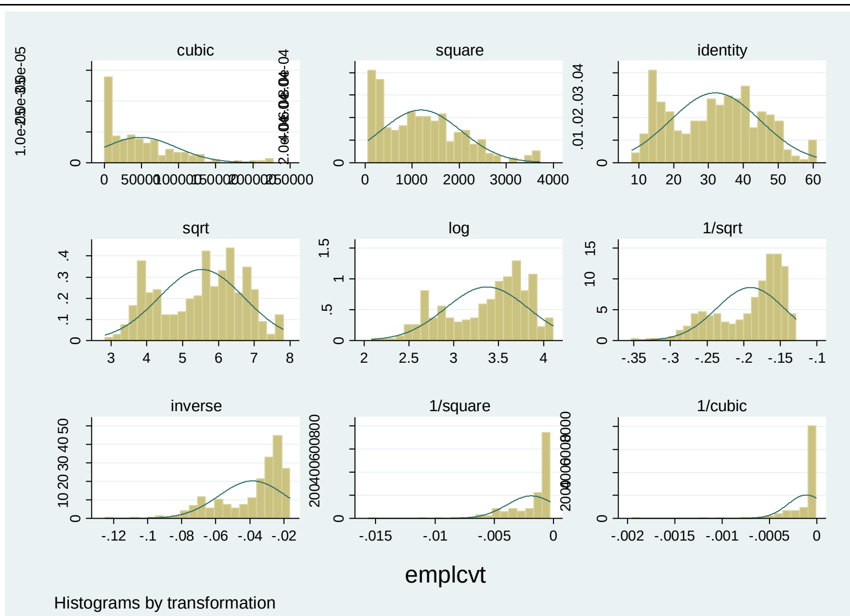
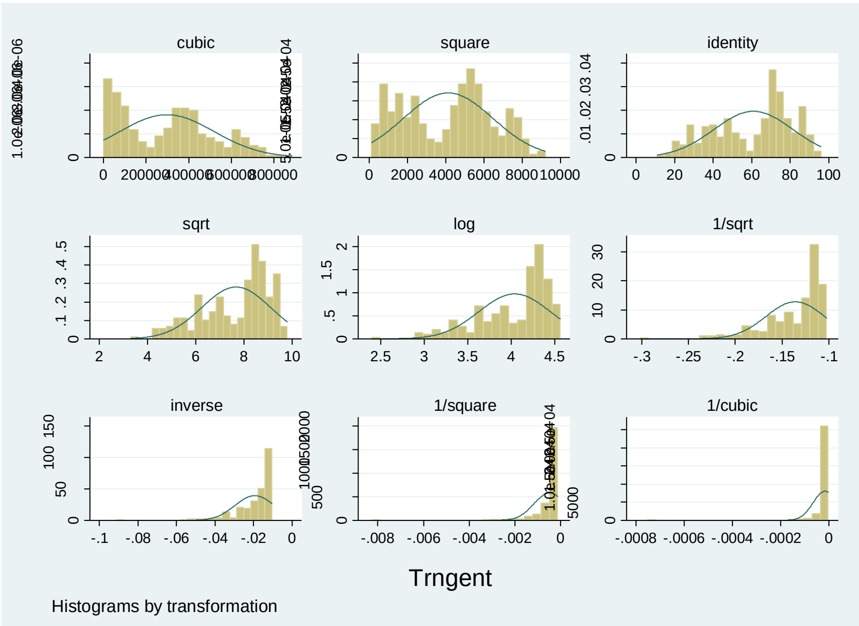


Figure A4.5.8 Functional transformation for *trngent*



Industry level analysis

Table A4.6 Model 1 - Fixed effects estimated results

```
 xtreg lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.0274                         Obs per group: min =         5
       between = 0.0000                                        avg =      13.3
       overall = 0.0024                                        max =        16

                                                F(25,3305)         =      3.72
corr(u_i, Xb)  = -0.5586                        Prob > F           =    0.0000

------------------------------------------------------------------------------
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1234209   .0684403     1.80   0.071    -.0107688    .2576106
     lntedut |  -.1546624   .0690227    -2.24   0.025    -.2899941   -.0193308
     cskills |  (omitted)
   lnpatappr |   .0679651   .0150417     4.52   0.000     .0384731     .097457
       lnfdi |   .0142454   .0032775     4.35   0.000     .0078193    .0206714
      lngdpc |   .0150208    .076413     0.20   0.844    -.1348007    .1648423
       lnpop |  -.5476247   .2176893    -2.52   0.012    -.9744442   -.1208051
        unem |  -.0011066   .0004864    -2.28   0.023    -.0020601    -.000153
   lnecofree |   -.113683   .0961946    -1.18   0.237      -.30229     .074924
```

```
      lnrulc |   .0473726   .1067171     0.44   0.657    -.1618658    .2566109
        serv |   .0055433   .0020919     2.65   0.008     .0014418    .0096448
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0056938   .0267864     0.21   0.832    -.0468259    .0582135
    year1997 |   .0015589   .0271223     0.06   0.954    -.0516193    .0547371
    year1998 |  -.0012644   .0277959    -0.05   0.964    -.0557633    .0532345
    year1999 |  -.0374796   .0288172    -1.30   0.193    -.0939809    .0190217
    year2000 |  -.0415794   .0291777    -1.43   0.154    -.0987875    .0156287
    year2001 |  -.0272956   .0302586    -0.90   0.367    -.0866231    .0320319
    year2002 |  -.0325108   .0322816    -1.01   0.314    -.0958048    .0307831
    year2003 |  -.0140008   .0338229    -0.41   0.679    -.0803167    .0523152
    year2004 |  -.0238826   .0355823    -0.67   0.502    -.0936481    .0458829
    year2005 |  -.0273414   .0380414    -0.72   0.472    -.1019285    .0472457
    year2006 |  -.0158675   .0400352    -0.40   0.692    -.0943638    .0626287
    year2007 |  -.0233036   .0416941    -0.56   0.576    -.1050524    .0584452
    year2008 |  -.0417289   .0428789    -0.97   0.331    -.1258007    .0423429
    year2009 |  -.0551752   .0435849    -1.27   0.206    -.1406312    .0302809
    year2010 |  -.0389955   .0444093    -0.88   0.380     -.126068     .048077
       _cons |   4.146145   2.583454     1.60   0.109    -.9191861    9.211477
-------------+----------------------------------------------------------------
     sigma_u |  .99724611
     sigma_e |  .20753679
         rho |  .95848814   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(269, 3305) =   185.25           Prob > F = 0.0000
```

Table A4.6.1 Model 1 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   3.4e+05
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,     269) =    256.882
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1670.2717
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 0
LM5= 40.868958
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0

Test for significance of fixed effects
```

```
F= 185.25419
Probability>F= 0
Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                   ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------
    __00000B |   3.6e+03   0.0020         0.0000            .         0.0000
```

Table A4.6.2 Model 1 - Driscoll-Kraay estimated results

```
xtscc lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =      3600
Method: Fixed-effects regression                 Number of groups  =       270
Group variable (i): cn_ind                       F( 28,    269)     =   6606.68
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.0274

------------------------------------------------------------------------------
             |             Drisc/Kraay
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1234209   .0398783     3.09   0.002     .0449076    .2019343
     lntedut |  -.1546624   .0433464    -3.57   0.000    -.2400038   -.0693211
     cskills |  (omitted)
   lnpatappr |   .0679651   .0151777     4.48   0.000     .0380828    .0978473
       lnfdi |   .0142454   .0013518    10.54   0.000     .0115839    .0169069
      lngdpc |   .0150208   .0819883     0.18   0.855    -.1463995    .1764411
       lnpop |  -.5476247    .156811    -3.49   0.001    -.8563575   -.2388918
        unem |  -.0011066   .0003679    -3.01   0.003    -.0018309   -.0003822
   lnecofree |   -.113683   .0358397    -3.17   0.002     -.184245    -.043121
      lnrulc |   .0473726   .0727631     0.65   0.516    -.0958851    .1906302
        serv |   .0055433   .0022764     2.44   0.016     .0010615    .0100251
        dist |   .0039818   .0018959     2.10   0.037     .0002491    .0077145
  transdummy |  (omitted)
    year1996 |   .0056938   .0062413     0.91   0.362    -.0065943    .0179818
    year1997 |   .0015589   .0059499     0.26   0.794    -.0101554    .0132731
    year1998 |  -.0012644   .0072446    -0.17   0.862    -.0155278     .012999
    year1999 |  -.0374796   .0094535    -3.96   0.000    -.0560919   -.0188674
    year2000 |  -.0415794   .0097198    -4.28   0.000    -.0607159   -.0224429
    year2001 |  -.0272956   .0111549    -2.45   0.015    -.0492576   -.0053335
    year2002 |  -.0325108   .0128895    -2.52   0.012    -.0578881   -.0071336
    year2003 |  -.0140008   .0156999    -0.89   0.373    -.0449111    .0169096
    year2004 |  -.0238826   .0179897    -1.33   0.185     -.059301    .0115359
    year2005 |  -.0273414   .0208688    -1.31   0.191    -.0684284    .0137456
    year2006 |  -.0158675   .0241009    -0.66   0.511     -.063318    .0315829
    year2007 |  -.0233036   .0271546    -0.86   0.392    -.0767661    .0301589
    year2008 |  -.0417289   .0274523    -1.52   0.130    -.0957776    .0123198
    year2009 |  -.0551752   .0234714    -2.35   0.019    -.1013862   -.0089641
    year2010 |  -.0389955    .024281    -1.61   0.109    -.0868004    .0088094
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.6.3 Model 1 - FEVD estimated results

```
xtfevd lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
```

```
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant(cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      3302          number of obs       =      3600
mean squared error         =   .039542          F( 30, 3302)        = 2.572316
root mean squared error    = .1988518           Prob > F            = .0000113
Residual Sum of Squares    = 142.3514           R-squared           = .9404561
Total Sum of Squares       = 2390.695           adj. R-squared      = .9351004
Estimation Sum of Squares  = 2248.343

------------------------------------------------------------------------------
             |                fevd
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1234209   .4874045     0.25   0.800    -.8322247    1.079067
     lntedut |  -.1546624   .7953648    -0.19   0.846     -1.71412    1.404796
   lnpatappr |    .067965   .1371675     0.50   0.620    -.2009769     .336907
       lnfdi |   .0142454   .0295928     0.48   0.630    -.0437767    .0722675
      lngdpc |   .0150208   1.088136     0.01   0.989    -2.118469     2.14851
       lnpop |  -.5476247   .3725321    -1.47   0.142    -1.278042    .1827927
        unem |  -.0011066    .001808    -0.61   0.541    -.0046514    .0024383
   lnecofree |   -.113683   .4776359    -0.24   0.812    -1.050175    .8228095
      lnrulc |   .0473725   .4302181     0.11   0.912    -.7961486    .8908937
        serv |   .0055433   .0128854     0.43   0.667    -.0197209    .0308076
    year1996 |   .0056938   .1110193     0.05   0.959    -.2119799    .2233674
    year1997 |   .0015589   .1293945     0.01   0.990    -.2521426    .2552604
    year1998 |  -.0012644   .1412976    -0.01   0.993    -.2783041    .2757753
    year1999 |  -.0374796   .1186475    -0.32   0.752    -.2701097    .1951505
    year2000 |  -.0415794   .1258059    -0.33   0.741    -.2882448    .2050859
    year2001 |  -.0272956    .152776    -0.18   0.858    -.3268409    .2722498
    year2002 |  -.0325108   .1518988    -0.21   0.831    -.3303362    .2653145
    year2003 |  -.0140008   .1615578    -0.09   0.931    -.3307643    .3027628
    year2004 |  -.0238826   .1577766    -0.15   0.880    -.3332325    .2854673
    year2005 |  -.0273414    .174896    -0.16   0.876    -.3702569    .3155741
    year2006 |  -.0158676   .1694724    -0.09   0.925    -.3481491     .316414
    year2007 |  -.0233036    .205376    -0.11   0.910    -.4259807    .3793735
    year2008 |  -.0417289   .1978709    -0.21   0.833    -.4296909    .3462331
    year2009 |  -.0551752   .1987421    -0.28   0.781    -.4448454    .3344951
    year2010 |  -.0389955   .2021095    -0.19   0.847    -.4352682    .3572771
     cskills |  -.3629372   .5723603    -0.63   0.526    -1.485154    .7592796
        dist |  -.0001364   .0004756    -0.29   0.774    -.0010688    .0007961
  transdummy |  -.0087393   1.446683    -0.01   0.995    -2.845226    2.827747
         eta |          1          .        .       .            .           .
       _cons |   6.078501   11.31066     0.54   0.591    -16.09812    28.25512
------------------------------------------------------------------------------
```

Table A4.6.4 Model 1 - Hausman and Taylor estimated results

```
xthtaylor lnrxa lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
endog (lnsedut lntedut cskills)

Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

                                                Obs per group: min =         5
                                                               avg =      13.3
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =     94.01
```

```
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lnrxa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |   .0685678   .0145664     4.71   0.000     .0400182    .0971173
       lnfdi |    .013809   .0032239     4.28   0.000     .0074902    .0201277
      lngdpc |   .1093974   .0598297     1.83   0.067    -.0078667    .2266615
       lnpop |  -.0939836   .0527848    -1.78   0.075    -.1974399    .0094727
        unem |  -.0008941     .00047    -1.90   0.057    -.0018153    .0000271
   lnecofree |  -.0921139   .0934604    -0.99   0.324    -.2752928     .091065
      lnrulc |   .0312761   .1048266     0.30   0.765    -.1741803    .2367325
        serv |   .0055438   .0020324     2.73   0.006     .0015603    .0095273
    year1996 |   .0046537   .0263899     0.18   0.860    -.0470695    .0563769
    year1997 |  -.0011457   .0266708    -0.04   0.966    -.0534195    .0511281
    year1998 |  -.0038903   .0273055    -0.14   0.887    -.0574081    .0496276
    year1999 |  -.0422605   .0282025    -1.50   0.134    -.0975365    .0130155
    year2000 |  -.0498774   .0283101    -1.76   0.078    -.1053641    .0056094
    year2001 |  -.0378999   .0291346    -1.30   0.193    -.0950027    .0192028
    year2002 |  -.0456874    .030842    -1.48   0.139    -.1061367    .0147618
    year2003 |  -.0287572   .0322045    -0.89   0.372    -.0918769    .0343625
    year2004 |  -.0432241   .0333396    -1.30   0.195    -.1085684    .0221203
    year2005 |  -.0506457   .0352089    -1.44   0.150    -.1196538    .0183624
    year2006 |  -.0436607   .0364289    -1.20   0.231      -.11506    .0277387
    year2007 |  -.0544594   .0374901    -1.45   0.146    -.1279386    .0190198
    year2008 |  -.0724745   .0386098    -1.88   0.061    -.1481484    .0031994
    year2009 |  -.0770145   .0406726    -1.89   0.058    -.1567313    .0027024
    year2010 |  -.0633935   .0411285    -1.54   0.123    -.1440038    .0172168
TVendogenous |
     lnsedut |   .1446695   .0650882     2.22   0.026     .0170989    .2722401
     lntedut |  -.2070473   .0632375    -3.27   0.001    -.3309905   -.0831041
TIexogenous  |
        dist |   .0000149     .00013     0.11   0.909    -.0002399    .0002696
  transdummy |   .3989881   .1596994     2.50   0.012      .085983    .7119931
TIendogenous |
     cskills |  -.4118763   .4520302    -0.91   0.362    -1.297839    .4740867
             |
       _cons |   .9925833   2.485329     0.40   0.690    -3.878573    5.863739
-------------+----------------------------------------------------------------
     sigma_u |  1.0202289
     sigma_e |  .20675628
         rho |  .96055042   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A4.6.5 Model 1 - IV estimated results

```
xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1), fe endog (lnsedut lntedut
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       270                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15
```

```
IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     3450
                                                      F( 24,  3156) =     1.85
                                                      Prob > F      =   0.0073
Total (centered) SS     =  129.2441112                Centered R2   =   0.0245
Total (uncentered) SS   =  129.2441112                Uncentered R2 =   0.0245
Residual SS             =  126.0740867                Root MSE      =    .1999

------------------------------------------------------------------------------
             |               Robust
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0942457   .1083871     0.87   0.385    -.1182707     .306762
     lntedut |   -.122198   .1254647    -0.97   0.330    -.3681986    .1238027
   lnpatappr |   .1062714     .03392     3.13   0.002      .039764    .1727789
       lnfdi |    .018941   .0056111     3.38   0.001     .0079393    .0299428
      lngdpc |  -.0465591   .1352415    -0.34   0.731    -.3117293    .2186111
       lnpop |  -.6157787   .3767464    -1.63   0.102    -1.354471     .122914
        unem |  -.0010206   .0006243    -1.63   0.102    -.0022446    .0002035
   lnecofree |   .0003291    .143375     0.00   0.998    -.2807886    .2814468
        serv |   .0059893   .0034451     1.74   0.082    -.0007657    .0127442
      lnrulc |   .0255151   .1757974     0.15   0.885    -.3191736    .3702038
    year1996 |   .0808597   .0522539     1.55   0.122    -.0215954    .1833148
    year1997 |   .0721762   .0481352     1.50   0.134    -.0222033    .1665556
    year1998 |   .0674149   .0437543     1.54   0.123    -.0183747    .1532046
    year1999 |   .0345248   .0422973     0.82   0.414    -.0484081    .1174577
    year2000 |    .029319   .0379832     0.77   0.440    -.0451553    .1037934
    year2001 |   .0413628   .0335962     1.23   0.218    -.0245097    .1072354
    year2002 |   .0312739   .0312173     1.00   0.317    -.0299343    .0924822
    year2003 |   .0479855   .0300909     1.59   0.111    -.0110143    .1069853
    year2004 |   .0454566   .0291213     1.56   0.119     -.011642    .1025552
    year2005 |   .0448666   .0276705     1.62   0.105    -.0093873    .0991205
    year2006 |   .0528517    .028987     1.82   0.068    -.0039837     .109687
    year2007 |   .0471474   .0283721     1.66   0.097    -.0084823    .1027771
    year2008 |   .0241729    .020202     1.20   0.232    -.0154376    .0637834
    year2010 |   .0148231   .0150658     0.98   0.325    -.0147166    .0443629
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            155.757
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              698.597
                         (Kleibergen-Paap rk Wald F statistic):        169.991
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              10.987
                                                   Chi-sq(4) P-val =    0.0267
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
```

```
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.6.5.1 Model 1 - IV estimated results (ETEs)

```
xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                     Obs per group: min =         7
                                                                avg =      13.3
                                                                max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      1330
                                                      F( 25,   1205) =      1.05
                                                      Prob > F      =    0.4013
Total (centered) SS     =  82.13284054                Centered R2   =    0.0401
Total (uncentered) SS   =  82.13284054                Uncentered R2 =    0.0401
Residual SS             =  78.84137663                Root MSE      =     .2558
```

lnrxa	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnsedut	-.600155	.4101264	-1.46	0.144	-1.404796	.2044862
lntedut	-.1129637	.2867444	-0.39	0.694	-.6755374	.4496101
lnpatappr	-.0282684	.1086767	-0.26	0.795	-.2414851	.1849483
lnfdi	.0659424	.0855849	0.77	0.441	-.1019696	.2338544
lngdpc	.289886	.2465175	1.18	0.240	-.1937653	.7735373
lnpop	-3.025744	1.594587	-1.90	0.058	-6.15422	.1027313
unem	.0004501	.001359	0.33	0.741	-.0022162	.0031164
lnecofree	.2634736	.2958641	0.89	0.373	-.3169925	.8439396
serv	-.0046543	.0078829	-0.59	0.555	-.02012	.0108115
lnrulc	.2403688	.2364923	1.02	0.310	-.2236138	.7043513
transindn	-.3848616	.4236559	-0.91	0.364	-1.216047	.4463236
year1996	.2569396	.2772193	0.93	0.354	-.2869465	.8008258
year1997	.2190671	.2430111	0.90	0.368	-.2577047	.6958389
year1998	.1904372	.2203951	0.86	0.388	-.2419637	.622838
year1999	.1141801	.2036971	0.56	0.575	-.2854604	.5138205
year2000	.1339896	.1800903	0.74	0.457	-.2193358	.4873151
year2001	.1323446	.1554394	0.85	0.395	-.1726174	.4373066
year2002	.1408549	.1188407	1.19	0.236	-.0923027	.3740126
year2003	.0937076	.111793	0.84	0.402	-.1256229	.3130382
year2004	.061726	.0902432	0.68	0.494	-.1153252	.2387772
year2005	.0640983	.0768106	0.83	0.404	-.086599	.2147956
year2006	.0287601	.0675869	0.43	0.671	-.103841	.1613612
year2007	-.006462	.059547	-0.11	0.914	-.1232894	.1103653

```
    year2008 |  -.0220229   .0455857    -0.48   0.629    -.1114591    .0674133
    year2010 |   .0052942   .0369475     0.14   0.886    -.0671944    .0777828
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            122.763
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              160.445
                         (Kleibergen-Paap rk Wald F statistic):        122.493
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               2.367
                                                   Chi-sq(4) P-val =    0.6686
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1996
                      year1997 year1998 year1999 year2000 year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.6.5.2 Model 1 - IV estimated results (N-ETEs)

```
xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     2120
                                                      F( 24,  1926) =     2.31
                                                      Prob > F      =   0.0003
Total (centered) SS     =  47.11127063                Centered R2   =   0.0594
Total (uncentered) SS   =  47.11127063                Uncentered R2 =   0.0594
Residual SS             =  44.31271944                Root MSE      =    .1517

------------------------------------------------------------------------------
             |               Robust
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
     lnsedut |   .2617736   .1072878     2.44   0.015     .0513611    .4721861
     lntedut |   .0083084   .1431877     0.06   0.954    -.2725108    .2891276
   lnpatappr |   .1107816   .0453566     2.44   0.015     .0218284    .1997348
       lnfdi |   .0194609   .0058887     3.30   0.001      .007912    .0310098
      lngdpc |   .0467309   .2310044     0.20   0.840    -.4063141    .4997758
       lnpop |  -1.331936   .4488725    -2.97   0.003    -2.212263   -.4516084
        unem |  -.0004952   .0006731    -0.74   0.462    -.0018153    .0008248
   lnecofree |   .1042241   .1694347     0.62   0.539    -.2280707    .4365189
        serv |   .0151488   .0046034     3.29   0.001     .0061206    .0241769
      lnrulc |  -.0227677   .2746152    -0.08   0.934     -.561342    .5158067
    year1996 |   .1251823   .0743513     1.68   0.092    -.0206352    .2709998
    year1997 |   .1174659   .0673052     1.75   0.081    -.0145329    .2494647
    year1998 |   .1083894   .0591354     1.83   0.067    -.0075868    .2243656
    year1999 |   .0985957    .052567     1.88   0.061    -.0044985    .2016899
    year2000 |   .0745485   .0442142     1.69   0.092    -.0121641    .1612612
    year2001 |   .0775124   .0396113     1.96   0.051    -.0001732     .155198
    year2002 |   .0445962   .0356336     1.25   0.211    -.0252883    .1144806
    year2003 |   .0662356   .0334325     1.98   0.048     .0006679    .1318033
    year2004 |   .0598957   .0321401     1.86   0.063    -.0031373    .1229287
    year2005 |   .0421549    .029088     1.45   0.147    -.0148924    .0992023
    year2006 |   .0552848   .0265654     2.08   0.038     .0031848    .1073848
    year2007 |   .0522269   .0261807     1.99   0.046     .0008815    .1035724
    year2008 |   .0295374   .0201756     1.46   0.143    -.0100309    .0691056
    year2010 |    .010323   .0159054     0.65   0.516    -.0208705    .0415165
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            101.470
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              296.127
                         (Kleibergen-Paap rk Wald F statistic):         73.906
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               7.171
                                                   Chi-sq(4) P-val =    0.1271
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.7 Model 2 - Fixed effects estimated results

```
xtreg lnrxa avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.0310                         Obs per group: min =         5
       between = 0.0000                                        avg =      13.3
       overall = 0.0018                                        max =        16
```

```
                                                F(25,3305)        =      4.23
corr(u_i, Xb)  = -0.7634                        Prob > F          =    0.0000

------------------------------------------------------------------------------
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4830082   .1100836     4.39   0.000     .2671692    .6988471
    sqravyrs |  -.0207875   .0050919    -4.08   0.000     -.030771   -.0108039
     cskills |  (omitted)
   lnpatappr |    .069517   .0150222     4.63   0.000     .0400633    .0989707
       lnfdi |   .0106467   .0032345     3.29   0.001     .0043049    .0169886
      lngdpc |  -.0939363   .0649537    -1.45   0.148    -.2212898    .0334172
       lnpop |  -.8503491   .1966108    -4.33   0.000     -1.23584   -.4648578
        unem |  -.0005264   .0005111    -1.03   0.303    -.0015284    .0004757
   lnecofree |  -.0702104   .0954394    -0.74   0.462    -.2573367     .116916
      lnrulc |   .1319793   .1078344     1.22   0.221    -.0794497    .3434084
        serv |   .0025944   .0021369     1.21   0.225    -.0015953    .0067842
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0020329   .0266115     0.08   0.939    -.0501438    .0542095
    year1997 |  -.0095525    .026952    -0.35   0.723    -.0623969    .0432918
    year1998 |  -.0145711   .0273733    -0.53   0.595    -.0682415    .0390992
    year1999 |   -.046926    .028096    -1.67   0.095    -.1020133    .0081613
    year2000 |  -.0448797   .0280785    -1.60   0.110    -.0999327    .0101732
    year2001 |  -.0389746   .0289264    -1.35   0.178      -.09569    .0177408
    year2002 |  -.0455315   .0306926    -1.48   0.138    -.1057098    .0146468
    year2003 |  -.0301498   .0318946    -0.95   0.345    -.0926851    .0323854
    year2004 |  -.0418106   .0335868    -1.24   0.213    -.1076636    .0240424
    year2005 |  -.0457036   .0357401    -1.28   0.201    -.1157785    .0243712
    year2006 |  -.0376922   .0378847    -0.99   0.320    -.1119721    .0365877
    year2007 |  -.0443865   .0393349    -1.13   0.259    -.1215098    .0327367
    year2008 |  -.0681821   .0400883    -1.70   0.089    -.1467826    .0104184
    year2009 |  -.0864546   .0396743    -2.18   0.029    -.1642433   -.0086659
    year2010 |  -.0778298   .0409272    -1.90   0.057    -.1580751    .0024155
       _cons |   4.909063   2.420573     2.03   0.043     .1630882    9.655037
-------------+----------------------------------------------------------------
     sigma_u |  1.2867459
     sigma_e |  .20715126
         rho |  .97473745   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(269, 3305) =   185.44           Prob > F = 0.0000
```

Table A4.7.1 Model 2 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   3.0e+05
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnrxa avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      269) =    251.294
           Prob > F =      0.0000
```

Normality of residuals

```
Test for serial correlation in residuals
```

```
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1669.6988
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 0
LM5= 40.861948
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0
Test for significance of fixed effects
F= 185.43749
Probability>F= 0

Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                       ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |   3.6e+03   0.0026         0.0000            .          0.0000
```

Table A4.7.2 Model 2 - Driscoll-Kraay estimated results

```
xtscc lnrxa avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =      3600
Method: Fixed-effects regression                 Number of groups  =       270
Group variable (i): cn_ind                       F( 28,    269)    =    974.30
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.0310

------------------------------------------------------------------------------
             |             Drisc/Kraay
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4830082   .0762068     6.34   0.000     .3329705    .6330458
    sqravyrs |  -.0207875    .003683    -5.64   0.000    -.0280386   -.0135363
     cskills |  (omitted)
   lnpatappr |    .069517   .0133581     5.20   0.000     .0432172    .0958168
       lnfdi |   .0106467   .0007563    14.08   0.000     .0091577    .0121358
      lngdpc |  -.0939363   .0665949    -1.41   0.160    -.2250497    .0371772
       lnpop |  -.8503491   .1638855    -5.19   0.000     -1.17301   -.5276877
        unem |  -.0005264   .0003013    -1.75   0.082    -.0011195    .0000668
   lnecofree |  -.0702104   .0276044    -2.54   0.012    -.1245584   -.0158623
      lnrulc |   .1319793    .053279     2.48   0.014     .0270824    .2368763
        serv |   .0025944   .0024943     1.04   0.299    -.0023163    .0075052
        dist |   .0047145   .0021526     2.19   0.029     .0004763    .0089526
  transdummy |  (omitted)
    year1996 |   .0020329   .0074585     0.27   0.785    -.0126515    .0167172
    year1997 |  -.0095525   .0069163    -1.38   0.168    -.0231695    .0040644
    year1998 |  -.0145711   .0077955    -1.87   0.063    -.0299191    .0007768
    year1999 |   -.046926    .010038    -4.67   0.000    -.0666891    -.027163
    year2000 |  -.0448797    .010839    -4.14   0.000    -.0662199   -.0235396
    year2001 |  -.0389746   .0115259    -3.38   0.001     -.061667   -.0162822
    year2002 |  -.0455315   .0133886    -3.40   0.001    -.0718913   -.0191717
    year2003 |  -.0301498   .0155421    -1.94   0.053    -.0607494    .0004498
    year2004 |  -.0418106   .0171901    -2.43   0.016    -.0756548   -.0079664
    year2005 |  -.0457036   .0193466    -2.36   0.019    -.0837935   -.0076137
    year2006 |  -.0376922   .0213753    -1.76   0.079    -.0797763    .0043919
    year2007 |  -.0443865   .0234229    -1.90   0.059    -.0905021    .0017291
    year2008 |  -.0681821   .0234934    -2.90   0.004    -.1144364   -.0219278
    year2009 |  -.0864546   .0225943    -3.83   0.000    -.1309388   -.0419705
```

```
    year2010 |  -.0778298   .0230108    -3.38   0.001     -.123134   -.0325256
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A4.7.3 Model 2 - FEVD estimated results

```
xtfevd lnrxa avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, invariant
(cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      3302           number of obs        =      3600
mean squared error         = .0393953            F( 30, 3302)         = 3.870213
root mean squared error    = .1984824            Prob > F             = 3.55e-11
Residual Sum of Squares    =  141.823            R-squared            = .9406771
Total Sum of Squares       = 2390.695            adj. R-squared       = .9353412
Estimation Sum of Squares  = 2248.872

------------------------------------------------------------------------------
             |              fevd
       lnrxa |      Coef.   Std. Err.       t     P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4830082   .7908615     0.61   0.541     -1.06762    2.033637
    sqravyrs |  -.0207875   .0346373    -0.60   0.548    -.0887003    .0471253
   lnpatappr |    .069517   .1078528     0.64   0.519     -.141948    .2809821
       lnfdi |   .0106467    .043342     0.25   0.806    -.0743332    .0956267
      lngdpc |  -.0939363   .7306091    -0.13   0.898    -1.526429    1.338556
       lnpop |  -.8503491   .3737762    -2.28   0.023    -1.583206   -.1174926
        unem |  -.0005264    .002196    -0.24   0.811    -.0048321    .0037794
   lnecofree |  -.0702103   .5734646    -0.12   0.903    -1.194592    1.054172
      lnrulc |   .1319793   .4715409     0.28   0.780    -.7925627    1.056521
        serv |   .0025944   .0134111     0.19   0.847    -.0237005    .0288894
    year1996 |   .0020329   .1077622     0.02   0.985    -.2092546    .2133204
    year1997 |  -.0095525   .1238833    -0.08   0.939    -.2524484    .2333433
    year1998 |  -.0145711   .1310643    -0.11   0.911    -.2715467    .2424045
    year1999 |   -.046926     .14301    -0.33   0.743    -.3273232    .2334712
    year2000 |  -.0448797   .1339905    -0.33   0.738    -.3075926    .2178331
    year2001 |  -.0389746   .1401024    -0.28   0.781    -.3136709    .2357217
    year2002 |  -.0455315   .1469168    -0.31   0.757    -.3335887    .2425256
    year2003 |  -.0301498   .1805425    -0.17   0.867    -.3841364    .3238367
    year2004 |  -.0418106   .2060778    -0.20   0.839    -.4458638    .3622426
    year2005 |  -.0457036   .2353333    -0.19   0.846    -.5071175    .4157103
    year2006 |  -.0376922   .2428116    -0.16   0.877    -.5137686    .4383842
    year2007 |  -.0443865   .3021498    -0.15   0.883    -.6368064    .5480334
    year2008 |  -.0681821   .2949383    -0.23   0.817    -.6464626    .5100984
    year2009 |  -.0864546   .2650839    -0.33   0.744    -.6062001    .4332908
    year2010 |  -.0778298    .271283    -0.29   0.774    -.6097296    .4540701
     cskills |  -.6681441   .5504917    -1.21   0.225    -1.747484    .4111954
        dist |  -.0003026   .0003875    -0.78   0.435    -.0010623    .0004571
  transdummy |  -.3068022   1.131639    -0.27   0.786    -2.525587    1.911983
         eta |          1          .        .       .            .           .
       _cons |   8.630719   9.639938     0.90   0.371    -10.27014    27.53158
```

Table A4.7.4 Model 2 - Hausman and Taylor estimated results

```
xthtaylor lnrxa avyrs sqravyrs  cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
endog (avyrs sqravyrs cskills)
```

```
Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

                                                Obs per group: min =         5
                                                               avg =      13.3
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =     93.11
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lnrxa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |   .0765332   .0144488     5.30   0.000      .048214    .1048523
       lnfdi |   .0091228   .0031418     2.90   0.004      .002965    .0152807
      lngdpc |   .0254856   .0550361     0.46   0.643    -.0823833    .1333544
       lnpop |  -.1443884   .0630392    -2.29   0.022    -.2679429   -.0208339
        unem |  -.0003334   .0004953    -0.67   0.501    -.0013042    .0006375
   lnecofree |  -.0197373   .0918539    -0.21   0.830    -.1997677    .1602931
      lnrulc |   .0983888   .1051942     0.94   0.350     -.107788    .3045656
        serv |   .0021562    .002065     1.04   0.296     -.001891    .0062035
    year1996 |   .0023962   .0260568     0.09   0.927    -.0486742    .0534666
    year1997 |  -.0117681   .0263657    -0.45   0.655    -.0634439    .0399077
    year1998 |  -.0149471   .0267763    -0.56   0.577    -.0674278    .0375336
    year1999 |   -.049337   .0274523    -1.80   0.072    -.1031425    .0044685
    year2000 |  -.0519156   .0273535    -1.90   0.058    -.1055275    .0016963
    year2001 |  -.0509954   .0280145    -1.82   0.069    -.1059028     .003912
    year2002 |  -.0613962   .0295791    -2.08   0.038    -.1193702   -.0034222
    year2003 |  -.0480625   .0306607    -1.57   0.117    -.1081564    .0120314
    year2004 |  -.0671229   .0319063    -2.10   0.035    -.1296581   -.0045877
    year2005 |  -.0770967   .0336381    -2.29   0.022    -.1430262   -.0111673
    year2006 |  -.0771328   .0351335    -2.20   0.028    -.1459933   -.0082723
    year2007 |  -.0896413   .0360916    -2.48   0.013    -.1603797    -.018903
    year2008 |  -.1156465   .0366004    -3.16   0.002     -.187382    -.043911
    year2009 |  -.1230803   .0371509    -3.31   0.001    -.1958948   -.0502657
    year2010 |  -.1189885   .0380092    -3.13   0.002    -.1934852   -.0444918
TVendogenous |
       avyrs |   .4629558   .1066994     4.34   0.000     .2538288    .6720828
    sqravyrs |  -.0202253   .0049407    -4.09   0.000    -.0299088   -.0105418
TIexogenous  |
        dist |  -.0000479    .000161    -0.30   0.766    -.0003635    .0002677
  transdummy |   .3115623   .1902851     1.64   0.102    -.0613895    .6845142
TIendogenous |
     cskills |  -.6371477   .5638827    -1.13   0.259    -1.742337     .468042
             |
       _cons |   .4556345     3.1143     0.15   0.884    -5.648281     6.55955
-------------+----------------------------------------------------------------
     sigma_u |  1.2877728
     sigma_e |   .2063722
         rho |  .97496133   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A4.7.5 Model 2 - IV estimated results

```
. xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs lnpatappr
lnfdi) small robust bw(3)
```

```
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       270                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     3450
                                                      F( 24,  3156) =     1.88
                                                      Prob > F      =   0.0059
Total (centered) SS     =  129.2441112                Centered R2   =   0.0273
Total (uncentered) SS   =  129.2441112                Uncentered R2 =   0.0273
Residual SS             =  125.7141955                Root MSE      =    .1996

------------------------------------------------------------------------------
             |               Robust
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .5160941   .1847943     2.79   0.005      .153765    .8784231
    sqravyrs |  -.0220156   .0085695    -2.57   0.010     -.038818   -.0052133
   lnpatappr |   .1061824   .0341583     3.11   0.002     .0392077     .173157
       lnfdi |   .0141061   .0054714     2.58   0.010     .0033783    .0248339
      lngdpc |  -.1362473   .1088761    -1.25   0.211    -.3497225    .0772278
       lnpop |  -.8348867   .3376568    -2.47   0.013    -1.496936   -.1728376
        unem |  -.0004697   .0006031    -0.78   0.436    -.0016522    .0007128
   lnecofree |   .0088918   .1421278     0.06   0.950    -.2697804    .2875641
        serv |   .0031296   .0035489     0.88   0.378    -.0038288    .0100879
      lnrulc |    .096033   .1732456     0.55   0.579    -.2436524    .4357184
    year1996 |   .1093559   .0480722     2.27   0.023     .0150999    .2036119
    year1997 |   .0946754   .0430999     2.20   0.028     .0101687    .1791822
    year1998 |   .0875996   .0391434     2.24   0.025     .0108504    .1643487
    year1999 |   .0549852   .0374399     1.47   0.142    -.0184238    .1283942
    year2000 |   .0576506   .0327564     1.76   0.079    -.0065753    .1218766
    year2001 |    .060846   .0297057     2.05   0.041     .0026017    .1190904
    year2002 |   .0496195   .0272101     1.82   0.068    -.0037318    .1029708
    year2003 |   .0628701   .0267928     2.35   0.019     .0103372    .1154031
    year2004 |    .057094   .0252483     2.26   0.024     .0075893    .1065987
    year2005 |   .0548447   .0239234     2.29   0.022     .0079378    .1017517
    year2006 |   .0595986   .0247215     2.41   0.016     .0111268    .1080704
    year2007 |   .0549333   .0240283     2.29   0.022     .0078207    .1020459
    year2008 |   .0263909   .0177325     1.49   0.137    -.0083774    .0611592
    year2010 |    .007029   .0149147     0.47   0.637    -.0222145    .0362726
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            141.983
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              693.024
                         (Kleibergen-Paap rk Wald F statistic):        153.911
Stock-Yogo weak ID test critical values:                         <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
```

```
-endog- option:
Endogeneity test of endogenous regressors:                          11.539
                                                   Chi-sq(4) P-val =    0.0211
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.7.5.1 Model 2 - IV estimated results (ETEs)

```
 xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindN year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small ro
> bust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1330
                                                      F( 25,   1205) =     1.05
                                                      Prob > F      =   0.3899
Total (centered) SS     =  82.13284054                Centered R2   =   0.0371
Total (uncentered) SS   =  82.13284054                Uncentered R2 =   0.0371
Residual SS             =  79.08637983                Root MSE      =    .2562

------------------------------------------------------------------------------
             |               Robust
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |    .901425   .6347637     1.42   0.156      -.34394     2.14679
    sqravyrs |  -.0448221   .0265018    -1.69   0.091     -.096817    .0071727
   lnpatappr |   .1103746   .1115165     0.99   0.322    -.1084134    .3291626
       lnfdi |   .0800574   .0813805     0.98   0.325    -.0796058    .2397207
      lngdpc |    .352139   .2779699     1.27   0.205    -.1932198    .8974978
       lnpop |  -.1689262   2.036301    -0.08   0.934    -4.164015    3.826163
        unem |   .0005633   .0013559     0.42   0.678    -.0020969    .0032235
   lnecofree |   .0987891   .2731213     0.36   0.718     -.437057    .6346352
        serv |  -.0011461   .0072724    -0.16   0.875    -.0154141    .0131218
      lnrulc |   .1961243   .2322245     0.84   0.399     -.259485    .6517335
   transindN |  -.4598909   .4418534    -1.04   0.298    -1.326778    .4069966
    year1996 |   .2509804   .2475202     1.01   0.311    -.2346381    .7365989
    year1997 |   .2244127   .2095868     1.07   0.285    -.1867829    .6356083
```

```
    year1998 |   .1999283    .184931     1.08   0.280    -.1628941    .5627508
    year1999 |   .1295103   .1671737     0.77   0.439    -.1984736    .4574942
    year2000 |   .1506967   .1420573     1.06   0.289    -.1280105    .4294039
    year2001 |   .1350756   .1232174     1.10   0.273     -.106669    .3768201
    year2002 |   .1236459   .0935996     1.32   0.187    -.0599903    .3072822
    year2003 |   .0984851    .091039     1.08   0.280    -.0801274    .2770977
    year2004 |   .0611992   .0737223     0.83   0.407    -.0834391    .2058375
    year2005 |    .077112   .0661004     1.17   0.244    -.0525726    .2067967
    year2006 |   .0431194   .0600526     0.72   0.473    -.0746999    .1609388
    year2007 |   .0023187   .0572929     0.04   0.968    -.1100862    .1147236
    year2008 |  -.0146788   .0467101    -0.31   0.753    -.1063209    .0769633
    year2010 |   .0062926   .0363223     0.17   0.862    -.0649695    .0775546
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            130.883
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              127.527
                         (Kleibergen-Paap rk Wald F statistic):         88.593
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.480
                                                   Chi-sq(4) P-val =    0.3450
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindN year1996
                      year1997 year1998 year1999 year2000 year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.7.5.2 Model 2 - IV estimated results (N-ETEs)

```
xtivreg2 lnrxa cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                     Obs per group: min =         3
                                                                avg =      12.5
                                                                max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      2120
                                                      F( 24,   1926) =     2.33
```

```
                                                      Prob > F      =   0.0003
Total (centered) SS     =  47.11127063                Centered R2   =   0.0539
Total (uncentered) SS   =  47.11127063                Uncentered R2 =   0.0539
Residual SS             =    44.570932                Root MSE      =    .1521

------------------------------------------------------------------------------
             |               Robust
       lnrxa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .0151932   .2013867     0.08   0.940    -.3797656     .410152
    sqravyrs |   .0018585   .0093226     0.20   0.842     -.016425     .020142
   lnpatappr |    .137351   .0477676     2.88   0.004     .0436693    .2310327
       lnfdi |    .019139   .0059339     3.23   0.001     .0075014    .0307766
      lngdpc |   .0199618   .2355933     0.08   0.932     -.442083    .4820065
       lnpop |  -1.711842   .3878337    -4.41   0.000     -2.47246    -.951224
        unem |  -.0005401   .0006767    -0.80   0.425    -.0018673     .000787
   lnecofree |   .0896178   .1682751     0.53   0.594    -.2404027    .4196383
        serv |   .0131628   .0046487     2.83   0.005     .0040458    .0222799
      lnrulc |  -.0445859   .2727608    -0.16   0.870    -.5795235    .4903517
    year1996 |   .1166062    .062987     1.85   0.064    -.0069236    .2401361
    year1997 |   .1105163   .0571548     1.93   0.053    -.0015755    .2226081
    year1998 |   .1029511   .0501197     2.05   0.040     .0046566    .2012456
    year1999 |   .0956655   .0450105     2.13   0.034      .007391      .18394
    year2000 |   .0702831   .0365825     1.92   0.055    -.0014623    .1420285
    year2001 |   .0769893   .0343317     2.24   0.025      .009658    .1443206
    year2002 |   .0469468   .0303351     1.55   0.122    -.0125462    .1064398
    year2003 |   .0725437   .0291378     2.49   0.013     .0153987    .1296887
    year2004 |   .0662835   .0277865     2.39   0.017     .0117887    .1207784
    year2005 |    .048232   .0251407     1.92   0.055    -.0010738    .0975379
    year2006 |   .0597444   .0237764     2.51   0.012     .0131142    .1063746
    year2007 |   .0563859    .024621     2.29   0.022     .0080993    .1046726
    year2008 |   .0294778   .0202292     1.46   0.145    -.0101956    .0691512
    year2010 |   .0067744   .0159293     0.43   0.671     -.024466    .0380149
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             93.323
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              270.658
                         (Kleibergen-Paap rk Wald F statistic):         62.370
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               8.806
                                                   Chi-sq(4) P-val =    0.0661
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A4.8 Model 1&2 - IV estimated results – emsh at industry level

	Model 1	**Model 2**
	IV	**IV**

	lnemshind	lnemshind
lnsedut	0.178*	
	(0.105)	
lntedut	0.444***	
	(0.123)	
avyrs		-0.725***
		(0.186)
sqravyrs		0.0329***
		(0.00861)
lnpatappr	0.116***	0.111***
	(0.0328)	(0.0332)
lnfdi	0.00726	0.0173***
	(0.00552)	(0.00537)
lngdpc	0.962***	1.170***
	(0.129)	(0.101)
lnpop	-3.121***	-2.864***
	(0.359)	(0.324)
unem	0.00147**	0.00109*
	(0.00068)	(0.000624)
lnecofree	0.0285	0.0817
	(0.141)	(0.139)
lnrulc	-0.194	-0.350**
	(0.166)	(0.166)
serv	0.000506	0.00325
	(0.00357)	(0.00363)
N	3,450	3,450
Year dummies included but not reported		
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Table A4.9 Model 1& 2 - Estimation results – old version dataset

		Model 1			**Model 2**	
	EU-27	**ETEs**	**N-ETEs**	**EU-27**	**ETEs**	**N-ETEs**
VARIABLES	**lnemsh**	**lnemsh**	**lnemsh**	**lnemsh**	**lnemsh**	**lnemsh**
lnsedut	0.476**	1.937***	0.179			
	(0.212)	(0.595)	(0.166)			
lntedut	0.116	0.813***	0.113			
	(0.194)	(0.299)	(0.092)			
avyrs				-1.060***	-0.0247	-0.325*
				(0.25)	(0.704)	(0.177)
sqravyrs				0.0523***	0.0194	0.0188**
				(0.012)	(0.0305)	(0.00854)

lnpatappr	0.0268	0.137	0.121**	0.08	0.0328	0.162***
	(0.0597)	(0.088)	(0.0576)	(0.0555)	(0.0896)	(0.0578)
lnfdi	0.000724	0.217***	0.0107**	0.00496	0.296***	0.0128**
	(0.00499)	(0.0734)	(0.00457)	(0.00505)	(0.0931)	(0.00524)
lngdpc	1.605***	0.906***	0.0371	1.463***	0.823***	0.218
	(0.168)	(0.253)	(0.236)	(0.172)	(0.258)	(0.244)
lnpop	-1.429***	4.792***	0.346	-1.589***	5.020***	0.0701
	(0.531)	(1.272)	(0.352)	(0.522)	(1.518)	(0.34)
unem	0.00421***	-0.00125	0.000662	0.00331**	-0.00207	0.000497
	(0.0013)	(0.002)	(0.000895)	(0.00136)	(0.0023)	(0.00089)
lnecofree	-0.105	-0.36	-0.172	-0.0244	-0.0972	-0.193
	(0.238)	(0.307)	(0.238)	(0.217)	(0.316)	(0.233)
serv	-0.00775	0.0128	-0.0365***	-0.00104	0.00192	-0.0325***
	(0.0094)	(0.0102)	(0.00506)	(0.00939)	(0.00861)	(0.00477)
lnrulc	-0.597*	-0.739*	-0.583**	-0.737**	-0.593	-0.469*
	(0.339)	(0.421)	(0.281)	(0.314)	(0.369)	(0.261)
transindN		-0.267			-0.574	
		(0.378)			(0.413)	
N	349	134	215	349	134	215
Year dummies included but not reported						
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Table A4.9.1 Model 1 - FE standard errors vs FEVD standard errors

Independent	**FE**		**FEVD**	
Variables	**Standard Errors**	**P. values**	**Standard Errors**	**P. values**
lnsedut	.1265099	0.073	7.1843	0.975
lntedut	.1272115	0.000	6.513698	0.928
lnpatappr	.0277064	0.045	1.449755	0.969
lnfdi	.0052079	0.412	.1037668	0.967
lngdpc	.1357031	0.000	10.12053	0.904
lnpop	.3773957	0.000	3.697784	0.604
unem	.0008909	0.000	.0209349	0.849
lnecofree	.1780905	0.742	6.536864	0.993
lnrulc	.1959859	0.019	4.341907	0.915
serv	.0038653	0.070	.1210407	0.954

Appendix – A5

Contents

Table A5.1. Relative export advantage (RXA) of ETEs in medium-high and high tech sub-industries

Industry	Tech intensity	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
ChePH	High	0.93	0.73	0.53	0.60	0.51	0.43
Ph	M. high	0.48	0.87	0.22	0.18	0.53	0.78
ME	M. high	0.58	0.48	**1.06**	0.37	0.61	0.36
OACM	High	0.14	0.15	**1.63**	0.31	**1.99**	0.29
EMA	M. high	0.80	**1.20**	**1.96**	**1.19**	**2.12**	0.59
RTCE	High	0.26	0.60	**1.02**	**2.49**	**3.62**	0.37
MPOI	High	0.29	0.31	0.47	0.51	0.58	0.26
MVTST	M. high	0.05	0.12	**1.26**	0.42	**1.29**	0.21
AS	High	0.07	0.09	0.24	0.04	0.02	0.08
RTE	M. high	0.81	0.51	**2.15**	**1.00**	**1.08**	**1.47**

Industry	Tech intensity	Lithuania	Poland	Romania	Slovak Republic	Slovenia
ChePH	High	0.91	0.58	0.58	0.55	0.64
Ph	M. high	0.32	0.20	0.10	0.19	**1.35**
ME	M. high	0.37	0.61	0.55	0.70	**1.28**
OACM	High	0.22	0.24	0.20	0.40	0.14
EMA	M. high	0.60	**1.34**	**1.54**	**1.38**	**1.44**
RTCE	High	0.70	0.85	0.51	**1.79**	0.37
MPOI	High	0.41	0.24	0.16	0.25	0.75
MVTST	M. high	0.44	**1.03**	0.39	**1.73**	**1.04**
AS	High	0.24	0.17	0.13	0.06	0.06
RTE	M. high	**1.30**	**1.19**	**1.73**	**1.89**	**1.08**

Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3
Notes: RXA>1 indicates a relative export advantage in industry *j*

Table A5.1.1 Relative export advantage (RXA) of EU -18 in medium-high and high tech sub-industries

Industry	Tech intensity	Austria	Belgium	Cyprus	Denmark	Finland	France
ChePH	High	0.42	**2.06**	0.27	0.51	0.52	**1.23**
Ph	M. high	0.78	**2.01**	**2.01**	**1.73**	0.22	**1.06**
ME	M. high	**1.25**	0.54	0.37	**1.17**	**1.03**	0.72
OACM	High	0.36	0.45	0.30	0.54	0.35	0.59
EMA	M. high	**1.24**	0.50	0.37	**1.27**	**1.22**	**1.03**
RTCE	High	0.73	0.46	**1.30**	0.83	3.29	0.90

MPOI	High	0.71	0.52	**1.08**	**1.44**	0.80	0.96
MVTST	M. high	**1.02**	**1.06**	0.76	0.19	0.25	**1.03**
AS	High	0.40	0.16	0.30	0.18	0.09	**3.64**
RTE	M. high	**2.77**	0.68	0.10	0.59	0.21	0.82

Industry	**Tech intensity**	**Germany**	**Greece**	**Ireland**	**Italy**	**Luxembourg**	**Malta**
ChePH	High	0.94	0.63	**2.96**	0.51	0.60	0.15
Ph	M. high	0.76	0.82	**4.44**	0.65	0.08	0.61
ME	M. high	1.58	0.34	0.18	**2.13**	0.71	0.23
OACM	High	0.68	0.16	**6.68**	0.25	0.49	0.35
EMA	M. high	**1.33**	0.64	0.49	0.81	0.72	**1.18**
RTCE	High	0.79	0.38	**1.37**	0.40	0.99	**17.03**
MPOI	High	**1.45**	0.29	**1.87**	0.69	0.40	**1.11**
MVTST	M. high	**1.92**	0.10	0.03	0.54	0.36	0.08
AS	High	**1.14**	0.57	0.26	0.42	0.39	0.57
RTE	M. high	0.82	0.22	0.07	**2.06**	0.71	0.04

Industry	**Tech intensity**	**Netherlands**	**Norway**	**Portugal**	**Spain**	**Sweden**	**UK**
ChePH	High	**1.58**	0.42	0.45	0.79	0.43	**1.09**
Ph	M. high	0.87	0.56	0.23	0.63	**1.23**	**1.41**
ME	M. high	0.55	0.88	0.43	0.57	**1.15**	0.86
OACM	High	4.22	0.37	0.27	0.27	0.37	**1.76**
EMA	M. high	0.59	0.72	**1.28**	0.89	0.91	0.89
RTCE	High	**1.31**	0.56	**1.09**	0.52	**2.34**	**1.48**
MPOI	High	**1.52**	0.87	0.29	0.37	**1.02**	**1.40**
MVTST	M. high	0.31	0.17	**1.04**	**2.27**	**1.01**	0.78
AS	High	0.28	0.58	0.23	0.56	0.52	**3.08**
RTE	M. high	0.74	0.34	0.83	**1.54**	0.68	0.72

Source: Own calculations based on STAN Bilateral Trade Database Ed. 2012 ISIC Revision 3
Notes: RXA>1 indicates a relative export advantage in industry *j*

Table A5.1.2 Correlation between Export sophistication and GDP per capita

Country	Austria	Belgium	Bulgaria	Croatia	Cyprus	Czech Republic	Denmark	Estonia
Correlation coefficient	0.9783	0.9332	0.8702	0.9189	0.8988	0.8719	0.9237	0.8479
Country	Finland	France	Germany	Greece	Hungary	Ireland	Italy	
Correlation coefficient	0.9055	0.9741	0.8513	0.9673	0.8455	0.9488	0.9324	
Country	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Norway	Poland	
Correlation coefficient	0.8092	0.9192	0.8865	0.2808	0.6448	-0.2094	0.9537	
Country	Portugal	Romania	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom	
Correlation coefficient	0.9181	0.9511	0.8836	0.8743	0.936	0.6995	0.2603	

Table A5.1.3 Correlation matrix between potential measures of international competitiveness

Medium-low, medium-high and high tech measures

```
             | lnemsh~d    lnrxa
-------------+------------------
   lnemshind |   1.0000
       lnrxa |   0.5624   1.0000
```

Medium-high and high tech measures

```
             | lnemsh~h lnrxam~h
-------------+------------------
lnemshmhtech |   1.0000
 lnrxamhtech |   0.7050   1.0000
```

High tech measures

```
             | lnemsh~h lnrxah~t
-------------+------------------
lnemshhtech |   1.0000
 lnrxahtech |   0.7241   1.0000
```

Medium-high tech measures

```
             | lnemsh~m lnrxam~t
-------------+------------------
lnemshmtech |   1.0000
 lnrxamtech |   0.6838   1.0000
```

Medium and high tech measures (country level analysis)

```
      |   lnEXPY lnmste~C lnhste~C lnRXAmid lnRXAh~h
-------------+----------------------------------------------
```

lnEXPY	1.0000				
lnmstechC	0.5895	1.0000			
lnhstechC	0.6371	0.9291	1.0000		
lnRXAmid	0.6319	0.6577	0.4147	1.0000	
lnRXAhigh	0.6770	0.1849	0.4788	-0.0449	1.0000

Table A5.1.4 Descriptive statistics for variables in levels

Variable	n	Mean	S.D.	Min	Quantiles .25	Mdn	.75	Max
emshind	1371	4.17	8.17	0.00	0.20	0.84	3.74	55.39
emshmhtech	4570	4.22	8.70	0.00	0.13	0.68	3.86	63.94
emshhtech	2285	4.23	8.71	0.00	0.09	0.52	3.65	62.75
emshmtech	2285	4.20	8.68	0.00	0.19	0.85	4.04	63.94
rxa	1371	0.90	0.65	0.03	0.48	0.78	1.13	5.66
rxamhtech	4570	0.89	1.30	0.00	0.31	0.61	1.07	25.76
rxahtech	2285	0.93	1.73	0.00	0.23	0.48	0.97	25.76
rxamtech	2285	0.85	0.62	0.00	0.45	0.70	1.14	6.39
EXPY	464	11154.73	3896.00	2848.85	8155.45	11685.00	14117.84	18723.78
mstechC	464	4.17	8.97	0.01	0.16	0.93	3.88	50.49
hstechC	464	3.98	6.80	0.02	0.18	0.61	3.51	32.78
RXAmid	464	0.79	0.48	0.11	0.35	0.69	1.21	1.99
RXAhigh	464	1.01	1.35	0.14	0.46	0.61	0.99	8.82

Industry level analysis

Table A5.2 Model 1 - Fixed effects estimated results (medium-high and high tech)

```
xtreg lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.2889                         Obs per group: min =         5
       between = 0.3573                                        avg =      13.3
       overall = 0.2967                                        max =        16

                                                F(25,3305)         =     53.71
corr(u_i, Xb)  = -0.9699                        Prob > F           =    0.0000

------------------------------------------------------------------------------
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0066473   .1371567     0.05   0.961    -.2622733    .2755679
     lntedut |   .4480713   .1383239     3.24   0.001     .1768622    .7192804
     cskills |  (omitted)
   lnpatappr |  -.0673167    .030144    -2.23   0.026    -.1264195   -.0082139
       lnfdi |   .0030749   .0065681     0.47   0.640    -.0098031    .0159529
      lngdpc |   1.541684   .1531341    10.07   0.000     1.241437    1.841932
       lnpop |  -4.392801   .4362566   -10.07   0.000    -5.248162   -3.537441
        unem |   .0035325   .0009747     3.62   0.000     .0016215    .0054435
   lnecofree |    .216126   .1927771     1.12   0.262    -.1618486    .5941006
      lnrulc |   .0190662   .2138647     0.09   0.929    -.4002544    .4383868
        serv |   .0057841   .0041922     1.38   0.168    -.0024355    .0140037
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .1284116   .0536809     2.39   0.017     .0231604    .2336629
    year1997 |   .0904508    .054354     1.66   0.096    -.0161201    .1970217
    year1998 |   .0375129   .0557039     0.67   0.501    -.0717048    .1467306
    year1999 |  -.0272276   .0577506    -0.47   0.637    -.1404581    .0860029
    year2000 |  -.0653485    .058473    -1.12   0.264    -.1799954    .0492985
    year2001 |   -.066461   .0606392    -1.10   0.273    -.1853552    .0524333
    year2002 |  -.1089596   .0646934    -1.68   0.092    -.2358028    .0178835
    year2003 |  -.1310579   .0677822    -1.93   0.053    -.2639573    .0018415
    year2004 |  -.1309639    .071308    -1.84   0.066    -.2707763    .0088485
    year2005 |  -.1544219   .0762363    -2.03   0.043     -.303897   -.0049468
    year2006 |  -.2081729   .0802318    -2.59   0.010    -.3654819   -.0508639
    year2007 |   -.204008   .0835563    -2.44   0.015    -.3678353   -.0401807
    year2008 |  -.1381461   .0859307    -1.61   0.108    -.3066288    .0303366
    year2009 |  -.0594517   .0873455    -0.68   0.496    -.2307084    .1118051
    year2010 |  -.1484804   .0889977    -1.67   0.095    -.3229766    .0260159
       _cons |   22.33965   5.177327     4.31   0.000     12.18856    32.49074
-------------+----------------------------------------------------------------
     sigma_u |  7.4539724
     sigma_e |  .41591057
         rho |  .99689634   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
F test that all u_i=0:     F(269, 3305) =    64.55           Prob > F = 0.0000
```

Table A5.2.1 Model 1 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   3.4e+06
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
. xtserial lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,     269) =     95.964
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1147.6511
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 1.45e-251
LM5= 33.876999
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0
Test for significance of fixed effects
F= 64.545133
Probability>F= 0
Test for normality of residuals
```

Skewness/Kurtosis tests for Normality

```
                                                       ------- joint ------
    Variable |    Obs    Pr(Skewness)    Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |   3.6e+03   0.0000          0.0000             .          0.0000
```

Table A5.2.2 Model 1 - Driscoll-Kraay estimated results (medium-high and high tech)

```
xtscc lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,fe

Regression with Driscoll-Kraay standard errors   Number of obs     =      3600
Method: Fixed-effects regression                 Number of groups  =       270
Group variable (i): cn_ind                       F( 28,    269)    =  85535.10
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.2889
```

```
------------------------------------------------------------------------------
             |             Drisc/Kraay
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0066473   .1782427     0.04   0.970    -.3442809    .3575755
     lntedut |   .4480713   .1414963     3.17   0.002     .1694902    .7266524
     cskills |  (omitted)
   lnpatappr |  -.0673167   .0527501    -1.28   0.203    -.1711722    .0365388
       lnfdi |   .0030749   .0042777     0.72   0.473    -.0053472     .011497
      lngdpc |   1.541684   .2733236     5.64   0.000     1.003559     2.07981
       lnpop |  -4.392801   .4697144    -9.35   0.000    -5.317585   -3.468017
        unem |   .0035325   .0018687     1.89   0.060    -.0001467    .0072117
   lnecofree |    .216126   .3049482     0.71   0.479    -.3842628    .8165148
      lnrulc |   .0190662   .4318098     0.04   0.965    -.8310904    .8692229
        serv |   .0057841    .006645     0.87   0.385    -.0072987    .0188669
        dist |   .0214541     .00571     3.76   0.000     .0102122     .032696
  transdummy |  (omitted)
    year1996 |   .1284116   .0246588     5.21   0.000     .0798629    .1769603
    year1997 |   .0904508   .0186104     4.86   0.000     .0538102    .1270914
    year1998 |   .0375129   .0242462     1.55   0.123    -.0102235    .0852494
    year1999 |  -.0272276    .029337    -0.93   0.354    -.0849869    .0305317
    year2000 |  -.0653485   .0296372    -2.20   0.028    -.1236988   -.0069982
    year2001 |   -.066461   .0361776    -1.84   0.067    -.1376881    .0047662
    year2002 |  -.1089596   .0427393    -2.55   0.011    -.1931057   -.0248135
    year2003 |  -.1310579   .0462134    -2.84   0.005     -.222044   -.0400719
    year2004 |  -.1309639   .0610153    -2.15   0.033    -.2510922   -.0108357
    year2005 |  -.1544219   .0710363    -2.17   0.031    -.2942797   -.0145641
    year2006 |  -.2081729   .0901684    -2.31   0.022    -.3856983   -.0306475
    year2007 |   -.204008   .0992636    -2.06   0.041    -.3994404   -.0085756
    year2008 |  -.1381461   .1069378    -1.29   0.198    -.3486876    .0723954
    year2009 |  -.0594517    .089528    -0.66   0.507    -.2357164     .116813
    year2010 |  -.1484804   .0944648    -1.57   0.117    -.3344647     .037504
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A5.2.4 Model 1 - FEVD estimated results (medium-high and high tech)

```
xtfevd lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, invariant (cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      3302          number of obs       =     3600
mean squared error         = .1588067           F( 30, 3302)        = 5.300627
root mean squared error    = .3985056           Prob > F            = 7.15e-18
Residual Sum of Squares    = 571.7042           R-squared           = .9642284
Total Sum of Squares       = 15982.06           adj. R-squared      = .9610109
Estimation Sum of Squares  = 15410.35

------------------------------------------------------------------------------
             |                fevd
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0066473   3.396927     0.00   0.998    -6.653648    6.666942
     lntedut |   .4480712   5.591645     0.08   0.936    -10.51537    11.41151
   lnpatappr |  -.0673167   .9623298    -0.07   0.944     -1.95414    1.819507
       lnfdi |   .0030749   .2075636     0.01   0.988    -.4038915    .4100413
      lngdpc |   1.541684   7.661675     0.20   0.841    -13.48043     16.5638
       lnpop |  -4.392801   2.624321    -1.67   0.094    -9.538261    .7526586
        unem |   .0035325   .0124319     0.28   0.776    -.0208424    .0279074
   lnecofree |   .2161257   3.333812     0.06   0.948    -6.320422    6.752673
```

```
       lnrulc |   .0190664   2.964983     0.01   0.995    -5.794325    5.832458
         serv |   .0057841   .0906264     0.06   0.949    -.1719056    .1834738
     year1996 |   .1284116   .7631332     0.17   0.866     -1.36785    1.624674
     year1997 |   .0904508    .895325     0.10   0.920    -1.664997    1.845899
     year1998 |   .0375129   .9795663     0.04   0.969    -1.883106    1.958132
     year1999 |  -.0272276   .8164943    -0.03   0.973    -1.628114    1.573659
     year2000 |  -.0653485   .8669077    -0.08   0.940    -1.765079    1.634382
     year2001 |   -.066461   1.058072    -0.06   0.950    -2.141005    2.008083
     year2002 |  -.1089596   1.050027    -0.10   0.917     -2.16773     1.94981
     year2003 |  -.1310579     1.1172    -0.12   0.907    -2.321532    2.059416
     year2004 |  -.1309639   1.089502    -0.12   0.904    -2.267132    2.005205
     year2005 |  -.1544219   1.212068    -0.13   0.899    -2.530902    2.222058
     year2006 |  -.2081729    1.17328    -0.18   0.859    -2.508603    2.092257
     year2007 |   -.204008   1.430642    -0.14   0.887    -3.009042    2.601026
     year2008 |  -.1381461   1.375258    -0.10   0.920     -2.83459    2.558298
     year2009 |  -.0594517   1.376848    -0.04   0.966    -2.759014     2.64011
     year2010 |  -.1484804   1.399729    -0.11   0.916    -2.892905    2.595944
      cskills |  -.8379719   4.035411    -0.21   0.836    -8.750132    7.074188
         dist |  -.0029434   .0033539    -0.88   0.380    -.0095193    .0036325
   transdummy |  -1.771144   10.18861    -0.17   0.862    -21.74778    18.20549
          eta |          1          .        .       .            .           .
        _cons |   30.20459   79.61571     0.38   0.704    -125.8966    186.3057
------------------------------------------------------------------------------
```

Table A5.2.5 Model 1 - Hausman and Taylor estimated results (medium-high and high tech)

```
xthtaylor lnemshmhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010,endo (lnsedut lntedut cskills)

Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

                                                Obs per group: min =         5
                                                               avg =      13.3
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =   1316.19
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
lnemshmhtech |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |  -.0402285   .0293262    -1.37   0.170    -.0977068    .0172499
       lnfdi |   .0004914   .0064159     0.08   0.939    -.0120835    .0130663
      lngdpc |    2.24496   .1328334    16.90   0.000     1.984611    2.505308
       lnpop |  -.9964431   .2729665    -3.65   0.000    -1.531448   -.4614387
        unem |   .0049675   .0009426     5.27   0.000       .00312     .006815
   lnecofree |   .3991721   .1875633     2.13   0.033     .0315548    .7667894
      lnrulc |  -.0626792   .2088904    -0.30   0.764    -.4720968    .3467385
        serv |   .0043484   .0040916     1.06   0.288     -.003671    .0123677
    year1996 |   .1176501   .0524684     2.24   0.025     .0148139    .2204862
    year1997 |   .0646099   .0530752     1.22   0.223    -.0394156    .1686354
    year1998 |   .0103687   .0543855     0.19   0.849    -.0962248    .1169622
    year1999 |  -.0699946   .0562891    -1.24   0.214    -.1803192    .0403301
    year2000 |  -.1384423   .0567016    -2.44   0.015    -.2495755   -.0273092
    year2001 |  -.1616747   .0585354    -2.76   0.006    -.2764021   -.0469474
    year2002 |  -.2265004   .0621804    -3.64   0.000    -.3483717   -.1046291
    year2003 |  -.2601939   .0650354    -4.00   0.000    -.3876608   -.1327269
    year2004 |  -.2979283   .0677657    -4.40   0.000    -.4307467   -.1651099
```

```
    year2005 |   -.353316   .0719421    -4.91   0.000    -.4943199   -.2123121
    year2006 |  -.4448567    .074952    -5.94   0.000    -.5917598   -.2979536
    year2007 |  -.4673665   .0775325    -6.03   0.000    -.6193274   -.3154057
    year2008 |  -.4054393   .0798445    -5.08   0.000    -.5619316    -.248947
    year2009 |  -.2635684   .0829911    -3.18   0.001     -.426228   -.1009088
    year2010 |  -.3726656   .0841737    -4.43   0.000     -.537643   -.2076881
TVendogenous |
     lnsedut |   .2496374   .1318766     1.89   0.058     -.008836    .5081108
     lntedut |   .1309138   .1313395     1.00   0.319     -.126507    .3883345
TIexogenous  |
        dist |  -.0013344   .0008806    -1.52   0.130    -.0030603    .0003916
  transdummy |   1.071381   .9672452     1.11   0.268    -.8243851    2.967146
TIendogenous |
     cskills |   .7655087   3.109235     0.25   0.806    -5.328479    6.859496
             |
       _cons |  -18.81571   16.20514    -1.16   0.246     -50.5772    12.94579
-------------+----------------------------------------------------------------
     sigma_u |   7.160894
     sigma_e |   .4143464
         rho |  .99666312   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A5.2.6 Model 1 - IV estimated results (medium-high and high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1), fe endog (lnsedut lntedut
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       270                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     3450
                                                      F( 24,   3156) =    15.66
                                                      Prob > F      =   0.0000
Total (centered) SS     =  687.4382722                Centered R2   =   0.3061
Total (uncentered) SS   =  687.4382722                Uncentered R2 =   0.3061
Residual SS             =  476.9999837                Root MSE      =    .3888

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1399436   .2024388     0.69   0.489    -.2569813    .5368685
     lntedut |   .5940303   .2378455     2.50   0.013     .1276829    1.060378
   lnpatappr |  -.0771282     .06909    -1.12   0.264    -.2125939    .0583376
       lnfdi |  -.0029849    .009637    -0.31   0.757    -.0218803    .0159106
```

```
      lngdpc |   1.571574   .2401647     6.54   0.000     1.100679    2.042469
       lnpop |  -4.431126   .6706334    -6.61   0.000    -5.746048   -3.116204
        unem |   .0020621   .0013306     1.55   0.121    -.0005468    .0046709
   lnecofree |  -.0611914   .2724328    -0.22   0.822    -.5953548    .4729719
        serv |   .0071299   .0084514     0.84   0.399     -.009441    .0237007
      lnrulc |  -.0859437   .3031814    -0.28   0.777    -.6803962    .5085088
    year1996 |   .2401015   .0990599     2.42   0.015     .0458733    .4343298
    year1997 |   .2021264   .0910967     2.22   0.027     .0235115    .3807412
    year1998 |   .1480505   .0835859     1.77   0.077    -.0158376    .3119387
    year1999 |   .0695011   .0782203     0.89   0.374    -.0838666    .2228688
    year2000 |   .0337942   .0728581     0.46   0.643    -.1090598    .1766482
    year2001 |   .0309833   .0632898     0.49   0.624      -.09311    .1550765
    year2002 |  -.0119223   .0579409    -0.21   0.837    -.1255279    .1016833
    year2003 |  -.0097416   .0553357    -0.18   0.860    -.1182391    .0987559
    year2004 |  -.0541639   .0533582    -1.02   0.310    -.1587841    .0504563
    year2005 |  -.0869496   .0515353    -1.69   0.092    -.1879957    .0140966
    year2006 |  -.1316133    .053001    -2.48   0.013    -.2355333   -.0276934
    year2007 |  -.1353721   .0517302    -2.62   0.009    -.2368003   -.0339439
    year2008 |  -.0831214   .0376148    -2.21   0.027    -.1568734   -.0093694
    year2010 |  -.0848502   .0313313    -2.71   0.007    -.1462819   -.0234184
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            155.757
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              698.597
                         (Kleibergen-Paap rk Wald F statistic):        169.991
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              18.858
                                                   Chi-sq(4) P-val =    0.0008
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.2.6.1 Model 1 - IV estimated results - ETEs (medium-high and high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
```

```
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                  Number of obs =     1330
                                                  F( 24,  1206) =    19.54
                                                  Prob > F      =   0.0000
Total (centered) SS     =  555.6833217            Centered R2   =   0.4378
Total (uncentered) SS   =  555.6833217            Uncentered R2 =   0.4378
Residual SS             =  312.3973365            Root MSE      =     .509

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1952297   .6618024     0.29   0.768    -1.103182    1.493642
     lntedut |  -.7948303   .4962951    -1.60   0.110    -1.768528    .1788675
   lnpatappr |  -.4790029   .1921727    -2.49   0.013    -.8560328    -.101973
       lnfdi |  -.1334717   .1566632    -0.85   0.394    -.4408344     .173891
      lngdpc |   .5816821   .4227933     1.38   0.169      -.24781    1.411174
       lnpop |   2.372562   2.910227     0.82   0.415    -3.337108    8.082232
        unem |  -.0086893   .0025283    -3.44   0.001    -.0136498   -.0037289
   lnecofree |   .1294825   .5211792     0.25   0.804    -.8930362    1.152001
        serv |   .0005366   .0141007     0.04   0.970    -.0271281    .0282013
      lnrulc |   .5205598   .4480107     1.16   0.245    -.3584072    1.399527
    year1996 |  -1.571125   .4189215    -3.75   0.000    -2.393021   -.7492292
    year1997 |   -1.44155   .3753862    -3.84   0.000    -2.178033   -.7050675
    year1998 |  -1.391926   .3501737    -3.97   0.000    -2.078944   -.7049088
    year1999 |  -1.430992   .3247988    -4.41   0.000    -2.068225   -.7937583
    year2000 |  -1.328463   .2942554    -4.51   0.000    -1.905772   -.7511536
    year2001 |  -1.096504   .2545619    -4.31   0.000    -1.595937   -.5970707
    year2002 |  -.9002179   .2024752    -4.45   0.000    -1.297461   -.5029751
    year2003 |  -.7976994   .1834149    -4.35   0.000    -1.157547   -.4378516
    year2004 |  -.5931634   .1496387    -3.96   0.000    -.8867444   -.2995823
    year2005 |  -.5092432   .1390069    -3.66   0.000    -.7819655   -.2365209
    year2006 |  -.3769978   .1222872    -3.08   0.002     -.616917   -.1370786
    year2007 |  -.1939025   .1065175    -1.82   0.069    -.4028826    .0150777
    year2008 |  -.0711946   .0905889    -0.79   0.432     -.248924    .1065349
    year2010 |   .1303283   .0756506     1.72   0.085    -.0180931    .2787497
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            115.494
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              177.500
                         (Kleibergen-Paap rk Wald F statistic):        128.890
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              20.047
                                                   Chi-sq(4) P-val =    0.0005
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
```

```
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.2.6.2 Model 1 - IV estimated results –N-ETEs (medium-high and high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     2120
                                                      F( 24,  1926) =     3.91
                                                      Prob > F      =   0.0000
Total (centered) SS     =  131.7549505                Centered R2   =   0.1022
Total (uncentered) SS   =  131.7549505                Uncentered R2 =   0.1022
Residual SS             =  118.2914517                Root MSE      =    .2478

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.3280825   .1565764    -2.10   0.036    -.6351596   -.0210053
     lntedut |   .2917022   .2340289     1.25   0.213    -.1672744    .7506788
   lnpatappr |   .1233427    .066653     1.85   0.064    -.0073769    .2540623
       lnfdi |   .0115541   .0093632     1.23   0.217     -.006809    .0299172
      lngdpc |  -.4715698   .3389591    -1.39   0.164    -1.136335    .1931956
       lnpop |  -2.701889   .6122162    -4.41   0.000    -3.902565   -1.501213
        unem |  -.0003338    .001271    -0.26   0.793    -.0028264    .0021588
   lnecofree |  -.0768207   .2653024    -0.29   0.772    -.5971309    .4434895
        serv |  -.0117376   .0071989    -1.63   0.103     -.025856    .0023809
      lnrulc |  -.8860703   .4119562    -2.15   0.032    -1.693997   -.0781433
    year1996 |  -.1153767   .1118698    -1.03   0.303    -.3347753    .1040219
    year1997 |  -.0993442   .1025621    -0.97   0.333    -.3004887    .1018004
    year1998 |  -.1163879   .0907828    -1.28   0.200    -.2944308    .0616551
    year1999 |  -.0987693   .0824043    -1.20   0.231    -.2603804    .0628418
    year2000 |  -.1002267   .0715184    -1.40   0.161    -.2404884    .0400351
    year2001 |  -.0585931   .0611852    -0.96   0.338    -.1785892     .061403
    year2002 |  -.0443178   .0557202    -0.80   0.427    -.1535961    .0649605
    year2003 |  -.0049112   .0513555    -0.10   0.924    -.1056294     .095807
    year2004 |  -.0154307    .049206    -0.31   0.754    -.1119333     .081072
    year2005 |  -.0251745    .044828    -0.56   0.574    -.1130909    .0627419
    year2006 |  -.0370108   .0406477    -0.91   0.363    -.1167288    .0427073
    year2007 |  -.0195811   .0401961    -0.49   0.626    -.0984135    .0592513
    year2008 |  -.0203023   .0312567    -0.65   0.516    -.0816028    .0409983
```

```
    year2010 |  -.0611201   .0244465    -2.50   0.012    -.1090644   -.0131758
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            101.470
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              296.127
                         (Kleibergen-Paap rk Wald F statistic):         73.906
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.588
                                                   Chi-sq(4) P-val =    0.3323
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
--------------------------------------------------------------------------------------
```

Table A5.2.6.3 Model 1 - IV estimated results (high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if mhtechintens==1, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                  Obs per group: min =         3
                                                             avg =      12.8
                                                             max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 24,  1566) =     6.57
                                                      Prob > F      =   0.0000
Total (centered) SS     =  493.2394608                Centered R2   =   0.2450
Total (uncentered) SS   =  493.2394608                Uncentered R2 =   0.2450
Residual SS             =  372.3798637                Root MSE      =    .4876

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .4473376   .3491348     1.28   0.200    -.2374834    1.132159
     lntedut |   .7832476    .431423     1.82   0.070      -.06298    1.629475
   lnpatappr |  -.2173787   .1219136    -1.78   0.075    -.4565097    .0217523
```

```
       lnfdi |  -.0122058   .0167072    -0.73   0.465    -.0449766    .0205651
      lngdpc |   1.793507   .4206616     4.26   0.000     .9683873    2.618626
       lnpop |  -3.423159   1.123148    -3.05   0.002    -5.626191   -1.220126
        unem |   .0035996   .0024182     1.49   0.137    -.0011436    .0083427
   lnecofree |   .0590562   .4855697     0.12   0.903    -.8933791    1.011492
        serv |    .013172   .0150688     0.87   0.382    -.0163852    .0427292
      lnrulc |   .2416909   .5202102     0.46   0.642     -.778691    1.262073
    year1996 |   .3567661    .172619     2.07   0.039     .0181773    .6953549
    year1997 |   .3349443   .1605689     2.09   0.037     .0199916    .6498969
    year1998 |   .2483239   .1482803     1.67   0.094    -.0425249    .5391727
    year1999 |   .1284968   .1401919     0.92   0.360    -.1464868    .4034803
    year2000 |   .1040232   .1300797     0.80   0.424    -.1511255    .3591719
    year2001 |   .0751594   .1122336     0.67   0.503    -.1449846    .2953033
    year2002 |   .0204579   .1027182     0.20   0.842    -.1810219    .2219376
    year2003 |   .0171007   .0982833     0.17   0.862     -.17568     .2098814
    year2004 |  -.0468091   .0948619    -0.49   0.622    -.2328789    .1392607
    year2005 |  -.1050729   .0913715    -1.15   0.250    -.2842963    .0741505
    year2006 |  -.1660474   .0937589    -1.77   0.077    -.3499535    .0178587
    year2007 |  -.1625663   .0918048    -1.77   0.077    -.3426396    .0175071
    year2008 |  -.0878096   .0667486    -1.32   0.189    -.2187356    .0431164
    year2010 |  -.1183215   .0565171    -2.09   0.036    -.2291787   -.0074644
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             77.879
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              346.642
                         (Kleibergen-Paap rk Wald F statistic):         84.349
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              13.641
                                                   Chi-sq(4) P-val =    0.0085
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.2.6.3.1 Model 1 - IV estimated results - ETEs (high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------
```

```
Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      665
                                                      F( 25,   590) =     9.42
                                                      Prob > F      =   0.0000
Total (centered) SS     =  401.3177204                Centered R2   =   0.4230
Total (uncentered) SS   =  401.3177204                Uncentered R2 =   0.4230
Residual SS             =  231.5427102                Root MSE      =    .6265

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |    .198904   1.280211     0.16   0.877    -2.315421    2.713229
     lntedut |  -1.251518   .8483557    -1.48   0.141    -2.917683    .4146463
   lnpatappr |  -.9870772   .3430659    -2.88   0.004    -1.660856   -.3132982
       lnfdi |  -.1711796   .2875938    -0.60   0.552    -.7360118    .3936526
      lngdpc |  -.0285719   .7144161    -0.04   0.968     -1.43168    1.374536
       lnpop |    5.02204   5.299476     0.95   0.344    -5.386092    15.43017
        unem |  -.0123027   .0045496    -2.70   0.007     -.021238   -.0033673
   lnecofree |   .5824788   .9035067     0.64   0.519    -1.192002     2.35696
        serv |  -.0138461   .0261494    -0.53   0.597    -.0652033    .0375112
      lnrulc |   1.482213   .7813957     1.90   0.058    -.0524425    3.016869
   transindn |    .104459   1.456044     0.07   0.943    -2.755202     2.96412
    year1997 |     .19873   .2359112     0.84   0.400     -.264598    .6620579
    year1998 |   .2495063   .2791831     0.89   0.372    -.2988073    .7978199
    year1999 |   .2308803   .3071002     0.75   0.452    -.3722624     .834023
    year2000 |   .3684242   .3485211     1.06   0.291    -.3160688    1.052917
    year2001 |   .7136917   .3960203     1.80   0.072    -.0640893    1.491473
    year2002 |   1.086806   .4918969     2.21   0.028     .1207237    2.052888
    year2003 |   1.226051   .5121049     2.39   0.017     .2202803    2.231821
    year2004 |   1.532979   .5730116     2.68   0.008     .4075884     2.65837
    year2005 |   1.623036   .6135215     2.65   0.008     .4180838    2.827988
    year2006 |    1.85954   .6783466     2.74   0.006     .5272725    3.191808
    year2007 |   2.180718    .724708     3.01   0.003     .7573966    3.604039
    year2008 |   2.415822   .7339488     3.29   0.001     .9743517    3.857292
    year2009 |   2.507309   .7820675     3.21   0.001     .9713335    4.043284
    year2010 |    2.68994   .8245002     3.26   0.001     1.070628    4.309252
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             61.383
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               78.557
                         (Kleibergen-Paap rk Wald F statistic):         59.978
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              17.344
                                                   Chi-sq(4) P-val =    0.0017
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
```

```
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.2.6.3.2 Model 1 - IV estimated results – N-ETEs (high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy transindn year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,    951) =     1.46
                                                      Prob > F      =   0.0727
Total (centered) SS     =   91.9217385                Centered R2   =   0.0585
Total (uncentered) SS   =   91.9217385                Uncentered R2 =   0.0585
Residual SS             =    86.545734                Root MSE      =    .3017

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.3375307     .273709    -1.23   0.218    -.8746741    .1996128
     lntedut |   .3103843    .4258358     0.73   0.466     -.525302    1.146071
   lnpatappr |   .1504939    .1167502     1.29   0.198    -.0786238    .3796117
       lnfdi |   .0091923    .0160264     0.57   0.566    -.0222588    .0406435
      lngdpc |  -.3710433    .5602907    -0.66   0.508    -1.470592    .7285056
       lnpop |  -1.437164     .965156    -1.49   0.137    -3.331245    .4569179
        unem |   .0015189    .0020722     0.73   0.464    -.0025477    .0055856
   lnecofree |   -.027151    .4676405    -0.06   0.954    -.9448776    .8905757
        serv |  -.0077963    .0119496    -0.65   0.514    -.0312469    .0156544
      lnrulc |  -.9998117      .69037    -1.45   0.148    -2.354636    .3550129
    year1996 |  -.0263008    .1874509    -0.14   0.888     -.394166    .3415643
    year1997 |   .0089463    .1721086     0.05   0.959    -.3288103    .3467029
    year1998 |  -.0280909    .1544092    -0.18   0.856    -.3311131    .2749313
    year1999 |  -.0354209    .1415122    -0.25   0.802    -.3131332    .2422913
    year2000 |  -.0152459    .1232223    -0.12   0.902    -.2570648     .226573
    year2001 |   .0226422    .1043773     0.22   0.828    -.1821942    .2274787
    year2002 |   .0308054    .0949041     0.32   0.746    -.1554402    .2170511
    year2003 |   .0765164    .0873999     0.88   0.382    -.0950026    .2480355
    year2004 |   .0541268    .0844058     0.64   0.522    -.1115164      .21977
    year2005 |   .0403186    .0744287     0.54   0.588    -.1057448     .186382
    year2006 |  -.0031439    .0684843    -0.05   0.963    -.1375418    .1312539
    year2007 |   .0020158    .0681561     0.03   0.976    -.1317378    .1357694
    year2008 |  -.0191508    .0533456    -0.36   0.720    -.1238396     .085538
```

```
    year2010 |  -.0773921   .0413598    -1.87   0.062    -.1585591     .003775
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             50.735
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              146.219
                         (Kleibergen-Paap rk Wald F statistic):         36.492
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               7.379
                                                   Chi-sq(4) P-val =    0.1171
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy transindn year2009
------------------------------------------------------------------------------
```

Table A5.2.6.4 Model 1 - IV estimated results (medium-high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if mhtechintens==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 24,  1566) =    17.01
                                                      Prob > F      =   0.0000
Total (centered) SS     =  194.1988114                Centered R2   =   0.5005
Total (uncentered) SS   =  194.1988114                Uncentered R2 =   0.5005
Residual SS             =  96.99830811                Root MSE      =    .2489

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.1674505   .1984741    -0.84   0.399    -.5567534    .2218525
     lntedut |   .4048131    .194179     2.08   0.037     .0239348    .7856913
   lnpatappr |   .0631224   .0583133     1.08   0.279     -.051258    .1775028
```

```
       lnfdi |    .006236   .0093863     0.66   0.507    -.0121749     .024647
      lngdpc |   1.349641   .2203114     6.13   0.000     .9175047    1.781778
       lnpop |  -5.439093   .6492838    -8.38   0.000     -6.71265   -4.165536
        unem |   .0005246   .0010658     0.49   0.623    -.0015659    .0026151
   lnecofree |  -.1814391   .2438059    -0.74   0.457    -.6596594    .2967812
        serv |   .0010877   .0072886     0.15   0.881    -.0132087    .0153841
      lnrulc |  -.4135783   .3000781    -1.38   0.168    -1.002176     .175019
    year1996 |   .1234369   .0948049     1.30   0.193     -.062521    .3093949
    year1997 |   .0693084     .08228     0.84   0.400    -.0920821     .230699
    year1998 |   .0477772     .07472     0.64   0.523    -.0987846     .194339
    year1999 |   .0105054   .0680696     0.15   0.877    -.1230118    .1440227
    year2000 |  -.0364348   .0644958    -0.56   0.572     -.162942    .0900723
    year2001 |  -.0131928   .0574562    -0.23   0.818     -.125892    .0995065
    year2002 |  -.0443024   .0526282    -0.84   0.400    -.1475316    .0589267
    year2003 |  -.0365839   .0503018    -0.73   0.467    -.1352499    .0620821
    year2004 |  -.0615187   .0487717    -1.26   0.207    -.1571835    .0341461
    year2005 |  -.0688262   .0478742    -1.44   0.151    -.1627306    .0250781
    year2006 |  -.0971792   .0488335    -1.99   0.047    -.1929651   -.0013933
    year2007 |  -.1081779   .0471089    -2.30   0.022    -.2005811   -.0157747
    year2008 |  -.0784331   .0340115    -2.31   0.021    -.1451459   -.0117203
    year2010 |  -.0513788   .0261566    -1.96   0.050    -.1026845   -.0000731
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             77.879
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              346.642
                         (Kleibergen-Paap rk Wald F statistic):         84.349
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               7.129
                                                   Chi-sq(4) P-val =    0.1292
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
--------------------------------------------------------------------------------------
```

Table A5.2.6.4.1 Model 1 - IV estimated results – ETEs (medium-high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1,
fe endog (lnsedut lntedut lnpatappr lnfd
> i) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                     Obs per group: min =         7
                                                                avg =      13.3
                                                                max =        15

IV (2SLS) estimation
--------------------
```

```
Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                     Number of obs =      665
                                                     F( 25,   590) =    18.47
                                                     Prob > F      =   0.0000
Total (centered) SS     =  154.3655902               Centered R2   =   0.6157
Total (uncentered) SS   =  154.3655902               Uncentered R2 =   0.6157
Residual SS             =  59.32992162               Root MSE      =    .3171

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0111428   .6243905     0.02   0.986    -1.215156    1.237441
     lntedut |  -.4679169   .4650778    -1.01   0.315    -1.381326    .4454926
   lnpatappr |   -.011925   .1867436    -0.06   0.949    -.3786882    .3548381
       lnfdi |  -.0453126   .1348395    -0.34   0.737    -.3101363    .2195111
      lngdpc |   1.201673   .3836031     3.13   0.002     .4482793    1.955067
       lnpop |  -.7327731   2.822518    -0.26   0.795    -6.276178    4.810631
        unem |  -.0054929    .002273    -2.42   0.016     -.009957   -.0010288
   lnecofree |  -.2989488    .483659    -0.62   0.537    -1.248852    .6509541
        serv |   .0119407   .0140464     0.85   0.396    -.0156462    .0395276
      lnrulc |  -.3595579    .422086    -0.85   0.395    -1.188532     .469416
   transindn |  -.8155096   .6574322    -1.24   0.215    -2.106702    .4756825
    year1997 |   .0846869   .1111557     0.76   0.446    -.1336221    .3029959
    year1998 |   .1333968   .1281721     1.04   0.298    -.1183323    .3851259
    year1999 |   .0818291   .1463964     0.56   0.576    -.2056925    .3693506
    year2000 |   .1487755   .1649361     0.90   0.367    -.1751578    .4727088
    year2001 |    .285964   .1909751     1.50   0.135    -.0891097    .6610378
    year2002 |   .3305668   .2389493     1.38   0.167    -.1387278    .7998615
    year2003 |   .3958062   .2473209     1.60   0.110    -.0899302    .8815426
    year2004 |   .5069215   .2779604     1.82   0.069    -.0389908    1.052834
    year2005 |    .603016   .2979247     2.02   0.043     .0178939    1.188138
    year2006 |   .6390865   .3279505     1.95   0.052     -.005006    1.283179
    year2007 |   .6839278   .3522095     1.94   0.053    -.0078091    1.375665
    year2008 |   .7064335   .3614573     1.95   0.051    -.0034661    1.416333
    year2009 |   .7575518   .3858116     1.96   0.050    -.0001794    1.515283
    year2010 |   .8530488   .4119988     2.07   0.039     .0438862    1.662212
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             61.383
                                                  Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               78.557
                         (Kleibergen-Paap rk Wald F statistic):         59.978
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               5.511
                                                  Chi-sq(4) P-val =    0.2387
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
```

```
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.2.6.4.2 Model 1 - IV estimated results – N-ETEs (medium-high tech)

```
xtivreg2 lnemshmhtech  cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy transindn year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,   951) =     4.36
                                                      Prob > F      =   0.0000
Total (centered) SS     =  39.83321916                Centered R2   =   0.2532
Total (uncentered) SS   =  39.83321916                Uncentered R2 =   0.2532
Residual SS             =  29.74760033                Root MSE      =    .1769

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   -.318634   .1566759    -2.03   0.042    -.6261044   -.0111636
     lntedut |   .2730445    .194708     1.40   0.161    -.1090624    .6551514
   lnpatappr |   .0961931   .0671562     1.43   0.152    -.0355984    .2279847
       lnfdi |   .0139154   .0092796     1.50   0.134    -.0042955    .0321263
      lngdpc |  -.5721201    .367021    -1.56   0.119    -1.292385    .1481445
       lnpop |  -3.966668   .7008103    -5.66   0.000    -5.341981   -2.591354
        unem |  -.0021867   .0013669    -1.60   0.110    -.0048691    .0004957
   lnecofree |   -.126508   .2490801    -0.51   0.612    -.6153181    .3623022
        serv |  -.0156783   .0081918    -1.91   0.056    -.0317544    .0003979
      lnrulc |  -.7723529   .4490001    -1.72   0.086    -1.653498    .1087926
    year1996 |  -.2044467   .1179135    -1.73   0.083    -.4358474    .0269539
    year1997 |  -.2076314   .1080195    -1.92   0.055    -.4196155    .0043527
    year1998 |  -.2046822   .0913745    -2.24   0.025    -.3840012   -.0253631
    year1999 |  -.1621109   .0825139    -1.96   0.050    -.3240412   -.0001805
    year2000 |  -.1852075   .0706913    -2.62   0.009    -.3239366   -.0464785
    year2001 |   -.139823   .0617644    -2.26   0.024    -.2610332   -.0186127
    year2002 |  -.1194326   .0564736    -2.11   0.035    -.2302599   -.0086052
    year2003 |  -.0863312   .0526675    -1.64   0.102     -.189689    .0170267
    year2004 |  -.0849828   .0499536    -1.70   0.089    -.1830149    .0130492
    year2005 |  -.0906651   .0499837    -1.81   0.070    -.1887563    .0074261
    year2006 |  -.0708732   .0436872    -1.62   0.105    -.1566076    .0148612
    year2007 |  -.0411719   .0422376    -0.97   0.330    -.1240616    .0417179
    year2008 |  -.0214471    .032233    -0.67   0.506    -.0847031    .0418089
```

```
    year2010 |  -.0448439   .0263458    -1.70   0.089    -.0965465    .0068587
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             50.735
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              146.219
                         (Kleibergen-Paap rk Wald F statistic):         36.492
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               2.508
                                                   Chi-sq(4) P-val =    0.6432
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy transindn year2009
------------------------------------------------------------------------------
```

Table A5.3 Model 2 - Fixed effects estimated results (medium-high and high tech)

```
xtreg lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.2959                         Obs per group: min =         5
       between = 0.3106                                        avg =      13.3
       overall = 0.2481                                        max =        16

                                                F(25,3305)         =     55.57
corr(u_i, Xb)  = -0.9590                        Prob > F           =    0.0000

------------------------------------------------------------------------------
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.8968393   .2199295    -4.08   0.000    -1.328051   -.4656276
    sqravyrs |   .0341225   .0101728     3.35   0.001      .014177    .0540681
     cskills |  (omitted)
   lnpatappr |  -.0885896   .0300119    -2.95   0.003    -.1474334   -.0297458
       lnfdi |   .0115371   .0064621     1.79   0.074     -.001133    .0242071
      lngdpc |   1.867017   .1297671    14.39   0.000     1.612585    2.121449
       lnpop |  -3.763733    .392797    -9.58   0.000    -4.533882   -2.993583
        unem |   .0024554    .001021     2.40   0.016     .0004535    .0044573
   lnecofree |   .2223198   .1906727     1.17   0.244    -.1515288    .5961684
      lnrulc |  -.1933507    .215436    -0.90   0.370    -.6157522    .2290507
        serv |   .0094993   .0042691     2.23   0.026      .001129    .0178697
        dist |  (omitted)
  transdummy |  (omitted)
```

```
    year1996 |    .166084   .0531655     3.12   0.002     .0618433    .2703247
    year1997 |   .1517407   .0538459     2.82   0.005     .0461661    .2573154
    year1998 |    .117544   .0546875     2.15   0.032     .0103192    .2247689
    year1999 |   .0568837   .0561313     1.01   0.311    -.0531718    .1669393
    year2000 |   .0146843   .0560963     0.26   0.794    -.0953026    .1246713
    year2001 |   .0434266   .0577902     0.75   0.452    -.0698817    .1567349
    year2002 |   .0185194   .0613188     0.30   0.763    -.1017073    .1387461
    year2003 |   .0169961   .0637204     0.27   0.790    -.1079393    .1419314
    year2004 |   .0321439    .067101     0.48   0.632    -.0994199    .1637076
    year2005 |   .0238619   .0714029     0.33   0.738    -.1161365    .1638603
    year2006 |  -.0170238   .0756877    -0.22   0.822    -.1654232    .1313756
    year2007 |  -.0077467   .0785849    -0.10   0.921    -.1618267    .1463332
    year2008 |    .085773   .0800901     1.07   0.284    -.0712583    .2428042
    year2009 |   .1981758   .0792629     2.50   0.012     .0427664    .3535853
    year2010 |   .1323395   .0817661     1.62   0.106    -.0279778    .2926568
       _cons |   21.02575   4.835919     4.35   0.000     11.54405    30.50744
-------------+----------------------------------------------------------------
     sigma_u |  6.6546768
     sigma_e |  .41385514
         rho |  .99614729   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(269, 3305) =    64.87           Prob > F = 0.0000
```

Table A5.3.1 Model 2 - Diagnostic tests

Groupwise heteroskedasticity

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   6.6e+05
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,     269) =     95.579
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1118.6225
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 2.96e-245
LM5= 33.445814
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0
Test for significance of fixed effects
F= 64.865809
Probability>F= 0
Test for normality of residuals
```

Skewness/Kurtosis tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	------- joint ------ adj chi2(2)	Prob>chi2
__00000B	3.6e+03	0.0000	0.0000	.	0.0000

Table A5.3.2 Model 2 - Driscoll-Kraay estimated results (medium-high and high tech)

```
xtscc lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
```

```
Regression with Driscoll-Kraay standard errors   Number of obs      =      3600
Method: Fixed-effects regression                 Number of groups   =       270
Group variable (i): cn_ind                       F( 28,    269)     = 147199.17
maximum lag: 2                                   Prob > F           =    0.0000
                                                 within R-squared   =    0.2959
```

lnemshmhtech	Coef.	Drisc/Kraay Std. Err.	t	P>|t|	[95% Conf.	Interval]
avyrs	-.8968393	.501026	-1.79	0.075	-1.88327	.0895917
sqravyrs	.0341225	.0223712	1.53	0.128	-.0099223	.0781674
cskills	(omitted)					
lnpatappr	-.0885896	.0418109	-2.12	0.035	-.1709078	-.0062715
lnfdi	.0115371	.0051818	2.23	0.027	.0013351	.0217391
lngdpc	1.867017	.3607054	5.18	0.000	1.156853	2.577182
lnpop	-3.763733	.6856884	-5.49	0.000	-5.113731	-2.413734
unem	.0024554	.0011102	2.21	0.028	.0002697	.0046412
lnecofree	.2223198	.2454636	0.91	0.366	-.2609543	.7055939
lnrulc	-.1933507	.3777967	-0.51	0.609	-.9371652	.5504638
serv	.0094993	.007884	1.20	0.229	-.0060229	.0250216
dist	.0201923	.011184	1.81	0.072	-.001827	.0422115
transdummy	(omitted)					
year1996	.166084	.0168978	9.83	0.000	.1328152	.1993528
year1997	.1517407	.0192261	7.89	0.000	.1138879	.1895936
year1998	.117544	.0227153	5.17	0.000	.0728216	.1622664
year1999	.0568837	.0313853	1.81	0.071	-.0049082	.1186757
year2000	.0146843	.0418711	0.35	0.726	-.0677524	.097121
year2001	.0434266	.0557711	0.78	0.437	-.0663768	.15323
year2002	.0185194	.0672279	0.28	0.783	-.1138404	.1508793
year2003	.0169961	.073638	0.23	0.818	-.127984	.1619761
year2004	.0321439	.0946313	0.34	0.734	-.1541684	.2184561
year2005	.0238619	.1104838	0.22	0.829	-.1936611	.2413848
year2006	-.0170238	.1351754	-0.13	0.900	-.2831601	.2491124
year2007	-.0077467	.1477067	-0.05	0.958	-.298555	.2830615
year2008	.085773	.1545156	0.56	0.579	-.2184407	.3899866
year2009	.1981758	.1191961	1.66	0.098	-.0365001	.4328517
year2010	.1323395	.127525	1.04	0.300	-.1187345	.3834135
_cons	(omitted)					

Table A5.3.4 Model 2 - FEVD estimated results (medium-high and high tech)

```
. xtfevd lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010,invariant (cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      3302          number of obs       =      3600
mean squared error         =   .157241          F( 30, 3302)        = 5.092318
root mean squared error    =  .3965362          Prob > F            = 7.15e-17
Residual Sum of Squares    =  566.0674          R-squared           = .9645811
Total Sum of Squares       =  15982.06          adj. R-squared      = .9613953
Estimation Sum of Squares  =  15415.99

------------------------------------------------------------------------------
             |                fevd
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.8968394   3.979761    -0.23   0.822    -8.699888    6.906209
    sqravyrs |   .0341225   .1741807     0.20   0.845    -.3073906    .3756357
   lnpatappr |  -.0885897   .5392303    -0.16   0.870    -1.145849    .9686697
       lnfdi |   .0115371   .2175439     0.05   0.958    -.4149974    .4380716
      lngdpc |   1.867017   3.675641     0.51   0.612    -5.339749    9.073784
       lnpop |  -3.763732   1.880162    -2.00   0.045    -7.450134   -.0773306
        unem |   .0024554   .0108626     0.23   0.821    -.0188427    .0237535
   lnecofree |   .2223195   2.868015     0.08   0.938    -5.400948    5.845587
      lnrulc |  -.1933509     2.3315    -0.08   0.934    -4.764683    4.377981
        serv |   .0094993   .0672242     0.14   0.888    -.1223061    .1413047
    year1996 |   .1660841   .5306033     0.31   0.754    -.8742606    1.206429
    year1997 |   .1517408   .6135297     0.25   0.805    -1.051196    1.354678
    year1998 |   .1175441    .650426     0.18   0.857    -1.157735    1.392823
    year1999 |   .0568838   .7107923     0.08   0.936    -1.336754    1.450522
    year2000 |   .0146844   .6649677     0.02   0.982    -1.289106    1.318475
    year2001 |   .0434267   .6957611     0.06   0.950     -1.32074    1.407593
    year2002 |   .0185195   .7299116     0.03   0.980    -1.412606    1.449645
    year2003 |   .0169961   .9005044     0.02   0.985    -1.748607    1.782599
    year2004 |    .032144   1.029664     0.03   0.975    -1.986701    2.050989
    year2005 |    .023862   1.177211     0.02   0.984    -2.284276       2.332
    year2006 |  -.0170237   1.214297    -0.01   0.989    -2.397876    2.363828
    year2007 |  -.0077467    1.51455    -0.01   0.996    -2.977298    2.961805
    year2008 |    .085773   1.478059     0.06   0.954    -2.812231    2.983778
    year2009 |   .1981759   1.326524     0.15   0.881    -2.402717    2.799069
    year2010 |   .1323396   1.357495     0.10   0.922    -2.529277    2.793956
     cskills |   .0738706   2.774635     0.03   0.979    -5.366308    5.514049
        dist |  -.0026613   .0019516    -1.36   0.173    -.0064877    .0011651
  transdummy |  -.9081958   5.696299    -0.16   0.873    -12.07683    10.26044
         eta |          1          .        .       .            .           .
       _cons |   23.77879   48.47387     0.49   0.624    -71.26309    118.8207
--------------------------------------------------------------------------------------
```

Table A5.3.5 Model 2 - Hausman and Taylor estimated results (medium-high and high tech)

```
xthtaylor lnemshmhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, endo (avyrs sqravyrs cskills)

Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270
```

```
                                                Obs per group: min =          5
                                                               avg =       13.3
                                                               max =         16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    1371.58
                                                Prob > chi2        =     0.0000

------------------------------------------------------------------------------
lnemshmhtech |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |  -.0493255   .0290654    -1.70   0.090    -.1062926    .0076416
       lnfdi |   .0049894   .0062839     0.79   0.427    -.0073269    .0173057
      lngdpc |   2.378784   .1162905    20.46   0.000     2.150859    2.606709
       lnpop |  -.7213987   .2451031    -2.94   0.003    -1.201792   -.2410054
        unem |   .0035239   .0009924     3.55   0.000     .0015789    .0054688
   lnecofree |   .4774073   .1846688     2.59   0.010     .1154632    .8393514
      lnrulc |  -.2947224   .2102893    -1.40   0.161    -.7068819    .1174371
        serv |   .0060939   .0041544     1.47   0.142    -.0020486    .0142363
    year1996 |   .1655502   .0519701     3.19   0.001     .0636907    .2674097
    year1997 |   .1369552   .0526115     2.60   0.009     .0338385     .240072
    year1998 |   .1090316   .0534438     2.04   0.041     .0042837    .2137796
    year1999 |   .0406922   .0548316     0.74   0.458    -.0667757      .14816
    year2000 |  -.0223529   .0546961    -0.41   0.683    -.1295553    .0848494
    year2001 |  -.0189106   .0561376    -0.34   0.736    -.1289383    .0911172
    year2002 |  -.0622019   .0593877    -1.05   0.295    -.1785996    .0541958
    year2003 |  -.0728442   .0616268    -1.18   0.237    -.1936305    .0479421
    year2004 |  -.0919865   .0644124    -1.43   0.153    -.2182324    .0342595
    year2005 |  -.1274186   .0681524    -1.87   0.062    -.2609948    .0061577
    year2006 |  -.2059943   .0715737    -2.88   0.004    -.3462762   -.0657124
    year2007 |  -.2220334   .0738266    -3.01   0.003    -.3667309    -.077336
    year2008 |  -.1407378   .0750102    -1.88   0.061    -.2877552    .0062795
    year2009 |   .0193886   .0754159     0.26   0.797    -.1284239    .1672011
    year2010 |  -.0685817   .0774025    -0.89   0.376    -.2202877    .0831244
TVendogenous |
       avyrs |  -.8301021   .2145482    -3.87   0.000    -1.250609   -.4095955
     sqravyrs |   .0302623   .0099237     3.05   0.002     .0108123    .0497123
TIexogenous  |
        dist |  -.0012344   .0007867    -1.57   0.117    -.0027764    .0003075
  transdummy |   1.613994   .8678819     1.86   0.063    -.0870229    3.315012
TIendogenous |
     cskills |   1.559119   2.781989     0.56   0.575     -3.89348    7.011718
             |
       _cons |  -19.57817   14.55544    -1.35   0.179    -48.10631     8.94997
-------------+----------------------------------------------------------------
     sigma_u |   6.406808
     sigma_e |   .4122987
         rho |  .99587574   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A5.3.6 Model 2 - IV estimated results (medium-high and high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr ln
fdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
```

```
------------------------
Number of groups =       270                   Obs per group: min =         3
                                                              avg =      12.8
                                                              max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     3450
                                                      F( 24,  3156) =    15.88
                                                      Prob > F      =   0.0000
Total (centered) SS     =  687.4382722                Centered R2   =   0.3078
Total (uncentered) SS   =  687.4382722                Uncentered R2 =   0.3078
Residual SS             =  475.8109864                Root MSE      =    .3883

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.5513998   .3693506    -1.49   0.136    -1.275591    .1727919
    sqravyrs |   .0191196   .0169249     1.13   0.259    -.0140654    .0523046
   lnpatappr |  -.1093611   .0702809    -1.56   0.120     -.247162    .0284398
       lnfdi |   .0094212   .0094038     1.00   0.316     -.009017    .0278594
      lngdpc |    1.98332   .1811352    10.95   0.000     1.628166    2.338475
       lnpop |  -3.763867   .5857229    -6.43   0.000    -4.912303   -2.615431
        unem |   .0020355   .0012573     1.62   0.106    -.0004297    .0045008
   lnecofree |   .0640747   .2740392     0.23   0.815    -.4732383    .6013877
        serv |   .0084355   .0085902     0.98   0.326    -.0084074    .0252785
      lnrulc |  -.1946806   .3003077    -0.65   0.517    -.7834986    .3941374
    year1996 |   .0110139   .0896577     0.12   0.902    -.1647795    .1868073
    year1997 |    -.01032   .0790476    -0.13   0.896      -.16531    .1446699
    year1998 |  -.0480895   .0732496    -0.66   0.512    -.1917112    .0955322
    year1999 |  -.1141843   .0694111    -1.65   0.100    -.2502798    .0219112
    year2000 |  -.1576835   .0623588    -2.53   0.011    -.2799515   -.0354155
    year2001 |   -.132196    .055883    -2.37   0.018    -.2417666   -.0226253
    year2002 |  -.1594589   .0499899    -3.19   0.001    -.2574748    -.061443
    year2003 |  -.1382347   .0492049    -2.81   0.005    -.2347115   -.0417579
    year2004 |  -.1665539    .046023    -3.62   0.000     -.256792   -.0763158
    year2005 |  -.1830104   .0444594    -4.12   0.000    -.2701828   -.0958381
    year2006 |  -.2198448   .0458408    -4.80   0.000    -.3097257    -.129964
    year2007 |  -.2178072   .0433901    -5.02   0.000    -.3028828   -.1327316
    year2008 |  -.1310017   .0327538    -4.00   0.000    -.1952227   -.0667808
    year2010 |  -.0658645   .0313051    -2.10   0.035    -.1272449   -.0044841
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            141.983
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              693.024
                         (Kleibergen-Paap rk Wald F statistic):        153.911
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               5.876
                                                   Chi-sq(4) P-val =    0.2086
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
```

```
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.1 Model 2 - IV estimated results - ETEs (medium-high and high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                   Obs per group: min =         7
                                                              avg =      13.3
                                                              max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1330
                                                      F( 25,   1205) =    18.34
                                                      Prob > F      =   0.0000
Total (centered) SS     =  555.6833217                Centered R2   =   0.4388
Total (uncentered) SS   =  555.6833217                Uncentered R2 =   0.4388
Residual SS             =  311.8640484                Root MSE      =    .5087

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4527492   1.270887     0.36   0.722    -2.040648    2.946147
    sqravyrs |  -.0290877   .0535775    -0.54   0.587    -.1342033    .0760279
   lnpatappr |  -.5195308   .2167962    -2.40   0.017    -.9448707   -.0941908
       lnfdi |  -.0372701   .1522718    -0.24   0.807    -.3360174    .2614772
      lngdpc |   .5357723   .4654535     1.15   0.250    -.3774171    1.448962
       lnpop |   .1910367   4.084891     0.05   0.963    -7.823253    8.205327
        unem |  -.0086146   .0026244    -3.28   0.001    -.0137635   -.0034656
   lnecofree |   .2067589   .4994755     0.41   0.679    -.7731794    1.186697
        serv |   -.009727   .0151936    -0.64   0.522    -.0395359    .0200819
      lnrulc |   .7819756   .4635162     1.69   0.092    -.1274129    1.691364
   transindn |  -.6665467    .873526    -0.76   0.446    -2.380347    1.047254
    year1996 |  -1.454255   .3906169    -3.72   0.000     -2.22062     -.68789
    year1997 |  -1.318902   .3289437    -4.01   0.000    -1.964268   -.6735361
    year1998 |  -1.272431   .3008235    -4.23   0.000    -1.862627   -.6822349
    year1999 |  -1.289788   .2707054    -4.76   0.000    -1.820894   -.7586818
    year2000 |  -1.175839   .2398671    -4.90   0.000    -1.646442    -.705235
```

```
    year2001 |  -.9742668   .2085044    -4.67   0.000    -1.383339   -.5651949
    year2002 |   -.788085   .1609791    -4.90   0.000    -1.103915   -.4722545
    year2003 |  -.7216679   .1551313    -4.65   0.000    -1.026025   -.4173104
    year2004 |  -.5444631   .1303149    -4.18   0.000    -.8001324   -.2887938
    year2005 |  -.4641797   .1229394    -3.78   0.000    -.7053789   -.2229806
    year2006 |  -.3498172   .1118385    -3.13   0.002     -.569237   -.1303975
    year2007 |   -.184907   .1056377    -1.75   0.080    -.3921613    .0223472
    year2008 |  -.0574928   .0896721    -0.64   0.522    -.2334237     .118438
    year2010 |    .130977   .0788465     1.66   0.097    -.0237146    .2856686
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            130.883
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              127.527
                         (Kleibergen-Paap rk Wald F statistic):         88.593
Stock-Yogo weak ID test critical values:                         <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               8.451
                                                   Chi-sq(4) P-val =    0.0764
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1996
                      year1997 year1998 year1999 year2000 year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.2 Model 2 - IV estimated results – N-ETEs (medium-high and high tech)

```
.xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     2120
                                                      F( 24,   1926) =     4.22
                                                      Prob > F      =   0.0000
```

```
Total (centered) SS     =  131.7549505                Centered R2   =   0.1058
Total (uncentered) SS   =  131.7549505                Uncentered R2 =   0.1058
Residual SS             =  117.8174087                Root MSE      =    .2473

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .1791761   .3253691     0.55   0.582    -.4589365    .8172888
    sqravyrs |  -.0118769   .0148419    -0.80   0.424    -.0409848     .017231
   lnpatappr |   .0542478   .0688315     0.79   0.431    -.0807444      .18924
       lnfdi |   .0150009   .0094609     1.59   0.113    -.0035538    .0335556
      lngdpc |  -.3967788   .3437401    -1.15   0.249    -1.070921     .277363
       lnpop |  -1.677714   .5350033    -3.14   0.002    -2.726961   -.6284679
        unem |   .0001508   .0012881     0.12   0.907    -.0023754     .002677
   lnecofree |  -.1003462   .2607965    -0.38   0.700    -.6118193     .411127
        serv |  -.0105956   .0072412    -1.46   0.144    -.0247969    .0036058
      lnrulc |  -.8250945   .4063667    -2.03   0.042    -1.622059   -.0281296
    year1996 |  -.1682992   .0910078    -1.85   0.065    -.3467833     .010185
    year1997 |   -.151271   .0824313    -1.84   0.067     -.312935     .010393
    year1998 |  -.1654227   .0722505    -2.29   0.022    -.3071202   -.0237252
    year1999 |  -.1470391   .0665014    -2.21   0.027    -.2774615   -.0166168
    year2000 |  -.1393508   .0556556    -2.50   0.012    -.2485023   -.0301993
    year2001 |  -.0993544    .049457    -2.01   0.045    -.1963492   -.0023596
    year2002 |  -.0876053   .0452004    -1.94   0.053    -.1762523    .0010417
    year2003 |  -.0528619   .0416987    -1.27   0.205    -.1346413    .0289175
    year2004 |   -.060854   .0405322    -1.50   0.133    -.1403456    .0186375
    year2005 |  -.0682429   .0378177    -1.80   0.071     -.142411    .0059251
    year2006 |  -.0733571   .0370786    -1.98   0.048    -.1460755   -.0006387
    year2007 |  -.0498415   .0381405    -1.31   0.191    -.1246426    .0249596
    year2008 |  -.0325552   .0312694    -1.04   0.298    -.0938806    .0287701
    year2010 |  -.0535569   .0242903    -2.20   0.028     -.101195   -.0059187
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             93.323
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              270.658
                         (Kleibergen-Paap rk Wald F statistic):         62.370
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.619
                                                   Chi-sq(4) P-val =    0.4600
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.3 Model 2 - IV estimated results (high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if mhtechintens==1, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                   Obs per group: min =         3
                                                              avg =      12.8
                                                              max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 24,   1566) =     6.59
                                                      Prob > F      =   0.0000
Total (centered) SS     =  493.2394608                Centered R2   =   0.2482
Total (uncentered) SS   =  493.2394608                Uncentered R2 =   0.2482
Residual SS             =  370.8359457                Root MSE      =    .4866

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.6015589   .6357493    -0.95   0.344    -1.848568    .6454506
    sqravyrs |   .0187715   .0291777     0.64   0.520    -.0384599     .076003
   lnpatappr |  -.2651346   .1230322    -2.16   0.031    -.5064598   -.0238094
       lnfdi |   .0035589   .0164395     0.22   0.829    -.0286868    .0358047
      lngdpc |   2.298096   .3140217     7.32   0.000     1.682149    2.914043
       lnpop |  -2.793913   .9366174    -2.98   0.003    -4.631069   -.9567563
        unem |   .0036252   .0022633     1.60   0.109    -.0008143    .0080647
   lnecofree |   .2991396   .4870772     0.61   0.539    -.6562526    1.254532
        serv |    .013142   .0152987     0.86   0.390     -.016866    .0431501
      lnrulc |   .0679941    .520302     0.13   0.896    -.9525678    1.088556
    year1996 |  -.0190269   .1572416    -0.12   0.904    -.3274531    .2893993
    year1997 |  -.0153783   .1398175    -0.11   0.912    -.2896276     .258871
    year1998 |  -.0724438   .1297551    -0.56   0.577    -.3269558    .1820682
    year1999 |  -.1686438   .1243151    -1.36   0.175    -.4124855    .0751978
    year2000 |  -.1950861   .1104167    -1.77   0.077    -.4116663    .0214941
    year2001 |  -.1825698   .0982752    -1.86   0.063    -.3753346    .0101949
    year2002 |  -.2096583   .0876661    -2.39   0.017    -.3816136   -.0377031
    year2003 |    -.18154   .0863826    -2.10   0.036    -.3509778   -.0121022
    year2004 |  -.2185546   .0805262    -2.71   0.007    -.3765052    -.060604
    year2005 |  -.2475542   .0773957    -3.20   0.001    -.3993643   -.0957442
    year2006 |  -.2959518   .0804449    -3.68   0.000    -.4537428   -.1381608
    year2007 |  -.2804218   .0763812    -3.67   0.000     -.430242   -.1306017
    year2008 |  -.1553569    .058051    -2.68   0.008    -.2692229   -.0414909
    year2010 |  -.0924394   .0563037    -1.64   0.101    -.2028779    .0179991
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             70.991
                                                   Chi-sq(1) P-val =    0.0000
```

```
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):             343.877
                         (Kleibergen-Paap rk Wald F statistic):        76.371
Stock-Yogo weak ID test critical values:                        <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):        0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              7.460
                                                   Chi-sq(4) P-val =    0.1135
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.3.1 Model 2 - IV estimated results – ETEs (high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                     Obs per group: min =          7
                                                                avg =       13.3
                                                                max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      665
                                                      F( 25,    590) =     9.09
                                                      Prob > F      =   0.0000
Total (centered) SS     =  401.3177204                Centered R2   =   0.4263
Total (uncentered) SS   =  401.3177204                Uncentered R2 =   0.4263
Residual SS             =  230.2259456                Root MSE      =    .6247

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   1.129014   2.216558     0.51   0.611    -3.224291    5.482319
    sqravyrs |  -.0620255   .0932789    -0.66   0.506    -.2452246    .1211736
   lnpatappr |  -.9785358   .3695272    -2.65   0.008    -1.704285   -.2527871
       lnfdi |   -.052484   .2646422    -0.20   0.843    -.5722393    .4672714
      lngdpc |  -.1494802   .7714283    -0.19   0.846     -1.66456    1.365599
       lnpop |   3.200568   7.111602     0.45   0.653    -10.76657     17.1677
        unem |  -.0117958   .0045927    -2.57   0.010    -.0208157   -.0027758
```

```
   lnecofree |   .6488538   .8748078     0.74   0.459    -1.069262     2.36697
        serv |  -.0272943   .0264002    -1.03   0.302     -.079144    .0245555
      lnrulc |   1.800013   .7748469     2.32   0.021     .2782194    3.321807
   transindn |  -.3797262   1.523892    -0.25   0.803     -3.37264    2.613187
    year1997 |   .1879103   .2364596     0.79   0.427    -.2764947    .6523152
    year1998 |   .2362427   .2801832     0.84   0.399     -.314035    .7865205
    year1999 |   .2469435   .3132865     0.79   0.431    -.3683489     .862236
    year2000 |   .4068803   .3544942     1.15   0.252    -.2893438    1.103104
    year2001 |   .6894817   .3871635     1.78   0.075    -.0709047    1.449868
    year2002 |   1.024315    .468258     2.19   0.029     .1046595     1.94397
    year2003 |   1.117352   .4743128     2.36   0.019     .1858046    2.048898
    year2004 |   1.375276   .5190807     2.65   0.008     .3558054    2.394747
    year2005 |   1.452851   .5503804     2.64   0.009     .3719083    2.533794
    year2006 |   1.658479   .6070084     2.73   0.006     .4663184    2.850639
    year2007 |   1.953835    .643251     3.04   0.002     .6904947    3.217176
    year2008 |   2.189779   .6442083     3.40   0.001     .9245588       3.455
    year2009 |   2.253332   .6764657     3.33   0.001     .9247582    3.581906
    year2010 |   2.422991   .7138113     3.39   0.001     1.021071    3.824911
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             65.444
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               62.442
                         (Kleibergen-Paap rk Wald F statistic):         43.380
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               6.910
                                                   Chi-sq(4) P-val =    0.1407
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.3.6.3.2 Model 2 - IV estimated results - N-ETEs (high tech)

```
. xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
```

```
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                    Number of obs =     1060
                                                    F( 24,    951) =     1.64
                                                    Prob > F      =   0.0279
Total (centered) SS     =   91.9217385               Centered R2   =   0.0656
Total (uncentered) SS   =   91.9217385               Uncentered R2 =   0.0656
Residual SS             =  85.89609255               Root MSE      =    .3005

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.0578471   .5632155    -0.10   0.918    -1.163136    1.047442
    sqravyrs |  -.0018724   .0256329    -0.07   0.942    -.0521759    .0484311
   lnpatappr |   .0840967   .1199154     0.70   0.483    -.1512327     .319426
       lnfdi |   .0139996   .0163698     0.86   0.393    -.0181256    .0461247
      lngdpc |  -.2629225   .5618005    -0.47   0.640    -1.365434    .8395895
       lnpop |  -.3542781   .8256291    -0.43   0.668    -1.974543    1.265987
        unem |   .0018903     .00211     0.90   0.371    -.0022505    .0060311
   lnecofree |  -.0776557   .4541934    -0.17   0.864    -.9689928    .8136815
        serv |  -.0055884   .0121497    -0.46   0.646    -.0294318     .018255
      lnrulc |  -.9847564   .6867501    -1.43   0.152    -2.332477    .3629643
    year1996 |  -.1027469   .1467757    -0.70   0.484    -.3907885    .1852947
    year1997 |  -.0636419   .1318912    -0.48   0.630    -.3224733    .1951895
    year1998 |  -.0941684   .1175163    -0.80   0.423    -.3247896    .1364528
    year1999 |  -.0986003   .1100095    -0.90   0.370    -.3144898    .1172892
    year2000 |  -.0708602   .0923614    -0.77   0.443    -.2521159    .1103955
    year2001 |   -.029749   .0809767    -0.37   0.713    -.1886625    .1291646
    year2002 |  -.0232007   .0748113    -0.31   0.757    -.1700151    .1236137
    year2003 |   .0196011   .0682753     0.29   0.774    -.1143867    .1535888
    year2004 |    .000375    .067864     0.01   0.996    -.1328056    .1335555
    year2005 |  -.0111933    .061194    -0.18   0.855    -.1312841    .1088976
    year2006 |  -.0450525    .062826    -0.72   0.473    -.1683461     .078241
    year2007 |   -.033667   .0649322    -0.52   0.604    -.1610939    .0937599
    year2008 |  -.0330199   .0534914    -0.62   0.537    -.1379948     .071955
    year2010 |  -.0683688   .0410737    -1.66   0.096    -.1489743    .0122367
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             46.662
                                                 Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              133.644
                         (Kleibergen-Paap rk Wald F statistic):         30.796
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                               (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               5.016
                                                 Chi-sq(4) P-val =    0.2857
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.4 Model 2 - IV estimated results (medium-high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if mhtechintens==0,
fe endog (avyrs sqravyrs lnpatappr lnfdi)small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 25,   1565) =    16.87
                                                      Prob > F      =   0.0000
Total (centered) SS     =  194.1988114                Centered R2   =   0.5006
Total (uncentered) SS   =  194.1988114                Uncentered R2 =   0.5006
Residual SS             =  96.98690621                Root MSE      =    .2489
```

lnemshmhtech	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
avyrs	-.4703411	.3599745	-1.31	0.192	-1.176424	.235742
sqravyrs	.0183234	.0162563	1.13	0.260	-.013563	.0502098
lnpatappr	.0538441	.0589889	0.91	0.361	-.0618615	.1695497
lnfdi	.0141475	.0089763	1.58	0.115	-.0034593	.0317543
lngdpc	1.520824	.2084777	7.29	0.000	1.111899	1.929749
lnpop	-4.414756	.608897	-7.25	0.000	-5.609096	-3.220416
unem	-.0000428	.001014	-0.04	0.966	-.0020317	.0019461
lnecofree	-.1810885	.2431714	-0.74	0.457	-.6580646	.2958876
serv	.0011216	.0066672	0.17	0.866	-.0119561	.0141992
lnrulc	-.4482164	.2960928	-1.51	0.130	-1.028997	.132564
transindn	.7603205	.5564915	1.37	0.172	-.3312271	1.851868
year1996	.0493583	.0870452	0.57	0.571	-.1213792	.2200959
year1997	-.0078561	.0729116	-0.11	0.914	-.1508708	.1351586
year1998	-.0238817	.0673898	-0.35	0.723	-.1560654	.108302
year1999	-.0588756	.0616001	-0.96	0.339	-.1797031	.0619519
year2000	-.1177411	.0575765	-2.04	0.041	-.2306763	-.0048058
year2001	-.0803646	.0521212	-1.54	0.123	-.1825994	.0218702
year2002	-.1074748	.0470664	-2.28	0.023	-.1997946	-.0151551
year2003	-.0903472	.046266	-1.95	0.051	-.181097	.0004026
year2004	-.1073362	.0437641	-2.45	0.014	-.1931786	-.0214938
year2005	-.1117752	.0429089	-2.60	0.009	-.1959402	-.0276103
year2006	-.1381458	.0422628	-3.27	0.001	-.2210435	-.0552481
year2007	-.1447722	.0407304	-3.55	0.000	-.224664	-.0648803
year2008	-.0991623	.0302698	-3.28	0.001	-.1585359	-.0397888
year2010	-.0377955	.0259266	-1.46	0.145	-.0886501	.0130591

```
Underidentification test (Kleibergen-Paap rk LM statistic):             71.366
```

```
                                                  Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):             342.660
                         (Kleibergen-Paap rk Wald F statistic):        76.490
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):        0.000
                                                (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              1.471
                                                  Chi-sq(4) P-val =    0.8317
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1996
                      year1997 year1998 year1999 year2000 year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.3.6.4.1 Model 2 - IV estimated results – ETEs (medium-high tech)

```
xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      665
                                                      F( 25,    590) =    18.68
                                                      Prob > F      =   0.0000
Total (centered) SS     =  154.3655902                Centered R2   =   0.6159
Total (uncentered) SS   =  154.3655902                Uncentered R2 =   0.6159
Residual SS             =  59.29914463                Root MSE      =     .317

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.2235932    1.11725    -0.20   0.841    -2.417864    1.970678
    sqravyrs |    .003853   .0460376     0.08   0.933    -.0865644    .0942705
   lnpatappr |   -.060539   .1991369    -0.30   0.761    -.4516425    .3305644
       lnfdi |  -.0220598   .1250471    -0.18   0.860    -.2676514    .2235318
      lngdpc |   1.221033    .440937     2.77   0.006     .3550356     2.08703
```

```
       lnpop |  -2.818836   3.876492    -0.73   0.467    -10.43224    4.794566
        unem |  -.0054334   .0022646    -2.40   0.017     -.009881   -.0009858
   lnecofree |  -.2353136   .4510029    -0.52   0.602     -1.12108    .6504528
        serv |   .0078397   .0132287     0.59   0.554    -.0181415    .0338208
     lnrulc |  -.2360412   .4332825    -0.54   0.586    -1.087005    .6149226
   transindn |  -.9533868   .6922261    -1.38   0.169    -2.312914    .4061404
    year1997 |   .0827963    .111923     0.74   0.460    -.1370196    .3026122
    year1998 |   .1274064   .1288699     0.99   0.323    -.1256932    .3805059
    year1999 |   .0819929    .148972     0.55   0.582     -.210587    .3745729
    year2000 |   .1499552   .1680655     0.89   0.373    -.1801243    .4800346
    year2001 |   .2704991   .1876543     1.44   0.150    -.0980527    .6390509
    year2002 |   .3080321   .2267256     1.36   0.175    -.1372553    .7533195
    year2003 |   .3478283   .2296858     1.51   0.130     -.103273    .7989295
    year2004 |   .4443146   .2524795     1.76   0.079    -.0515533    .9401826
    year2005 |   .5273062   .2667497     1.98   0.049     .0034117    1.051201
    year2006 |   .5504036   .2953291     1.86   0.063    -.0296207    1.130428
    year2007 |   .5848678   .3149429     1.86   0.064    -.0336778    1.203413
    year2008 |    .603752   .3184632     1.90   0.058    -.0217074    1.229211
    year2009 |   .6551889   .3315656     1.98   0.049     .0039965    1.306381
    year2010 |   .7474848   .3524502     2.12   0.034     .0552751    1.439695
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             65.444
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               62.442
                         (Kleibergen-Paap rk Wald F statistic):         43.380
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.835
                                                   Chi-sq(4) P-val =    0.4289
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.3.6.4.2 Model 2 - IV estimated results – N-ETEs (medium-high tech)

```
. xtivreg2 lnemshmhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------
```

```
Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,   951) =     4.45
                                                      Prob > F      =   0.0000
Total (centered) SS     =  39.83321916                Centered R2   =   0.2587
Total (uncentered) SS   =  39.83321916                Uncentered R2 =   0.2587
Residual SS             =  29.52772596                Root MSE      =    .1762

------------------------------------------------------------------------------
             |               Robust
lnemshmhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4162129   .3230949     1.29   0.198    -.2178484    1.050274
    sqravyrs |   -.021882   .0148667    -1.47   0.141    -.0510573    .0072933
   lnpatappr |   .0243997   .0704304     0.35   0.729    -.1138172    .1626167
       lnfdi |   .0160023   .0092417     1.73   0.084    -.0021342    .0341387
      lngdpc |  -.5306194   .3799658    -1.40   0.163    -1.276288    .2150489
       lnpop |  -3.001187   .6135748    -4.89   0.000    -4.205304    -1.79707
        unem |  -.0015886   .0013692    -1.16   0.246    -.0042756    .0010983
   lnecofree |   -.123056   .2528611    -0.49   0.627    -.6192862    .3731742
        serv |  -.0156024   .0079552    -1.96   0.050    -.0312142    9.29e-06
      lnrulc |  -.6654343   .4317375    -1.54   0.124    -1.512703     .181834
    year1996 |  -.2338446   .1028531    -2.27   0.023    -.4356898   -.0319994
    year1997 |  -.2388962   .0949609    -2.52   0.012    -.4252534    -.052539
    year1998 |  -.2366741   .0793285    -2.98   0.003    -.3923532    -.080995
    year1999 |  -.1954731    .072383    -2.70   0.007    -.3375219   -.0534243
    year2000 |  -.2078419   .0597177    -3.48   0.001    -.3250356   -.0906482
    year2001 |  -.1689569   .0541564    -3.12   0.002    -.2752368   -.0626769
    year2002 |  -.1520052   .0483146    -3.15   0.002    -.2468208   -.0571897
    year2003 |  -.1253205   .0460571    -2.72   0.007    -.2157058   -.0349353
    year2004 |  -.1220811    .043061    -2.84   0.005    -.2065867   -.0375755
    year2005 |  -.1252929   .0437517    -2.86   0.004    -.2111539   -.0394319
    year2006 |  -.1016604   .0391893    -2.59   0.010    -.1785679   -.0247529
    year2007 |  -.0660142   .0395378    -1.67   0.095    -.1436057    .0115772
    year2008 |   -.032088   .0318407    -1.01   0.314    -.0945742    .0303981
    year2010 |  -.0387423   .0262428    -1.48   0.140    -.0902428    .0127582
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             46.662
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              133.644
                         (Kleibergen-Paap rk Wald F statistic):         30.796
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               2.673
                                                   Chi-sq(4) P-val =    0.6140
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
```

```
------------------------------------------------------------------------------
```

Table A5.4 Model 1 - Fixed effects estimated results (medium-high and high tech)

```
xtreg lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.0598                         Obs per group: min =         5
       between = 0.0326                                        avg =      13.3
       overall = 0.0298                                        max =        16

                                                F(25,3305)         =      8.41
corr(u_i, Xb)  = -0.9350                        Prob > F           =    0.0000

------------------------------------------------------------------------------
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0684092   .1310535     0.52   0.602     -.188545    .3253634
     lntedut |  -.0491646   .1321687    -0.37   0.710    -.3083054    .2099763
     cskills |  (omitted)
   lnpatappr |  -.0870021   .0288026    -3.02   0.003    -.1434749   -.0305292
       lnfdi |   .0087483   .0062759     1.39   0.163    -.0035567    .0210533
      lngdpc |    .529116   .1463199     3.62   0.000     .2422292    .8160029
       lnpop |  -1.742003    .416844    -4.18   0.000    -2.559302   -.9247047
        unem |   -.000038   .0009313    -0.04   0.967    -.0018639     .001788
   lnecofree |  -.0297467   .1841989    -0.16   0.872    -.3909022    .3314087
      lnrulc |    .196702   .2043481     0.96   0.336    -.2039597    .5973636
        serv |   .0132255   .0040057     3.30   0.001     .0053716    .0210793
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0587531   .0512922     1.15   0.252    -.0418147    .1593208
    year1997 |   .0485495   .0519354     0.93   0.350    -.0532792    .1503782
    year1998 |   .0257366   .0532252     0.48   0.629    -.0786211    .1300943
    year1999 |  -.0114175   .0551808    -0.21   0.836    -.1196094    .0967744
    year2000 |  -.0416281   .0558711    -0.75   0.456    -.1511735    .0679173
    year2001 |  -.0243133   .0579409    -0.42   0.675     -.137917    .0892904
    year2002 |  -.0518795   .0618147    -0.84   0.401    -.1730784    .0693194
    year2003 |  -.0716304    .064766    -1.11   0.269     -.198616    .0553552
    year2004 |  -.0326971    .068135    -0.48   0.631    -.1662881    .1008939
    year2005 |  -.0563684   .0728439    -0.77   0.439    -.1991921    .0864553
    year2006 |  -.0596159   .0766616    -0.78   0.437     -.209925    .0906931
    year2007 |  -.0318939   .0798382    -0.40   0.690    -.1884313    .1246434
    year2008 |   .0091779   .0821069     0.11   0.911    -.1518076    .1701635
    year2009 |   .0124326   .0834588     0.15   0.882    -.1512036    .1760688
    year2010 |  -.0260488   .0850375    -0.31   0.759    -.1927803    .1406827
       _cons |   8.829708   4.946946     1.78   0.074    -.8696791     18.5291
-------------+----------------------------------------------------------------
     sigma_u |  2.7889395
     sigma_e |  .39740336
         rho |   .9800999   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(269, 3305) =    67.24           Prob > F = 0.0000
```

Table A5.4.1 Model 1 - Diagnostic tests

Groupwise heteroskedasticity

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   2.6e+06
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      269) =     85.147
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year201
> 0, fe

Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1581.0459
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 0
LM5= 39.762368
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0

Test for significance of fixed effects
F= 67.240915
Probability>F= 0
Test for normality of residuals
```

Skewness/Kurtosis tests for Normality

```
                                                        ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |   3.6e+03    0.0000         0.0000            .         0.0000
```

Table A5.4.2 Model 1 - Driscoll-Kraay estimated results (medium-high and high tech)

```
xtscc lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =      3600
Method: Fixed-effects regression                 Number of groups  =       270
Group variable (i): cn_ind                       F( 28,    269)    =  17518.72
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.0598
```

```
------------------------------------------------------------------------------
             |             Drisc/Kraay
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0684092    .083937     0.82   0.416    -.0968477    .2336662
     lntedut |  -.0491646   .0951096    -0.52   0.606    -.2364185    .1380893
     cskills |  (omitted)
   lnpatappr |  -.0870021   .0233325    -3.73   0.000    -.1329396   -.0410645
       lnfdi |   .0087483   .0037076     2.36   0.019     .0014487    .0160479
      lngdpc |    .529116   .2333677     2.27   0.024     .0696565    .9885755
       lnpop |  -1.742003   .3014533    -5.78   0.000    -2.335511   -1.148495
        unem |   -.000038   .0008504    -0.04   0.964    -.0017122    .0016363
   lnecofree |  -.0297467   .2064144    -0.14   0.886    -.4361399    .3766464
      lnrulc |    .196702   .2736492     0.72   0.473    -.3420646    .7354685
        serv |   .0132255   .0030248     4.37   0.000     .0072702    .0191808
        dist |   .0084797   .0043825     1.93   0.054    -.0001486     .017108
  transdummy |  (omitted)
    year1996 |   .0587531   .0108313     5.42   0.000     .0374283    .0800779
    year1997 |   .0485495   .0112585     4.31   0.000     .0263836    .0707154
    year1998 |   .0257366   .0161208     1.60   0.112    -.0060024    .0574755
    year1999 |  -.0114175   .0224486    -0.51   0.611    -.0556148    .0327798
    year2000 |  -.0416281   .0265766    -1.57   0.118    -.0939528    .0106966
    year2001 |  -.0243133    .030679    -0.79   0.429    -.0847147    .0360881
    year2002 |  -.0518795   .0362151    -1.43   0.153    -.1231806    .0194217
    year2003 |  -.0716304   .0413304    -1.73   0.084    -.1530027    .0097418
    year2004 |  -.0326971   .0504501    -0.65   0.517    -.1320244    .0666302
    year2005 |  -.0563684   .0590427    -0.95   0.341     -.172613    .0598761
    year2006 |  -.0596159   .0693482    -0.86   0.391    -.1961502    .0769183
    year2007 |  -.0318939   .0764777    -0.42   0.677    -.1824649     .118677
    year2008 |   .0091779   .0781229     0.12   0.907    -.1446321    .1629879
    year2009 |   .0124326   .0622809     0.20   0.842    -.1101874    .1350526
    year2010 |  -.0260488   .0644465    -0.40   0.686    -.1529326     .100835
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A5.4.3 Model 1 - FEVD estimated results (medium-high and high tech)

```
xtfevd lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010,invariant (cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      3302          number of obs       =      3600
mean squared error         =   .144988          F( 30, 3302)        = 5.313432
root mean squared error    =  .3807729          Prob > F            = 6.20e-18
Residual Sum of Squares    =  521.9568          R-squared           = .8664393
Total Sum of Squares       =  3908.013          adj. R-squared      = .8544262
Estimation Sum of Squares  =  3386.056

------------------------------------------------------------------------------
             |                fevd
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .0684092   1.324926     0.05   0.959     -2.52935    2.666169
     lntedut |  -.0491646   2.172454    -0.02   0.982    -4.308658    4.210329
   lnpatappr |   -.087002   .3742291    -0.23   0.816    -.8207465    .6467425
       lnfdi |   .0087483   .0807259     0.11   0.914    -.1495296    .1670262
      lngdpc |    .529116   2.974658     0.18   0.859    -5.303245    6.361477
       lnpop |  -1.742003   1.018675    -1.71   0.087    -3.739301    .2552944
        unem |   -.000038   .0048786    -0.01   0.994    -.0096034    .0095275
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnecofree	-.0297465	1.299436	-0.02	0.982	-2.577528	2.518035
lnrulc	.196702	1.162341	0.17	0.866	-2.082279	2.475683
serv	.0132255	.0352034	0.38	0.707	-.0557972	.0822481
year1996	.0587531	.299522	0.20	0.845	-.5285146	.6460207
year1997	.0485495	.3503511	0.14	0.890	-.6383778	.7354769
year1998	.0257366	.3829817	0.07	0.946	-.725169	.7766421
year1999	-.0114175	.3202995	-0.04	0.972	-.6394232	.6165882
year2000	-.0416281	.3398695	-0.12	0.903	-.7080043	.6247481
year2001	-.0243133	.413865	-0.06	0.953	-.8357711	.7871446
year2002	-.0518795	.411068	-0.13	0.900	-.8578535	.7540945
year2003	-.0716304	.4372932	-0.16	0.870	-.9290236	.7857627
year2004	-.0326972	.4267279	-0.08	0.939	-.8693752	.8039809
year2005	-.0563684	.4739582	-0.12	0.905	-.9856501	.8729132
year2006	-.0596159	.459004	-0.13	0.897	-.9595772	.8403453
year2007	-.0318939	.5581275	-0.06	0.954	-1.126205	1.062417
year2008	.0091779	.5370674	0.02	0.986	-1.043841	1.062197
year2009	.0124326	.5384776	0.02	0.982	-1.043351	1.068216
year2010	-.0260488	.5475057	-0.05	0.962	-1.099534	1.047436
cskills	-.21452	1.565827	-0.14	0.891	-3.28461	2.85557
dist	-.0009117	.0013012	-0.70	0.484	-.003463	.0016396
transdummy	-.5432119	3.955336	-0.14	0.891	-8.298371	7.211947
eta	1	.	.	.	.	.
_cons	11.042	30.91505	0.36	0.721	-49.57261	71.65661

Table A5.4.4 Model 1 - Hausman and Taylor estimated results (medium-high and high tech)

```
xthtaylor lnrxamhtech lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, endo (lnsedut lntedut cskills)

Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

                                                Obs per group: min =         5
                                                               avg =      13.3
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    203.57
                                                Prob > chi2        =    0.0000
```

lnrxamhtech	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TVexogenous						
lnpatappr	-.0713658	.0275886	-2.59	0.010	-.1254384	-.0172931
lnfdi	.0072799	.0060729	1.20	0.231	-.0046227	.0191825
lngdpc	.903275	.1156017	7.81	0.000	.6766999	1.12985
lnpop	.1224206	.132223	0.93	0.355	-.1367318	.381573
unem	.0007312	.0008869	0.82	0.410	-.0010071	.0024695
lnecofree	.0798291	.1766995	0.45	0.651	-.2664955	.4261537
lnrulc	.1508803	.1976039	0.76	0.445	-.2364163	.5381769
serv	.0124967	.0038525	3.24	0.001	.004946	.0200475
year1996	.0527059	.0496916	1.06	0.289	-.044688	.1500997
year1997	.0342405	.050234	0.68	0.495	-.0642163	.1326973
year1998	.0106676	.0514525	0.21	0.836	-.0901774	.1115126
year1999	-.0349863	.053182	-0.66	0.511	-.1392211	.0692486
year2000	-.0817057	.0534192	-1.53	0.126	-.1864054	.0229939
year2001	-.0768772	.0550061	-1.40	0.162	-.1846872	.0309327
year2002	-.1168202	.0582764	-2.00	0.045	-.2310398	-.0026006

	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
year2003	-.1428977	.0608794	-2.35	0.019	-.262219	-.0235763
year2004	-.1246676	.0630912	-1.98	0.048	-.2483242	-.0010111
year2005	-.1657058	.0666955	-2.48	0.013	-.2964266	-.034985
year2006	-.1897018	.0690768	-2.75	0.006	-.3250899	-.0543138
year2007	-.1764892	.0711542	-2.48	0.013	-.3159489	-.0370295
year2008	-.1381005	.0733068	-1.88	0.060	-.2817793	.0055783
year2009	-.1014571	.0771307	-1.32	0.188	-.2526305	.0497163
year2010	-.1508886	.0780279	-1.93	0.053	-.3038204	.0020432
TVendogenous						
lnsedut	.2037041	.1233412	1.65	0.099	-.0380402	.4454483
lntedut	-.2134415	.1210888	-1.76	0.078	-.4507712	.0238881
TIexogenous						
dist	.0001264	.000342	0.37	0.712	-.0005439	.0007967
transdummy	.8448319	.3972765	2.13	0.033	.0661843	1.62348
TIendogenous						
cskills	.5334601	1.193932	0.45	0.655	-1.806604	2.873524
_cons	-15.26586	6.418311	-2.38	0.017	-27.84552	-2.686204
sigma_u	2.758089					
sigma_e	.3959088					
rho	.97981094	(fraction of variance due to u_i)				

Note: TV refers to time varying; TI refers to time invariant.

Table A5.4.5 Model 1 - IV estimated results (medium-high and high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1), fe endog (lnsedut lntedut
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       270                    Obs per group: min =          3
                                                               avg =       12.8
                                                               max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                     Number of obs =      3450
                                                     F( 24,   3156) =      2.53
                                                     Prob > F      =    0.0001
Total (centered) SS     =  474.7834512               Centered R2   =    0.0649
Total (uncentered) SS   =  474.7834512               Uncentered R2 =    0.0649
Residual SS             =  443.9596097               Root MSE      =     .3751
```

lnrxamhtech	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnsedut	.0995346	.1939387	0.51	0.608	-.2807241	.4797932
lntedut	.0684942	.2280949	0.30	0.764	-.378735	.5157235

```
   lnpatappr |  -.0845821   .0667826    -1.27   0.205    -.2155237    .0463596
       lnfdi |    .007232    .009672     0.75   0.455    -.0117319     .026196
      lngdpc |   .4993471   .2329709     2.14   0.032     .0425574    .9561368
       lnpop |  -1.995353   .6539367    -3.05   0.002    -3.277537   -.7131687
        unem |  -.0007574   .0012856    -0.59   0.556    -.0032782    .0017634
   lnecofree |  -.0936801   .2668952    -0.35   0.726    -.6169857    .4296256
        serv |   .0132192   .0079244     1.67   0.095    -.0023182    .0287567
      lnrulc |   .1802852   .2980351     0.60   0.545    -.4040769    .7646473
    year1996 |   .0733332   .0944003     0.78   0.437     -.111759    .2584253
    year1997 |   .0632403   .0880788     0.72   0.473    -.1094571    .2359377
    year1998 |   .0388113   .0803739     0.48   0.629    -.1187792    .1964018
    year1999 |  -.0033112    .075303    -0.04   0.965    -.1509591    .1443366
    year2000 |   -.030571   .0697098    -0.44   0.661    -.1672521    .1061102
    year2001 |  -.0156013    .060508    -0.26   0.797    -.1342403    .1030376
    year2002 |  -.0437111   .0554716    -0.79   0.431    -.1524752    .0650531
    year2003 |  -.0399871   .0525468    -0.76   0.447    -.1430165    .0630423
    year2004 |  -.0348189   .0506626    -0.69   0.492    -.1341538     .064516
    year2005 |  -.0608427   .0489231    -1.24   0.214     -.156767    .0350817
    year2006 |  -.0575511   .0504597    -1.14   0.254    -.1564883    .0413862
    year2007 |  -.0338404   .0492986    -0.69   0.492     -.130501    .0628201
    year2008 |  -.0029349   .0360492    -0.08   0.935    -.0736173    .0677474
    year2010 |  -.0359769   .0309577    -1.16   0.245    -.0966761    .0247223
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            155.757
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              698.597
                         (Kleibergen-Paap rk Wald F statistic):        169.991
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               1.291
                                                   Chi-sq(4) P-val =    0.8629
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.4.5.1 Model 1 - IV estimated results - ETEs (medium-high and high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
```

```
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                   Number of obs =     1330
                                                   F( 24,  1206) =     3.29
                                                   Prob > F      =   0.0000
Total (centered) SS     =  356.6827202             Centered R2   =   0.1110
Total (uncentered) SS   =  356.6827202             Uncentered R2 =   0.1110
Residual SS             =  317.1025499             Root MSE      =    .5128

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.9442801   .6713344    -1.41   0.160    -2.261393    .3728331
     lntedut |  -1.011508   .5081643    -1.99   0.047    -2.008492   -.0145233
   lnpatappr |  -.5215919    .193792    -2.69   0.007    -.9017988   -.1413851
       lnfdi |  -.1287024   .1579845    -0.81   0.415    -.4386574    .1812525
     lngdpc |  -.0166063   .4281068    -0.04   0.969    -.8565231    .8233105
       lnpop |  -2.954911   2.920887    -1.01   0.312    -8.685495    2.775672
        unem |  -.0031771   .0024949    -1.27   0.203    -.0080721    .0017178
   lnecofree |   .8890269   .5217102     1.70   0.089    -.1345336    1.912587
        serv |  -.0022495   .0140327    -0.16   0.873    -.0297806    .0252817
     lnrulc |   .8550871   .4519132     1.89   0.059    -.0315363     1.74171
    year1996 |  -1.061463   .4281761    -2.48   0.013    -1.901516   -.2214103
    year1997 |  -1.025364    .386043    -2.66   0.008    -1.782754    -.267973
    year1998 |  -1.004534   .3590958    -2.80   0.005    -1.709056   -.3000126
    year1999 |   -.971986    .333672    -2.91   0.004    -1.626628   -.3173438
    year2000 |  -.9732826    .302517    -3.22   0.001    -1.566801   -.3797646
    year2001 |  -.8207132   .2609725    -3.14   0.002    -1.332724   -.3087027
    year2002 |  -.6655833   .2075007    -3.21   0.001    -1.072686   -.2584809
    year2003 |  -.6232196   .1879879    -3.32   0.001    -.9920393   -.2543999
    year2004 |  -.4732842   .1530197    -3.09   0.002    -.7734985   -.1730699
    year2005 |  -.4482208    .141531    -3.17   0.002    -.7258952   -.1705464
    year2006 |  -.3484128   .1236612    -2.82   0.005    -.5910278   -.1057978
    year2007 |  -.1761372   .1073942    -1.64   0.101    -.3868374    .0345631
    year2008 |  -.0838068   .0915862    -0.92   0.360    -.2634928    .0958791
    year2010 |   .0393881   .0763687     0.52   0.606    -.1104422    .1892183
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            115.494
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              177.500
                         (Kleibergen-Paap rk Wald F statistic):        128.890
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              10.324
                                                   Chi-sq(4) P-val =    0.0353
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
```

```
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------------
```

Table A5.4.5.2 Model 1 - IV estimated results – N-ETEs (medium-high and high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robu
> st bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     2120
                                                      F( 24,  1926) =     0.80
                                                      Prob > F      =   0.7351
Total (centered) SS     =   118.100731                Centered R2   =   0.0172
Total (uncentered) SS   =   118.100731                Uncentered R2 =   0.0172
Residual SS             =  116.0732856                Root MSE      =    .2455

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |    .102369   .1474384     0.69   0.488    -.1867866    .3915246
     lntedut |   .0646693   .2341571     0.28   0.782    -.3945587    .5238974
   lnpatappr |   .0306843   .0670471     0.46   0.647    -.1008083    .1621769
       lnfdi |   .0138864   .0095354     1.46   0.145    -.0048145    .0325872
      lngdpc |  -.0994538   .3351943    -0.30   0.767    -.7568357    .5579282
       lnpop |  -1.364503    .624744    -2.18   0.029    -2.589749   -.1392572
        unem |   -.000348   .0012546    -0.28   0.782    -.0028085    .0021125
   lnecofree |  -.2451217   .2607663    -0.94   0.347    -.7565358    .2662923
        serv |   .0047392   .0070925     0.67   0.504    -.0091706     .018649
      lnrulc |   .0289567   .4112271     0.07   0.944    -.7775405    .8354538
    year1996 |    -.01204    .111394    -0.11   0.914    -.2305054    .2064254
    year1997 |   .0046242   .1022433     0.05   0.964     -.195895    .2051435
    year1998 |  -.0098131   .0902728    -0.11   0.913    -.1868559    .1672297
    year1999 |  -.0212849   .0818904    -0.26   0.795     -.181888    .1393183
    year2000 |  -.0093495   .0708415    -0.13   0.895    -.1482835    .1295845
    year2001 |   .0150988   .0603106     0.25   0.802    -.1031823    .1333798
    year2002 |   .0055897   .0551598     0.10   0.919    -.1025895     .113769
    year2003 |   .0184432   .0508563     0.36   0.717     -.081296    .1181823
    year2004 |   .0246136   .0489273     0.50   0.615    -.0713424    .1205696
    year2005 |  -.0011153   .0444314    -0.03   0.980    -.0882539    .0860234
    year2006 |   .0104431   .0394004     0.27   0.791    -.0668288     .087715
    year2007 |   .0195957    .038946     0.50   0.615    -.0567851    .0959765
```

```
    year2008 |   .0197894    .030343     0.65   0.514    -.0397192     .079298
    year2010 |  -.0209648   .0236926    -0.88   0.376    -.0674307    .0255012
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            101.470
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              296.127
                         (Kleibergen-Paap rk Wald F statistic):         73.906
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               1.754
                                                   Chi-sq(4) P-val =    0.7809
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.4.5.3 Model 1 - IV estimated results (high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if mhtechintens==1, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 24,  1566) =     1.67
                                                      Prob > F      =   0.0227
Total (centered) SS     =  367.7232203                Centered R2   =   0.0680
Total (uncentered) SS   =  367.7232203                Uncentered R2 =   0.0680
Residual SS             =  342.7277551                Root MSE      =    .4678

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .4315659   .3292442     1.31   0.190      -.21424    1.077372
     lntedut |   .2716371   .4108917     0.66   0.509    -.5343188    1.077593
```

```
   lnpatappr |  -.2278271   .1166354    -1.95   0.051    -.4566051     .000951
       lnfdi |  -.0024775   .0167996    -0.15   0.883    -.0354295    .0304745
      lngdpc |   .7124172   .4020616     1.77   0.077    -.0762185    1.501053
       lnpop |  -.9800767   1.093072    -0.90   0.370    -3.124116    1.163963
        unem |   .0008052   .0023212     0.35   0.729    -.0037478    .0053583
   lnecofree |   .0253038   .4704199     0.05   0.957    -.8974154     .948023
        serv |   .0191616   .0140748     1.36   0.174    -.0084459    .0467691
      lnrulc |    .499033   .5009676     1.00   0.319    -.4836049    1.481671
    year1996 |   .1953418   .1634296     1.20   0.232    -.1252221    .5159057
    year1997 |   .2015073   .1537035     1.31   0.190    -.0999791    .5029937
    year1998 |   .1443397   .1412327     1.02   0.307    -.1326854    .4213649
    year1999 |   .0598277   .1338985     0.45   0.655    -.2028116     .322467
    year2000 |   .0441437   .1228898     0.36   0.719    -.1969021    .2851895
    year2001 |   .0324847   .1062159     0.31   0.760    -.1758557    .2408252
    year2002 |  -.0075433   .0975658    -0.08   0.938    -.1989166      .18383
    year2003 |   -.009853   .0925776    -0.11   0.915    -.1914422    .1717362
    year2004 |  -.0248771   .0891546    -0.28   0.780    -.1997521     .149998
    year2005 |  -.0762697   .0855921    -0.89   0.373    -.2441569    .0916175
    year2006 |  -.0903387   .0881716    -1.02   0.306    -.2632857    .0826082
    year2007 |  -.0596381   .0864154    -0.69   0.490    -.2291402     .109864
    year2008 |  -.0054124   .0632003    -0.09   0.932    -.1293786    .1185538
    year2010 |   -.069109   .0555997    -1.24   0.214    -.1781667    .0399487
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             77.879
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              346.642
                         (Kleibergen-Paap rk Wald F statistic):         84.349
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.267
                                                   Chi-sq(4) P-val =    0.3711
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.4.5.3.1 Model 1 - IV estimated results - ETEs (high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------
```

```
Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                   Number of obs =      665
                                                   F( 24,   591) =     3.05
                                                   Prob > F      =   0.0000
Total (centered) SS     =  282.1985173             Centered R2   =   0.1713
Total (uncentered) SS   =  282.1985173             Uncentered R2 =   0.1713
Residual SS             =  233.8615182             Root MSE      =    .6291

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.9053043   1.158915    -0.78   0.435    -3.181398     1.37079
     lntedut |  -1.465818   .8562761    -1.71   0.087    -3.147532    .2158961
   lnpatappr |  -1.047901   .3118148    -3.36   0.001    -1.660301   -.4355007
       lnfdi |   -.166202   .2749374    -0.60   0.546    -.7061751    .3737712
      lngdpc |  -.6320686   .7243768    -0.87   0.383    -2.054735    .7905972
       lnpop |   -.338424   5.024181    -0.07   0.946    -10.20585    9.528998
        unem |  -.0068298   .0043817    -1.56   0.120    -.0154355    .0017759
   lnecofree |   1.317612   .8932248     1.48   0.141    -.4366695    3.071893
        serv |  -.0176323   .0241093    -0.73   0.465    -.0649827     .029718
      lnrulc |   1.844057   .7537059     2.45   0.015     .3637888    3.324325
    year1997 |   .1128854   .2234507     0.51   0.614    -.3259687    .5517396
    year1998 |   .1354787   .2665477     0.51   0.611    -.3880174    .6589747
    year1999 |   .1893637   .2898101     0.65   0.514    -.3798192    .7585466
    year2000 |   .2250237   .3325099     0.68   0.499    -.4280212    .8780686
    year2001 |    .494073   .3717945     1.33   0.184    -.2361263    1.224272
    year2002 |   .8307532   .4505583     1.84   0.066     -.054137    1.715643
    year2003 |   .9090783   .4813095     1.89   0.059    -.0362068    1.854364
    year2004 |   1.164843   .5414713     2.15   0.032     .1014008    2.228285
    year2005 |   1.195251   .5732441     2.09   0.037     .0694075    2.321094
    year2006 |   1.401981   .6372919     2.20   0.028     .1503486    2.653613
    year2007 |   1.712912   .6895902     2.48   0.013     .3585663    3.067258
    year2008 |   1.920144   .6878454     2.79   0.005     .5692252    3.271063
    year2009 |   2.025174    .734997     2.76   0.006       .58165    3.468698
    year2010 |   2.121111   .7657313     2.77   0.006     .6172259    3.624997
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             57.748
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               86.983
                         (Kleibergen-Paap rk Wald F statistic):         63.164
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              12.490
                                                   Chi-sq(4) P-val =    0.0141
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1997 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
```

```
------------------------------------------------------------------------------
```

Table A5.4.5.3.2 Model 1 - IV estimated results – N-ETEs (high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi = lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                   Obs per group: min =         3
                                                              avg =      12.5
                                                              max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,    951) =     0.42
                                                      Prob > F      =   0.9942
Total (centered) SS     =   85.5247373                Centered R2   =   0.0134
Total (uncentered) SS   =   85.5247373                Uncentered R2 =   0.0134
Residual SS             =  84.38208579                Root MSE      =    .2979

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |    .083057   .2503893     0.33   0.740    -.4083224    .5744365
     lntedut |   .0823298   .4238164     0.19   0.846    -.7493936    .9140533
   lnpatappr |   .0577876   .1153689     0.50   0.617    -.1686195    .2841946
       lnfdi |   .0112644   .0163094     0.69   0.490    -.0207422     .043271
      lngdpc |  -.0698795   .5519502    -0.13   0.899    -1.153061    1.013302
       lnpop |  -.0924936   .9888848    -0.09   0.925    -2.033142    1.848155
        unem |   .0014315   .0020534     0.70   0.486    -.0025983    .0054613
   lnecofree |  -.1765668   .4591603    -0.38   0.701    -1.077651    .7245177
        serv |   .0096166   .0116731     0.82   0.410    -.0132914    .0325245
      lnrulc |   -.194223   .6803324    -0.29   0.775    -1.529349    1.140903
    year1996 |   .0694312   .1850715     0.38   0.708    -.2937645    .4326269
    year1997 |   .1071826   .1700884     0.63   0.529    -.2266093    .4409746
    year1998 |   .0751715   .1524247     0.49   0.622    -.2239561    .3742991
    year1999 |   .0394048   .1401805     0.28   0.779     -.235694    .3145036
    year2000 |   .0747285   .1217028     0.61   0.539    -.1641085    .3135655
    year2001 |   .0971287   .1022445     0.95   0.342    -.1035222    .2977797
    year2002 |   .0817046   .0935852     0.87   0.383    -.1019529     .265362
    year2003 |   .1001245   .0861008     1.16   0.245    -.0688451    .2690941
    year2004 |   .0940485    .083194     1.13   0.259    -.0692166    .2573135
    year2005 |   .0667097   .0725384     0.92   0.358    -.0756442    .2090635
    year2006 |   .0460772   .0656163     0.70   0.483    -.0826922    .1748466
    year2007 |   .0440435   .0652328     0.68   0.500    -.0839734    .1720605
    year2008 |   .0247016    .051506     0.48   0.632    -.0763771    .1257802
    year2010 |  -.0375521   .0400841    -0.94   0.349    -.1162157    .0411114
------------------------------------------------------------------------------
```

```
Underidentification test (Kleibergen-Paap rk LM statistic):              50.735
                                                Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               146.219
                         (Kleibergen-Paap rk Wald F statistic):          36.492
Stock-Yogo weak ID test critical values:                          <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):          0.000
                                              (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                                4.333
                                                Chi-sq(4) P-val =    0.3629
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.4.5.4 Model 1 - IV estimated results (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if mhtechintens==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small r
> obust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1725
                                                      F( 24,  1566) =     2.37
                                                      Prob > F      =   0.0002
Total (centered) SS     =  107.0602309                Centered R2   =   0.1261
Total (uncentered) SS   =  107.0602309                Uncentered R2 =   0.1261
Residual SS             =  93.55857671                Root MSE      =    .2444

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.2324968   .1973697    -1.18   0.239    -.6196335    .1546399
     lntedut |  -.1346487   .1914078    -0.70   0.482    -.5100913    .2407939
   lnpatappr |   .0586629   .0576525     1.02   0.309    -.0544214    .1717472
       lnfdi |   .0169415   .0094068     1.80   0.072    -.0015096    .0353927
```

```
      lngdpc |    .286277   .2236042     1.28   0.201    -.1523181    .7248721
       lnpop |  -3.010629   .6309527    -4.77   0.000     -4.24823   -1.773028
        unem |    -.00232   .0010579    -2.19   0.028    -.004395    -.000245
   lnecofree |  -.2126639   .2485274    -0.86   0.392    -.7001455    .2748176
        serv |   .0072769   .0068847     1.06   0.291    -.0062274    .0207811
      lnrulc |  -.1384627    .311796    -0.44   0.657    -.7500443     .473119
    year1996 |  -.0486755   .0918292    -0.53   0.596    -.2287967    .1314457
    year1997 |  -.0750267   .0821374    -0.91   0.361    -.2361376    .0860842
    year1998 |  -.0667171   .0741512    -0.90   0.368    -.2121633     .078729
    year1999 |  -.0664502   .0675804    -0.98   0.326    -.1990078    .0661075
    year2000 |  -.1052856   .0647496    -1.63   0.104    -.2322906    .0217194
    year2001 |  -.0636874   .0569227    -1.12   0.263    -.1753402    .0479654
    year2002 |  -.0798788   .0518504    -1.54   0.124    -.1815823    .0218246
    year2003 |  -.0701213   .0492302    -1.42   0.155    -.1666854    .0264428
    year2004 |  -.0447607   .0481483    -0.93   0.353    -.1392027    .0496813
    year2005 |  -.0454157   .0476932    -0.95   0.341     -.138965    .0481337
    year2006 |  -.0247634   .0485351    -0.51   0.610     -.119964    .0704372
    year2007 |  -.0080427   .0469255    -0.17   0.864    -.1000862    .0840008
    year2008 |  -.0004574   .0340192    -0.01   0.989    -.0671854    .0662706
    year2010 |  -.0028447   .0262951    -0.11   0.914     -.054422    .0487326
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             77.879
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              346.642
                         (Kleibergen-Paap rk Wald F statistic):         84.349
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               2.894
                                                   Chi-sq(4) P-val =    0.5757
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
```

Table A5.4.5.4.1 Model 1 - IV estimated results – ETEs (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
```

```
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      665
                                                      F( 25,   590) =     2.26
                                                      Prob > F      =   0.0005
Total (centered) SS     =  74.48418935                Centered R2   =   0.1891
Total (uncentered) SS   =  74.48418935                Uncentered R2 =   0.1891
Residual SS             =   60.3998402                Root MSE      =      .32

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -1.377799   .6284355    -2.19   0.029    -2.612042   -.1435563
     lntedut |  -.8409825   .4808385    -1.75   0.081    -1.785346     .103381
   lnpatappr |  -.0849494   .1863563    -0.46   0.649    -.4509518     .281053
       lnfdi |   .0191531   .1375068     0.14   0.889    -.2509093    .2892154
      lngdpc |   .6201053   .3831024     1.62   0.106    -.1323052    1.372516
       lnpop |   -6.56837   2.799506    -2.35   0.019    -12.06658    -1.07016
        unem |  -.0004365   .0022346    -0.20   0.845    -.0048252    .0039522
   lnecofree |   .5141365   .4936524     1.04   0.298    -.4553934    1.483666
        serv |   .0066182   .0139699     0.47   0.636    -.0208186     .034055
      lnrulc |   .0445731   .4357808     0.10   0.919    -.8112972    .9004435
   transindn |  -1.555182   .6575679    -2.37   0.018    -2.846641   -.2637235
    year1997 |   .0123838   .1126383     0.11   0.912    -.2088371    .2336047
    year1998 |   .0319799   .1279063     0.25   0.803    -.2192272    .2831869
    year1999 |   .0605549   .1451777     0.42   0.677     -.224573    .3456828
    year2000 |   .0210509   .1648376     0.13   0.898    -.3026889    .3447907
    year2001 |   .0976884   .1912737     0.51   0.610    -.2779718    .4733486
    year2002 |   .1262712   .2395391     0.53   0.598     -.344182    .5967244
    year2003 |   .1314531   .2489519     0.53   0.598    -.3574867    .6203929
    year2004 |   .1951793   .2806788     0.70   0.487    -.3560718    .7464304
    year2005 |   .2549542   .3015144     0.85   0.398    -.3372179    .8471264
    year2006 |   .2655105   .3319789     0.80   0.424    -.3864937    .9175146
    year2007 |   .2987661    .356843     0.84   0.403     -.402071    .9996031
    year2008 |   .3028585   .3656184     0.83   0.408    -.4152135    1.020931
    year2009 |   .3659084   .3912617     0.94   0.350    -.4025267    1.134344
    year2010 |   .3869613   .4188367     0.92   0.356     -.435631    1.209554
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             61.383
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               78.557
                         (Kleibergen-Paap rk Wald F statistic):         59.978
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.583
                                                   Chi-sq(4) P-val =    0.4653
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.4.5.4.2 Model 1 - IV estimated results – N-ETEs (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi= lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe
endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy transindn year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,    951) =     1.32
                                                      Prob > F      =   0.1395
Total (centered) SS     =  32.57607307                Centered R2   =   0.0902
Total (uncentered) SS   =  32.57607307                Uncentered R2 =   0.0902
Residual SS             =   29.6379555                Root MSE      =    .1765

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   .1216814   .1593933     0.76   0.445    -.1911217    .4344845
     lntedut |   .0470201   .1989672     0.24   0.813    -.3434454    .4374856
   lnpatappr |   .0035823   .0711223     0.05   0.960    -.1359925    .1431571
       lnfdi |   .0165081   .0095334     1.73   0.084    -.0022009     .035217
      lngdpc |  -.1290177   .3658555    -0.35   0.724    -.8469952    .5889597
       lnpop |  -2.636544   .7146087    -3.69   0.000    -4.038936   -1.234152
        unem |  -.0021275   .0013329    -1.60   0.111    -.0047433    .0004883
   lnecofree |   -.313683   .2446967    -1.28   0.200     -.793891    .1665249
        serv |  -.0001379   .0082115    -0.02   0.987    -.0162527    .0159768
      lnrulc |   .2521338   .4630926     0.54   0.586    -.6566676    1.160935
    year1996 |  -.0935057   .1199258    -0.78   0.436    -.3288556    .1418441
    year1997 |  -.0979297   .1100192    -0.89   0.374    -.3138381    .1179788
    year1998 |  -.0947945   .0926153    -1.02   0.306    -.2765485    .0869595
    year1999 |  -.0819705   .0827093    -0.99   0.322    -.2442843    .0803432
    year2000 |  -.0934271   .0705763    -1.32   0.186    -.2319305    .0450763
    year2001 |  -.0669281   .0617954    -1.08   0.279    -.1881993    .0543431
    year2002 |  -.0705208   .0564374    -1.25   0.212    -.1812771    .0402354
    year2003 |  -.0632339   .0528139    -1.20   0.231    -.1668791    .0404113
    year2004 |   -.044818   .0508175    -0.88   0.378    -.1445455    .0549094
    year2005 |  -.0689388   .0513617    -1.34   0.180    -.1697341    .0318566
    year2006 |  -.0251902    .043472    -0.58   0.562    -.1105024     .060122
    year2007 |  -.0048507   .0421044    -0.12   0.908    -.0874789    .0777776
    year2008 |   .0148792   .0317029     0.47   0.639    -.0473365    .0770948
    year2010 |  -.0043756   .0255327    -0.17   0.864    -.0544826    .0457315
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             50.735
```

```
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):             146.219
                         (Kleibergen-Paap rk Wald F statistic):        36.492
Stock-Yogo weak ID test critical values:                      <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):        0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              7.163
                                                   Chi-sq(4) P-val =    0.1275
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy transindn year2009
------------------------------------------------------------------------------
```

Table A5.5 Model 2 - Fixed effects estimated results (medium-high and high tech)

```
xtreg lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

R-sq:  within  = 0.0636                         Obs per group: min =         5
       between = 0.0328                                        avg =      13.3
       overall = 0.0298                                        max =        16

                                                F(25,3305)         =      8.98
corr(u_i, Xb)  = -0.9354                        Prob > F           =    0.0000

------------------------------------------------------------------------------
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .3294195   .2107553     1.56   0.118    -.0838047    .7426437
    sqravyrs |  -.0194701   .0097484    -2.00   0.046    -.0385837   -.0003566
     cskills |  (omitted)
   lnpatappr |  -.1027553     .02876    -3.57   0.000    -.1591445   -.0463661
       lnfdi |   .0073231   .0061925     1.18   0.237    -.0048184    .0194647
      lngdpc |   .5774677    .124354     4.64   0.000     .3336491    .8212863
       lnpop |  -1.725759   .3764118    -4.58   0.000    -2.463783   -.9877351
        unem |   .0002908   .0009784     0.30   0.766    -.0016275    .0022092
   lnecofree |   .0408001    .182719     0.22   0.823    -.3174537     .399054
      lnrulc |   .2498943   .2064493     1.21   0.226    -.1548871    .6546756
        serv |   .0106243    .004091     2.60   0.009     .0026031    .0186455
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0765638   .0509478     1.50   0.133    -.0233285    .1764562
    year1997 |   .0681594   .0515997     1.32   0.187    -.0330113    .1693301
    year1998 |   .0515029   .0524063     0.98   0.326    -.0512491     .154255
    year1999 |    .023538   .0537898     0.44   0.662    -.0819267    .1290027
    year2000 |   .0006101   .0537563     0.01   0.991    -.1047889     .106009
```

```
    year2001 |   .0212656   .0553796     0.38   0.701    -.0873161    .1298474
    year2002 |   .0031826    .058761     0.05   0.957    -.1120289    .1183942
    year2003 |  -.0091338   .0610623    -0.15   0.881    -.1288576      .11059
    year2004 |   .0372318    .064302     0.58   0.563    -.0888439    .1633075
    year2005 |   .0225801   .0684244     0.33   0.741    -.1115784    .1567386
    year2006 |   .0220509   .0725304     0.30   0.761    -.1201582      .16426
    year2007 |   .0539607   .0753068     0.72   0.474     -.093692    .2016134
    year2008 |   .1041141   .0767492     1.36   0.175    -.0463667     .254595
    year2009 |   .1227964   .0759566     1.62   0.106    -.0261303    .2717231
    year2010 |   .0886447   .0783553     1.13   0.258    -.0649851    .2422745
       _cons |   6.725036   4.634193     1.45   0.147    -2.361143    15.81122
-------------+----------------------------------------------------------------
     sigma_u |    2.80004
     sigma_e |  .39659157
         rho |  .98033327   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(269, 3305) =    67.68           Prob > F = 0.0000
```

Table A5.5.1 Model 2 - Diagnostic tests

Groupwise heteroskedasticity

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (270)  =   3.0e+06
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,     269) =     85.213
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 1565.6363
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 0
LM5= 39.568122
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 0
Test for significance of fixed effects
F= 67.676565
Probability>F= 0
Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                       ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
     __00000B |   3.6e+03   0.0000          0.0000            .          0.0000
```

Table A5.5.2 Model 2 - Driscoll-Kraay estimated results (medium-high and high tech)

```
xtscc lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =      3600
Method: Fixed-effects regression                 Number of groups  =       270
Group variable (i): cn_ind                       F( 28,    269)    = 189090.42
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.0636

------------------------------------------------------------------------------
             |             Drisc/Kraay
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .3294195   .1672355     1.97   0.050     .0001626    .6586763
    sqravyrs |  -.0194701   .0072196    -2.70   0.007    -.0336842   -.005256
     cskills |  (omitted)
   lnpatappr |  -.1027553   .0231275    -4.44   0.000    -.1482892   -.0572214
       lnfdi |   .0073231    .003697     1.98   0.049     .0000443    .014602
      lngdpc |   .5774677   .2065258     2.80   0.006     .1708551    .9840803
       lnpop |  -1.725759   .2990008    -5.77   0.000    -2.314438   -1.13708
        unem |   .0002908   .0007878     0.37   0.712    -.0012602    .0018419
   lnecofree |   .0408001   .1673327     0.24   0.808    -.2886482    .3702485
      lnrulc |   .2498943     .23119     1.08   0.281    -.2052778    .7050663
        serv |   .0106243   .0030153     3.52   0.001     .0046878    .0165608
        dist |   .0064585   .0048509     1.33   0.184    -.003092     .0160089
  transdummy |  (omitted)
    year1996 |   .0765638   .0092841     8.25   0.000     .0582852    .0948425
    year1997 |   .0681594   .0159262     4.28   0.000     .0368036    .0995152
    year1998 |   .0515029   .0202091     2.55   0.011     .0117147    .0912911
    year1999 |    .023538   .0276046     0.85   0.395    -.0308107    .0778866
    year2000 |   .0006101   .0334239     0.02   0.985    -.0651957    .0664159
    year2001 |   .0212656   .0425818     0.50   0.618    -.0625704    .1051017
    year2002 |   .0031826   .0514488     0.06   0.951    -.0981109    .1044762
    year2003 |  -.0091338   .0585142    -0.16   0.876    -.1243379    .1060703
    year2004 |   .0372318   .0711204     0.52   0.601    -.1027916    .1772552
    year2005 |   .0225801   .0815052     0.28   0.782    -.1378892    .1830494
    year2006 |   .0220509   .0949559     0.23   0.817    -.1649003    .2090021
    year2007 |   .0539607     .10238     0.53   0.599    -.1476072    .2555286
    year2008 |   .1041141   .1056155     0.99   0.325    -.1038241    .3120523
    year2009 |   .1227964   .0881548     1.39   0.165    -.0507646    .2963575
    year2010 |   .0886447   .0938972     0.94   0.346    -.0962222    .2735116
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A5.5.3 Model 2 - FEVD estimated results (medium-high and high tech)

```
xtfevd lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant (cskills dist transdummy)
panel fixed effects regression with vector decomposition

degrees of freedom fevd     =      3302         number of obs       =      3600
mean squared error          = .1443963          F( 30, 3302)        = 5.078067
root mean squared error     = .3799951          Prob > F            = 8.36e-17
Residual Sum of Squares     = 519.8265          R-squared           = .8669844
Total Sum of Squares        = 3908.013          adj. R-squared      = .8550203
Estimation Sum of Squares   = 3388.186
```

```
------------------------------------------------------------------------------
             |                fevd
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .3294195   1.730964     0.19   0.849    -3.064452    3.723291
    sqravyrs |  -.0194701   .0757963    -0.26   0.797    -.1680826    .1291424
   lnpatappr |  -.1027553   .2356341    -0.44   0.663    -.5647589    .3592483
       lnfdi |   .0073231    .094795     0.08   0.938    -.1785398     .193186
      lngdpc |   .5774678   1.598978     0.36   0.718     -2.55762    3.712556
       lnpop |  -1.725759   .8179957    -2.11   0.035    -3.329589   -.1219289
        unem |   .0002908   .0047838     0.06   0.952    -.0090887    .0096704
   lnecofree |   .0407999   1.252996     0.03   0.974    -2.415928    2.497528
      lnrulc |   .2498942   1.027078     0.24   0.808     -1.76388    2.263669
        serv |   .0106243   .0293211     0.36   0.717    -.0468652    .0681138
    year1996 |   .0765638    .234455     0.33   0.744     -.383128    .5362557
    year1997 |   .0681594   .2699537     0.25   0.801    -.4611342    .5974529
    year1998 |   .0515029   .2857617     0.18   0.857    -.5087851     .611791
    year1999 |    .023538   .3119372     0.08   0.940     -.588072    .6351479
    year2000 |   .0006101   .2921441     0.00   0.998    -.5721917    .5734119
    year2001 |   .0212656   .3055254     0.07   0.945    -.5777728     .620304
    year2002 |   .0031826   .3204229     0.01   0.992    -.6250651    .6314303
    year2003 |  -.0091338   .3941853    -0.02   0.982     -.782006    .7637384
    year2004 |   .0372318    .450154     0.08   0.934    -.8453773    .9198408
    year2005 |   .0225801    .514225     0.04   0.965    -.9856519    1.030812
    year2006 |   .0220509   .5305267     0.04   0.967    -1.018144    1.062245
    year2007 |   .0539607      .6606     0.08   0.935    -1.241266    1.349188
    year2008 |   .1041141   .6447918     0.16   0.872    -1.160118    1.368346
    year2009 |   .1227964   .5792921     0.21   0.832    -1.013012    1.258604
    year2010 |   .0886447   .5928329     0.15   0.881    -1.073713    1.251002
     cskills |  -.0846318   1.205406    -0.07   0.944     -2.44805    2.278787
        dist |  -.0009524   .0008483    -1.12   0.262    -.0026156    .0007108
  transdummy |  -.3914323    2.47703    -0.16   0.874    -5.248102    4.465238
         eta |          1          .        .       .            .           .
       _cons |   8.282433   21.09462     0.39   0.695    -33.07743     49.6423
------------------------------------------------------------------------------
```

Table A5.5.4 Model 1 - Hausman and Taylor estimated results (medium-high and high tech)

```
xthtaylor lnrxamhtech avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem
lnecofree lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000
year2001 year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009
year2010, endo (avyrs sqravyrs cskills)

Hausman-Taylor estimation                       Number of obs      =      3600
Group variable: cn_ind                          Number of groups   =       270

                                                Obs per group: min =         5
                                                               avg =      13.3
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    213.79
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
 lnrxamhtech |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |  -.0789832   .0274345    -2.88   0.004    -.1327538   -.0252127
       lnfdi |   .0034393   .0059588     0.58   0.564    -.0082398    .0151183
      lngdpc |   .8812029    .104968     8.39   0.000     .6754695    1.086936
       lnpop |   .1003167   .1313037     0.76   0.445    -.1570337    .3576671
```

```
        unem |   .0009143   .0009398     0.97   0.331    -.0009277    .0027563
   lnecofree |   .1973001   .1743803     1.13   0.258    -.1444789    .5390792
      lnrulc |   .1856409   .1995586     0.93   0.352    -.2054868    .5767685
        serv |   .0086736   .0039228     2.21   0.027     .0009851    .0163622
    year1996 |   .0760551   .0494082     1.54   0.124    -.0207832    .1728933
    year1997 |   .0591605    .049998     1.18   0.237    -.0388338    .1571549
    year1998 |   .0462499   .0507809     0.91   0.362    -.0532788    .1457785
    year1999 |   .0135529   .0520703     0.26   0.795     -.088503    .1156089
    year2000 |  -.0219144   .0518891    -0.42   0.673    -.1236153    .0797864
    year2001 |  -.0164564   .0531536    -0.31   0.757    -.1206355    .0877227
    year2002 |  -.0456664   .0561344    -0.81   0.416    -.1556878    .0643549
    year2003 |  -.0634069   .0581957    -1.09   0.276    -.1774684    .0506547
    year2004 |  -.0376252   .0605847    -0.62   0.535     -.156369    .0811187
    year2005 |  -.0685413   .0638965    -1.07   0.283    -.1937761    .0566934
    year2006 |  -.0917173   .0667693    -1.37   0.170    -.2225828    .0391482
    year2007 |  -.0749394   .0686163    -1.09   0.275    -.2094249    .0595461
    year2008 |  -.0322409   .0695957    -0.46   0.643    -.1686459    .1041642
    year2009 |   .0145622   .0705825     0.21   0.837    -.1237769    .1529013
    year2010 |  -.0327808   .0722351    -0.45   0.650     -.174359    .1087973
TVendogenous |
       avyrs |   .3637942    .202713     1.79   0.073    -.0335159    .7611043
    sqravyrs |  -.0214986   .0093838    -2.29   0.022    -.0398904   -.0031067
TIexogenous  |
        dist |   .0000431    .000342     0.13   0.900    -.0006272    .0007133
  transdummy |   .9700191   .3978296     2.44   0.015     .1902874    1.749751
TIendogenous |
     cskills |   .7038131   1.198758     0.59   0.557     -1.64571    3.053337
             |
       _cons |  -17.26372   6.548996    -2.64   0.008    -30.09951   -4.427918
-------------+----------------------------------------------------------------
     sigma_u |  2.7686119
     sigma_e |  .39510006
         rho |   .9800412   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A5.5.5 Model 2 - IV estimated results (medium-high and high tech)

```
. xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs lnpatappr
lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       270                     Obs per group: min =          3
                                                                avg =       12.8
                                                                max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =       3450
                                                      F( 24,   3156) =      2.82
```

```
                                                      Prob > F      =   0.0000
Total (centered) SS     =  474.7834512                Centered R2   =   0.0683
Total (uncentered) SS   =  474.7834512                Uncentered R2 =   0.0683
Residual SS             =  442.3435879                Root MSE      =    .3744

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .6159592   .3514508     1.75   0.080     -.073136    1.305054
    sqravyrs |  -.0320945   .0161425    -1.99   0.047    -.0637454   -.0004436
   lnpatappr |  -.1110618    .067202    -1.65   0.099    -.2428258    .0207021
       lnfdi |   .0056667   .0095171     0.60   0.552    -.0129936     .024327
      lngdpc |   .6206497    .180374     3.44   0.001     .2669875    .9743119
       lnpop |   -1.82075    .567507    -3.21   0.001     -2.93347     -.70803
        unem |   .0000993   .0012134     0.08   0.935    -.0022799    .0024785
   lnecofree |  -.0060476   .2710259    -0.02   0.982    -.5374524    .5253572
        serv |   .0091416   .0081272     1.12   0.261    -.0067935    .0250768
      lnrulc |   .2765848   .2923818     0.95   0.344    -.2966928    .8498624
    year1996 |  -.0313309   .0835702    -0.37   0.708    -.1951883    .1325266
    year1997 |  -.0404453   .0752436    -0.54   0.591    -.1879767    .1070861
    year1998 |  -.0596778   .0692807    -0.86   0.389    -.1955176     .076162
    year1999 |  -.0932591   .0659026    -1.42   0.157    -.2224753    .0359571
    year2000 |  -.1108519    .059109    -1.88   0.061    -.2267477     .005044
    year2001 |  -.0943692   .0526779    -1.79   0.073    -.1976556    .0089172
    year2002 |  -.1127343     .04722    -2.39   0.017    -.2053194   -.0201492
    year2003 |  -.1027388   .0462073    -2.22   0.026    -.1933381   -.0121395
    year2004 |  -.0906912   .0437397    -2.07   0.038    -.1764524   -.0049301
    year2005 |  -.1080765   .0427354    -2.53   0.011    -.1918684   -.0242846
    year2006 |  -.1040941   .0442674    -2.35   0.019    -.1908898   -.0172984
    year2007 |  -.0744521   .0421562    -1.77   0.077    -.1571083    .0082042
    year2008 |  -.0308625   .0319414    -0.97   0.334    -.0934906    .0317656
    year2010 |  -.0336965    .030762    -1.10   0.273    -.0940122    .0266191
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            141.983
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              693.024
                         (Kleibergen-Paap rk Wald F statistic):        153.911
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               4.680
                                                   Chi-sq(4) P-val =    0.3217
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.1 Model 2 - IV estimated results –ETEs (medium-high and high tech)

```
. xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
```

```
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       100                    Obs per group: min =          7
                                                               avg =       13.3
                                                               max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      1330
                                                      F( 25,  1205) =      3.31
                                                      Prob > F      =    0.0000
Total (centered) SS     =  356.6827202                Centered R2   =    0.1267
Total (uncentered) SS   =  356.6827202                Uncentered R2 =    0.1267
Residual SS             =   311.501085                Root MSE      =     .5084

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   1.184516   1.276105     0.93   0.353    -1.319119    3.688151
    sqravyrs |   -.077475   .0538763    -1.44   0.151    -.1831768    .0282267
   lnpatappr |  -.4264457   .2162005    -1.97   0.049    -.8506169   -.0022745
       lnfdi |   .0255854   .1540183     0.17   0.868    -.2765883    .3277592
      lngdpc |   .2117617   .4666915     0.45   0.650    -.7038564     1.12738
       lnpop |  -2.807272   4.094409    -0.69   0.493    -10.84023     5.22569
        unem |  -.0035036   .0025682    -1.36   0.173    -.0085422    .0015351
   lnecofree |   .7922318   .4972095     1.59   0.111    -.1832608    1.767724
        serv |  -.0091833   .0151252    -0.61   0.544    -.0388581    .0204914
      lnrulc |   1.188467   .4647462     2.56   0.011      .276665    2.100268
   transindn |  -1.564774    .876834    -1.78   0.075    -3.285065    .1555168
    year1996 |  -1.073142   .3927075    -2.73   0.006    -1.843608   -.3026752
    year1997 |   -.978278   .3338388    -2.93   0.003    -1.633248   -.3233081
    year1998 |  -.9574495   .3041693    -3.15   0.002     -1.55421   -.3606893
    year1999 |  -.8836847   .2742248    -3.22   0.001    -1.421696   -.3456735
    year2000 |  -.8826555   .2421566    -3.64   0.000    -1.357751   -.4075601
    year2001 |  -.7622384    .210336    -3.62   0.000    -1.174904   -.3495729
    year2002 |   -.616273   .1618144    -3.81   0.000    -.9337421   -.2988038
    year2003 |  -.5850459   .1558562    -3.75   0.000    -.8908254   -.2792663
    year2004 |  -.4604133   .1310225    -3.51   0.000    -.7174708   -.2033558
    year2005 |  -.4064333   .1238253    -3.28   0.001    -.6493704   -.1634961
    year2006 |  -.3199922   .1122759    -2.85   0.004    -.5402701   -.0997142
    year2007 |  -.1809783   .1055074    -1.72   0.087    -.3879769    .0260204
    year2008 |  -.0795048   .0905541    -0.88   0.380     -.257166    .0981564
    year2010 |    .065579    .078614     0.83   0.404    -.0886566    .2198145
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):            130.883
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              127.527
                         (Kleibergen-Paap rk Wald F statistic):         88.593
Stock-Yogo weak ID test critical values:                       <not available>
```

```
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.196
                                                   Chi-sq(4) P-val =    0.5256
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1996
                      year1997 year1998 year1999 year2000 year2001 year2002
                      year2003 year2004 year2005 year2006 year2007 year2008
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.2 Model 2 - IV estimated results –N-ETEs (medium-high and high tech)

```
 xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       170                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     2120
                                                      F( 24,  1926) =     0.83
                                                      Prob > F      =   0.7023
Total (centered) SS     =   118.100731                Centered R2   =   0.0189
Total (uncentered) SS   =   118.100731                Uncentered R2 =   0.0189
Residual SS             =  115.8644161                Root MSE      =    .2453

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .4303903   .3236645     1.33   0.184    -.2043794     1.06516
    sqravyrs |  -.0202541   .0147481    -1.37   0.170    -.0491779    .0086698
   lnpatappr |     .00581   .0689973     0.08   0.933    -.1295074    .1411273
       lnfdi |    .011767   .0096788     1.22   0.224     -.007215     .030749
      lngdpc |  -.1473983   .3392192    -0.43   0.664    -.8126738    .5178771
       lnpop |  -1.265435   .5443551    -2.32   0.020    -2.333022   -.1978479
        unem |   .0000795   .0012682     0.06   0.950    -.0024077    .0025667
   lnecofree |  -.2872237   .2566781    -1.12   0.263      -.79062    .2161726
        serv |    .002368   .0071802     0.33   0.742    -.0117138    .0164498
```

```
      lnrulc |   .0771994   .4073377     0.19   0.850    -.7216699    .8760686
    year1996 |  -.0612756   .0904411    -0.68   0.498    -.2386484    .1160972
    year1997 |  -.0445163   .0819084    -0.54   0.587    -.2051547    .1161221
    year1998 |  -.0574464   .0716329    -0.80   0.423    -.1979325    .0830398
    year1999 |  -.0670378   .0660696    -1.01   0.310    -.1966132    .0625376
    year2000 |  -.0443333   .0552805    -0.80   0.423    -.1527492    .0640826
    year2001 |  -.0196898   .0489348    -0.40   0.687    -.1156605     .076281
    year2002 |  -.0223705    .044885    -0.50   0.618    -.1103988    .0656579
    year2003 |  -.0075825   .0414177    -0.18   0.855    -.0888108    .0736458
    year2004 |   .0031439   .0403963     0.08   0.938    -.0760812     .082369
    year2005 |  -.0181479   .0375506    -0.48   0.629     -.091792    .0554961
    year2006 |   -.004773    .036056    -0.13   0.895    -.0754858    .0659398
    year2007 |   .0093744   .0371233     0.25   0.801    -.0634318    .0821806
    year2008 |   .0139197   .0306009     0.45   0.649    -.0460947    .0739341
    year2010 |  -.0216593   .0234713    -0.92   0.356    -.0676912    .0243725
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             93.323
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              270.658
                         (Kleibergen-Paap rk Wald F statistic):         62.370
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.867
                                                   Chi-sq(4) P-val =    0.4242
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.3 Model 2 - IV estimated results (high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs lnpatappr
lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind
```

```
                                                      Number of obs =      1725
                                                      F( 24,  1566) =      1.74
                                                      Prob > F      =    0.0150
Total (centered) SS     =  367.7232546                Centered R2   =    0.0701
Total (uncentered) SS   =  367.7232546                Uncentered R2 =    0.0701
Residual SS             =  341.9516623                Root MSE      =     .4673

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .5613475   .6042551     0.93   0.353    -.6238869    1.746582
    sqravyrs |  -.0321423   .0277834    -1.16   0.247    -.0866389    .0223543
   lnpatappr |  -.2700577   .1163328    -2.32   0.020    -.4982421   -.0418733
       lnfdi |  -.0004972   .0165979    -0.03   0.976    -.0330536    .0320592
      lngdpc |   .9286508   .3099063     3.00   0.003     .3207757    1.536526
       lnpop |  -.8562444   .9074494    -0.94   0.346    -2.636188    .9236995
        unem |   .0017244   .0021667     0.80   0.426    -.0025256    .0059744
   lnecofree |   .2331856   .4764538     0.49   0.625    -.7013691     1.16774
        serv |    .013672   .0144741     0.94   0.345    -.0147186    .0420627
      lnrulc |   .5248821   .4947889     1.06   0.289    -.4456365    1.495401
    year1996 |  -.0614847   .1458157    -0.42   0.673    -.3474993    .2245298
    year1997 |  -.0452241   .1323431    -0.34   0.733    -.3048124    .2143642
    year1998 |  -.0833105   .1221668    -0.68   0.495    -.3229382    .1563171
    year1999 |  -.1476402   .1178398    -1.25   0.210    -.3787806    .0835002
    year2000 |  -.1476025   .1040251    -1.42   0.156    -.3516456    .0564406
    year2001 |  -.1440819   .0919649    -1.57   0.117    -.3244691    .0363054
    year2002 |   -.162017   .0824456    -1.97   0.050    -.3237324   -.0003017
    year2003 |  -.1451262   .0807204    -1.80   0.072    -.3034577    .0132053
    year2004 |  -.1421972   .0760157    -1.87   0.062    -.2913005    .0069061
    year2005 |  -.1715544   .0738213    -2.32   0.020    -.3163534   -.0267555
    year2006 |  -.1800938   .0770602    -2.34   0.020    -.3312458   -.0289418
    year2007 |  -.1369672   .0736159    -1.86   0.063    -.2813633     .007429
    year2008 |  -.0537049   .0562481    -0.95   0.340    -.1640344    .0566246
    year2010 |  -.0599489    .055138    -1.09   0.277    -.1681011    .0482033
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             70.991
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              343.876
                         (Kleibergen-Paap rk Wald F statistic):         76.370
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               6.906
                                                   Chi-sq(4) P-val =    0.1409
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.3.1 Model 2 - IV estimated results - ETEs (high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
```

```
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =         7
                                                               avg =      13.3
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =      665
                                                      F( 25,   590) =     2.96
                                                      Prob > F      =   0.0000
Total (centered) SS     =  282.1985173                Centered R2   =   0.1892
Total (uncentered) SS   =  282.1985173                Uncentered R2 =   0.1892
Residual SS             =  228.7997756                Root MSE      =    .6227

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   1.795148   2.221732     0.81   0.419    -2.568317    6.158614
    sqravyrs |  -.1067643   .0936947    -1.14   0.255      -.29078    .0772515
   lnpatappr |  -.9073153   .3670101    -2.47   0.014    -1.628121   -.1865101
       lnfdi |  -.0018009   .2673199    -0.01   0.995    -.5268153    .5232135
      lngdpc |   -.490308   .7731682    -0.63   0.526    -2.008805    1.028189
       lnpop |   .0629572   7.091814     0.01   0.993    -13.86531    13.99123
        unem |  -.0066389   .0044954    -1.48   0.140    -.0154678    .0021901
   lnecofree |   1.225125   .8662458     1.41   0.158    -.4761757    2.926426
        serv |  -.0275081   .0262343    -1.05   0.295     -.079032    .0240158
      lnrulc |   2.219255   .7701008     2.88   0.004     .7067821    3.731727
   transindn |   -1.21322   1.529209    -0.79   0.428    -4.216576    1.790135
    year1997 |     .14829   .2331958     0.64   0.525    -.3097049    .6062849
    year1998 |   .1714269   .2746495     0.62   0.533    -.3679828    .7108366
    year1999 |   .2721834   .3101252     0.88   0.380    -.3369002     .881267
    year2000 |   .3215077   .3525748     0.91   0.362    -.3709467    1.013962
    year2001 |   .5239688   .3868793     1.35   0.176    -.2358594    1.283797
    year2002 |   .8204322   .4697386     1.75   0.081    -.1021311    1.742995
    year2003 |   .8764355   .4768753     1.84   0.067    -.0601442    1.813015
    year2004 |   1.084319   .5230016     2.07   0.039     .0571479    2.111491
    year2005 |    1.13025   .5549959     2.04   0.042     .0402416    2.220258
    year2006 |   1.309115   .6134261     2.13   0.033     .1043505     2.51388
    year2007 |   1.580336   .6502661     2.43   0.015     .3032176    2.857454
    year2008 |   1.790807   .6500331     2.75   0.006     .5141465    3.067467
    year2009 |    1.87815   .6804121     2.76   0.006      .541825    3.214474
    year2010 |   1.982936   .7172382     2.76   0.006     .5742853    3.391587
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             65.444
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               62.442
                         (Kleibergen-Paap rk Wald F statistic):         43.380
Stock-Yogo weak ID test critical values:                       <not available>
```

```
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.663
                                                   Chi-sq(4) P-val =    0.4535
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.5.5.3.2 Model 2 - IV estimated results – N-ETEs (high tech)

```
 xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robus
> t bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,    951) =     0.47
                                                      Prob > F      =   0.9857
Total (centered) SS     =   85.5247373                Centered R2   =   0.0153
Total (uncentered) SS   =   85.5247373                Uncentered R2 =   0.0153
Residual SS             =  84.22032954                Root MSE      =    .2976

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .1971484   .5592138     0.35   0.725    -.9002872    1.294584
    sqravyrs |  -.0104402   .0253952    -0.41   0.681    -.0602774    .0393969
   lnpatappr |   .0350449   .1178183     0.30   0.766     -.196169    .2662588
       lnfdi |   .0105083   .0166483     0.63   0.528    -.0221634      .04318
      lngdpc |  -.0841741   .5538802    -0.15   0.879    -1.171143    1.002795
       lnpop |   .0743456   .8460375     0.09   0.930    -1.585971    1.734662
        unem |   .0017456   .0020813     0.84   0.402    -.0023389    .0058302
   lnecofree |  -.2428827   .4489965    -0.54   0.589    -1.124021    .6382556
        serv |   .0083599   .0120321     0.69   0.487    -.0152526    .0319724
```

```
      lnrulc |  -.1895933   .6810409    -0.28   0.781     -1.52611    1.146923
    year1996 |  -.0009039   .1454393    -0.01   0.995    -.2863229    .2845151
    year1997 |   .0396082   .1308747     0.30   0.762    -.2172285    .2964449
    year1998 |   .0124627   .1163774     0.11   0.915    -.2159235    .2408488
    year1999 |  -.0195095    .109807    -0.18   0.859    -.2350014    .1959825
    year2000 |   .0249141   .0922713     0.27   0.787    -.1561648    .2059929
    year2001 |   .0519933   .0801289     0.65   0.517    -.1052566    .2092432
    year2002 |   .0440085   .0744488     0.59   0.555    -.1020943    .1901113
    year2003 |   .0658509    .067785     0.97   0.332    -.0671745    .1988763
    year2004 |    .064832   .0672654     0.96   0.335    -.0671737    .1968377
    year2005 |   .0417338   .0599803     0.70   0.487    -.0759753    .1594429
    year2006 |   .0256672    .060707     0.42   0.673     -.093468    .1448024
    year2007 |   .0286823   .0627534     0.46   0.648    -.0944688    .1518335
    year2008 |   .0173791   .0522454     0.33   0.739    -.0851505    .1199088
    year2010 |  -.0367263    .039584    -0.93   0.354    -.1144085    .0409559
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             46.662
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              133.644
                         (Kleibergen-Paap rk Wald F statistic):         30.796
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               5.077
                                                   Chi-sq(4) P-val =    0.2795
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.4 Model 2 - IV estimated results (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if mhtechintens==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       135                    Obs per group: min =         3
                                                               avg =      12.8
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind
```

```
                                                      Number of obs =     1725
                                                      F( 24,  1566) =     2.35
                                                      Prob > F      =   0.0002
Total (centered) SS     =  107.0602309                Centered R2   =   0.1318
Total (uncentered) SS   =  107.0602309                Uncentered R2 =   0.1318
Residual SS             =   92.9479214                Root MSE      =    .2436

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .6705759   .3349812     2.00   0.045     .0135171    1.327635
    sqravyrs |   -.032047   .0152247    -2.10   0.035    -.0619098   -.0021841
   lnpatappr |   .0479333   .0587323     0.82   0.415    -.0672689    .1631355
       lnfdi |   .0118303   .0092269     1.28   0.200    -.0062681    .0299287
      lngdpc |   .3126517   .1795705     1.74   0.082    -.0395722    .6648757
       lnpop |  -2.785229   .6105743    -4.56   0.000    -3.982858     -1.5876
        unem |  -.0015258   .0010255    -1.49   0.137    -.0035373    .0004856
   lnecofree |   -.245275   .2508757    -0.98   0.328    -.7373625    .2468126
        serv |    .004611   .0067586     0.68   0.495    -.0086458    .0178678
      lnrulc |   .0283002   .3103313     0.09   0.927    -.5804084    .6370087
    year1996 |  -.0011775   .0830825    -0.01   0.989    -.1641422    .1617872
    year1997 |  -.0356663   .0714933    -0.50   0.618     -.175899    .1045664
    year1998 |  -.0360451    .065377    -0.55   0.581    -.1642808    .0921907
    year1999 |  -.0388773   .0594487    -0.65   0.513    -.1554847    .0777302
    year2000 |  -.0741012   .0561496    -1.32   0.187    -.1842375    .0360351
    year2001 |  -.0446555   .0506023    -0.88   0.378    -.1439109    .0545999
    year2002 |  -.0634503   .0453695    -1.40   0.162    -.1524416     .025541
    year2003 |  -.0603509   .0443154    -1.36   0.173    -.1472747    .0265728
    year2004 |  -.0391839   .0425734    -0.92   0.358    -.1226909    .0443231
    year2005 |  -.0445979   .0423795    -1.05   0.293    -.1277245    .0385287
    year2006 |  -.0280953     .04201    -0.67   0.504    -.1104971    .0543064
    year2007 |  -.0119371   .0403549    -0.30   0.767    -.0910924    .0672182
    year2008 |  -.0080204   .0298074    -0.27   0.788    -.0664869    .0504462
    year2010 |  -.0074437   .0260065    -0.29   0.775    -.0584549    .0435675
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             70.991
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              343.877
                         (Kleibergen-Paap rk Wald F statistic):         76.371
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               0.912
                                                   Chi-sq(4) P-val =    0.9229
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Table A5.5.5.4.1 Model 2 - IV estimated results -ETEs (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindn year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi = avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1996

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        50                    Obs per group: min =          7
                                                               avg =       13.3
                                                               max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =       665
                                                      F( 25,    590) =      2.47
                                                      Prob > F      =    0.0001
Total (centered) SS     =  74.48418935                Centered R2   =    0.1980
Total (uncentered) SS   =  74.48418935                Uncentered R2 =    0.1980
Residual SS             =  59.73870785                Root MSE      =     .3182

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .5739272   1.119495     0.51   0.608    -1.624754    2.772608
    sqravyrs |  -.0481873   .0459766    -1.05   0.295    -.1384849    .0421104
   lnpatappr |   .0544242   .1985917     0.27   0.784    -.3356086    .4444569
       lnfdi |   .0529761   .1272308     0.42   0.677    -.1969042    .3028565
      lngdpc |   .9138058   .4411921     2.07   0.039     .0473077    1.780304
       lnpop |    -5.6774   3.935366    -1.44   0.150    -13.40643    2.051631
        unem |  -.0003683   .0021876    -0.17   0.866    -.0046647    .0039281
   lnecofree |     .35933   .4573645     0.79   0.432    -.5389306    1.257591
        serv |   .0091407   .0132122     0.69   0.489     -.016808    .0350895
      lnrulc |   .1577376   .4447999     0.35   0.723    -.7158463    1.031321
   transindn |  -1.916339   .6909908    -2.77   0.006    -3.273441   -.5592384
    year1997 |   .0414342   .1128028     0.37   0.714    -.1801097     .262978
    year1998 |   .0599588   .1271188     0.47   0.637    -.1897017    .3096193
    year1999 |   .1067351   .1456314     0.73   0.464     -.179284    .3927542
    year2000 |   .0594654   .1654179     0.36   0.719     -.265414    .3843449
    year2001 |   .0978408   .1854172     0.53   0.598    -.2663172    .4619989
    year2002 |   .0933107   .2241518     0.42   0.677    -.3469219    .5335433
    year2003 |   .0997584   .2276736     0.44   0.661     -.347391    .5469078
    year2004 |   .1411394   .2505483     0.56   0.573    -.3509358    .6332145
    year2005 |   .2031741   .2650198     0.77   0.444     -.317323    .7236711
    year2006 |   .1971858   .2936986     0.67   0.502    -.3796362    .7740079
    year2007 |   .2039972   .3135133     0.65   0.516    -.4117407     .819735
    year2008 |    .196471   .3157511     0.62   0.534    -.4236619     .816604
    year2009 |   .2681362   .3287433     0.82   0.415    -.3775132    .9137857
    year2010 |   .2945089   .3503868     0.84   0.401    -.3936483    .9826661
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             65.444
```

```
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):             62.442
                         (Kleibergen-Paap rk Wald F statistic):       43.380
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):       0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                             5.124
                                                   Chi-sq(4) P-val =    0.2748
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindn year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1996
------------------------------------------------------------------------------
```

Table A5.5.5.4.2 Model 2 - IV estimated results –N-ETEs (medium-high tech)

```
xtivreg2 lnrxamhtech cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year2009

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        85                    Obs per group: min =         3
                                                               avg =      12.5
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): cn_ind

                                                      Number of obs =     1060
                                                      F( 24,   951) =     1.36
                                                      Prob > F      =   0.1186
Total (centered) SS     =  32.57607307                Centered R2   =   0.1035
Total (uncentered) SS   =  32.57607307                Uncentered R2 =   0.1035
Residual SS             =   29.2059059                Root MSE      =    .1752

------------------------------------------------------------------------------
             |               Robust
 lnrxamhtech |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .6636438   .3228711     2.06   0.040     .0300217    1.297266
    sqravyrs |  -.0300684   .0148948    -2.02   0.044    -.0592988   -.0008379
   lnpatappr |  -.0234247   .0747644    -0.31   0.754    -.1701469    .1232975
       lnfdi |   .0130256   .0096888     1.34   0.179    -.0059884    .0320395
      lngdpc |  -.2106046   .3757369    -0.56   0.575    -.9479738    .5267646
```

```
       lnpop |  -2.605247   .6224117    -4.19   0.000    -3.826706   -1.383788
        unem |  -.0015867   .0013386    -1.19   0.236    -.0042137    .0010403
   lnecofree |   -.331575   .2443302    -1.36   0.175    -.8110635    .1479136
        serv |  -.0036238   .0079074    -0.46   0.647    -.0191417    .0118942
      lnrulc |   .3439934   .4457957     0.77   0.441    -.5308635     1.21885
    year1996 |  -.1216424    .102819    -1.18   0.237    -.3234206    .0801359
    year1997 |  -.1286369   .0946173    -1.36   0.174    -.3143198    .0570459
    year1998 |  -.1273531   .0787292    -1.62   0.106    -.2818561      .02715
    year1999 |  -.1145631   .0711191    -1.61   0.108    -.2541315    .0250053
    year2000 |  -.1135813   .0584138    -1.94   0.052    -.2282161    .0010534
    year2001 |  -.0913708   .0534216    -1.71   0.088    -.1962086     .013467
    year2002 |  -.0887464   .0476817    -1.86   0.063    -.1823199    .0048271
    year2003 |  -.0810128   .0457396    -1.77   0.077     -.170775    .0087494
    year2004 |  -.0585424     .04345    -1.35   0.178    -.1438113    .0267266
    year2005 |  -.0780295    .044533    -1.75   0.080    -.1654238    .0093649
    year2006 |  -.0352134   .0386812    -0.91   0.363    -.1111237     .040697
    year2007 |  -.0099331   .0391212    -0.25   0.800     -.086707    .0668407
    year2008 |   .0104613   .0312978     0.33   0.738    -.0509593     .071882
    year2010 |  -.0065907   .0255264    -0.26   0.796    -.0566852    .0435039
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             46.662
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              133.644
                         (Kleibergen-Paap rk Wald F statistic):         30.796
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               2.680
                                                   Chi-sq(4) P-val =    0.6127
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1997
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year2009
------------------------------------------------------------------------------
```

Country level analysis

Table A5.6 Model 1 - Fixed effects estimated results

```
xtreg lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.6859                         Obs per group: min =         5
       between = 0.0063                                        avg =      13.6
       overall = 0.0010                                        max =        16

                                                F(25,314)          =     27.42
```

```
corr(u_i, Xb)  = -0.9314                        Prob > F          =    0.0000

------------------------------------------------------------------------------
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.2386216   .1009995    -2.36   0.019     -.437343   -.0399002
     lntedut |   .0279932   .1015597     0.28   0.783    -.1718303    .2278167
     cskills |  (omitted)
   lnpatappr |   .0012863   .0221195     0.06   0.954    -.0422348    .0448074
       lnfdi |   .0049525   .0041577     1.19   0.234     -.003228     .013133
      lngdpc |   .6109679    .108339     5.64   0.000     .3978057      .82413
       lnpop |  -.6414952    .301295    -2.13   0.034    -1.234307    -.048683
        unem |   .0002162   .0007112     0.30   0.761    -.0011832    .0016156
   lnecofree |   .0979272   .1421791     0.69   0.491    -.1818169    .3776714
      lnrulc |   .2836756   .1564659     1.81   0.071    -.0241786    .5915297
        serv |   .0063964   .0030859     2.07   0.039     .0003248    .0124681
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |   .0607501   .0368016     1.65   0.100    -.0116589     .133159
    year1997 |   .1381549   .0376817     3.67   0.000     .0640143    .2122955
    year1998 |   .1817794   .0386975     4.70   0.000     .1056404    .2579185
    year1999 |   .2103717   .0407567     5.16   0.000      .130181    .2905624
    year2000 |   .1934972   .0412078     4.70   0.000      .112419    .2745754
    year2001 |   .2275407   .0427425     5.32   0.000     .1434427    .3116386
    year2002 |   .2354343    .045593     5.16   0.000     .1457279    .3251406
    year2003 |   .2323779   .0479226     4.85   0.000     .1380879    .3266678
    year2004 |   .2338066   .0503733     4.64   0.000     .1346948    .3329184
    year2005 |   .2462277    .053948     4.56   0.000     .1400824    .3523729
    year2006 |   .2521093   .0566858     4.45   0.000     .1405773    .3636414
    year2007 |   .2499677   .0589742     4.24   0.000     .1339332    .3660021
    year2008 |   .2156327   .0607414     3.55   0.000     .0961212    .3351443
    year2009 |   .2034776   .0620803     3.28   0.001     .0813317    .3256235
    year2010 |   .1876792   .0632092     2.97   0.003     .0633122    .3120463
       _cons |    7.55294   3.560794     2.12   0.035     .5469093    14.55897
-------------+----------------------------------------------------------------
     sigma_u |  1.1144565
     sigma_e |   .0971843
         rho |  .99245297   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(26, 314) =    75.01             Prob > F = 0.0000
```

Table A5.6.1 Model 1 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (27)  =    6292.83
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,       26) =     97.769
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 64.388648
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 1.021e-15
LM5= 8.0242538
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 5.551e-16
Test for significance of fixed effects
F= 75.012361
Probability>F= 2.52e-118

Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                       ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
     __00000B |    366      0.0365         0.0000        29.11         0.0000
```

Table A5.6.2 Model 1 - Driscoll-Kraay estimated results

```
xtscc lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       366
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 28,     26)    = 486532.70
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.6859

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.2386216    .117998    -2.02   0.054    -.4811699    .0039267
     lntedut |   .0279932   .0703227     0.40   0.694    -.1165571    .1725435
     cskills |  (omitted)
   lnpatappr |   .0012863   .0095113     0.14   0.893    -.0182645    .0208371
       lnfdi |   .0049525   .0024424     2.03   0.053     -.000068     .009973
      lngdpc |   .6109679    .089773     6.81   0.000     .4264369    .7954989
       lnpop |  -.6414952   .2521325    -2.54   0.017    -1.159761   -.1232294
        unem |   .0002162   .0006746     0.32   0.751    -.0011706    .0016029
   lnecofree |   .0979272    .147756     0.66   0.513    -.2057896     .401644
      lnrulc |   .2836756   .2282301     1.24   0.225    -.1854581    .7528092
        serv |   .0063964   .0031992     2.00   0.056    -.0001796    .0129725
        dist |   .0072926   .0032385     2.25   0.033     .0006358    .0139494
  transdummy |  (omitted)
    year1996 |   .0607501   .0088558     6.86   0.000     .0425468    .0789533
    year1997 |   .1381549   .0116641    11.84   0.000      .114179    .1621307
    year1998 |   .1817794   .0158447    11.47   0.000     .1492101    .2143488
    year1999 |   .2103717   .0204183    10.30   0.000     .1684014     .252342
    year2000 |   .1934972   .0211542     9.15   0.000     .1500141    .2369803
    year2001 |   .2275407   .0222052    10.25   0.000     .1818973     .273184
    year2002 |   .2354343   .0253591     9.28   0.000     .1833079    .2875607
    year2003 |   .2323779   .0287601     8.08   0.000     .1732606    .2914952
    year2004 |   .2338066   .0317073     7.37   0.000     .1686312     .298982
    year2005 |   .2462277   .0360672     6.83   0.000     .1720905    .3203649
```

```
    year2006 |   .2521093   .0381714     6.60   0.000     .1736469    .3305718
    year2007 |   .2499677   .0407531     6.13   0.000     .1661985    .3337368
    year2008 |   .2156327    .040466     5.33   0.000     .1324538    .2988117
    year2009 |   .2034776   .0404388     5.03   0.000     .1203544    .2866007
    year2010 |   .1876792   .0416063     4.51   0.000     .1021563    .2732022
       _cons |  (omitted)
------------------------------------------------------------------------------
```

Table A5.6.3 Model 1 - FEVD estimated results

```
xtfevd lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant (cskills dist transdummy)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =       311           number of obs       =      366
mean squared error         = .0081029            F( 30, 311)         = 5.851626
root mean squared error    = .0900162            Prob > F            = 2.70e-16
Residual Sum of Squares    = 2.965664            R-squared           = .9507343
Total Sum of Squares       = 60.19739            adj. R-squared      = .9421802
Estimation Sum of Squares  = 57.23173

------------------------------------------------------------------------------
             |                fevd
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.2386216    2.21275    -0.11   0.914    -4.592476    4.115233
     lntedut |   .0279932   2.008215     0.01   0.989    -3.923413      3.9794
   lnpatappr |   .0012863   .4467247     0.00   0.998    -.8776986    .8802712
       lnfdi |   .0049525    .032149     0.15   0.878    -.0583045    .0682096
      lngdpc |   .6109679   3.117605     0.20   0.845    -5.523298    6.745233
       lnpop |  -.6414952   1.138808    -0.56   0.574    -2.882239    1.599248
        unem |   .0002162   .0064695     0.03   0.973    -.0125133    .0129457
   lnecofree |   .0979272   2.014234     0.05   0.961    -3.865322    4.061177
      lnrulc |   .2836755   1.342552     0.21   0.833    -2.357957    2.925308
        serv |   .0063964   .0373047     0.17   0.864     -.067005    .0797979
    year1996 |   .0607501   .3019041     0.20   0.841    -.5332828    .6547829
    year1997 |   .1381549   .4227108     0.33   0.744    -.6935797    .9698895
    year1998 |   .1817794   .4665564     0.39   0.697    -.7362268    1.099786
    year1999 |   .2103717   .4763786     0.44   0.659     -.726961    1.147704
    year2000 |   .1934972   .5005347     0.39   0.699    -.7913655     1.17836
    year2001 |   .2275407   .5598575     0.41   0.685    -.8740468    1.329128
    year2002 |   .2354343   .6019378     0.39   0.696    -.9489513     1.41982
    year2003 |   .2323779   .6878947     0.34   0.736    -1.121138    1.585894
    year2004 |   .2338066   .7068029     0.33   0.741    -1.156914    1.624527
    year2005 |   .2462277   .7727858     0.32   0.750    -1.274322    1.766777
    year2006 |   .2521093   .7485354     0.34   0.736    -1.220725    1.724943
    year2007 |   .2499676   .8827054     0.28   0.777    -1.486862    1.986797
    year2008 |   .2156327   .9077494     0.24   0.812    -1.570474     2.00174
    year2009 |   .2034776   .8469324     0.24   0.810    -1.462965     1.86992
    year2010 |   .1876792   .8395349     0.22   0.823    -1.464207    1.839566
     cskills |   .5675052   1.680204     0.34   0.736    -2.738501    3.873511
        dist |  -.0001257   .0013328    -0.09   0.925    -.0027482    .0024969
  transdummy |   .4596955   4.129105     0.11   0.911    -7.664818    8.584209
         eta |          1          .        .       .            .           .
       _cons |   4.714104   35.07336     0.13   0.893    -64.29699    73.72519
-----------------------------------------------------------------------------
```

Table A5.6.4 Model 1 - Hausman and Taylor estimated results

```
xthtaylor lnEXPY lnsedut lntedut cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
```

```
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, endo
(lnsedut lntedut cskills)

Hausman-Taylor estimation                       Number of obs      =       366
Group variable: country                         Number of groups   =        27

                                                Obs per group: min =         5
                                                               avg =      13.6
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    714.04
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnEXPY |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |   .0064612   .0214357     0.30   0.763     -.035552    .0484743
       lnfdi |   .0032765   .0039971     0.82   0.412    -.0045577    .0111107
      lngdpc |   .7287862   .0927469     7.86   0.000     .5470055    .9105668
       lnpop |  -.0423171   .1548225    -0.27   0.785    -.3457637    .2611295
        unem |    .000453   .0006876     0.66   0.510    -.0008946    .0018006
   lnecofree |   .1372826   .1377823     1.00   0.319    -.1327658     .407331
      lnrulc |   .2566149    .152358     1.68   0.092    -.0420012     .555231
        serv |   .0062612   .0030049     2.08   0.037     .0003716    .0121507
    year1996 |   .0636566   .0359109     1.77   0.076    -.0067275    .1340406
    year1997 |   .1373336   .0367853     3.73   0.000     .0652357    .2094315
    year1998 |   .1805362    .037768     4.78   0.000     .1065123      .25456
    year1999 |   .2050968   .0397081     5.17   0.000     .1272703    .2829233
    year2000 |    .183248   .0399699     4.58   0.000     .1049084    .2615875
    year2001 |   .2134243   .0412683     5.17   0.000       .13254    .2943085
    year2002 |   .2182175   .0438736     4.97   0.000     .1322267    .3042082
    year2003 |   .2134154    .046044     4.64   0.000     .1231707    .3036601
    year2004 |   .2083411   .0479286     4.35   0.000     .1144029    .3022793
    year2005 |   .2153065   .0509492     4.23   0.000      .115448    .3151651
    year2006 |   .2147976   .0529722     4.05   0.000      .110974    .3186212
    year2007 |   .2083794   .0547287     3.81   0.000      .101113    .3156457
    year2008 |   .1732754   .0564084     3.07   0.002      .062717    .2838338
    year2009 |   .1722207   .0590177     2.92   0.004     .0565481    .2878933
    year2010 |   .1528609   .0598007     2.56   0.011     .0356537    .2700681
TVendogenous |
     lnsedut |  -.1927718   .0964358    -2.00   0.046    -.3817825   -.0037611
     lntedut |  -.0303265   .0957492    -0.32   0.751    -.2179915    .1573384
TIexogenous  |
        dist |   .0001004   .0004513     0.22   0.824    -.0007842    .0009849
  transdummy |   .9004043   .5025249     1.79   0.073    -.0845263    1.885335
TIendogenous |
     cskills |   .2431767   1.585119     0.15   0.878      -2.8636    3.349953
             |
       _cons |  -.7570688   8.334575    -0.09   0.928    -17.09254     15.5784
-------------+----------------------------------------------------------------
     sigma_u |  1.1175008
     sigma_e |  .09353218
         rho |  .99304344   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A5.6.5 Model 1 - IV estimated results

```
xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi =  lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1), fe endog (lnsedut lntedut
lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        27                    Obs per group: min =         3
                                                               avg =      12.9
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      349
                                                      F( 24,    298) =    11.71
                                                      Prob > F      =   0.0000
Total (centered) SS     =  7.642422083                Centered R2   =   0.6625
Total (uncentered) SS   =  7.642422083                Uncentered R2 =   0.6625
Residual SS             =   2.57929974                Root MSE      =   .09303

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.1834326   .1658806    -1.11   0.270    -.5098785    .1430132
     lntedut |   .0578985   .1766735     0.33   0.743    -.2897871    .4055842
   lnpatappr |  -.0087444   .0493608    -0.18   0.860    -.1058843    .0883954
       lnfdi |   .0055529   .0045059     1.23   0.219    -.0033146    .0144204
      lngdpc |   .6070447   .1795567     3.38   0.001     .2536848    .9604045
       lnpop |  -.8190879   .4326585    -1.89   0.059    -1.670541    .0323652
        unem |  -.0001631    .000864    -0.19   0.850    -.0018634    .0015372
   lnecofree |   .0214996   .2188513     0.10   0.922    -.4091902    .4521894
        serv |   .0086074   .0058938     1.46   0.145    -.0029914    .0202062
      lnrulc |   .1935282   .2736938     0.71   0.480    -.3450892    .7321456
    year1996 |   -.074001   .0321089    -2.30   0.022    -.1371899    -.010812
    year1998 |   .0410134   .0210914     1.94   0.053    -.0004935    .0825203
    year1999 |   .0670403   .0255149     2.63   0.009     .0168281    .1172525
    year2000 |   .0459142   .0323732     1.42   0.157    -.0177949    .1096233
    year2001 |   .0816322   .0304448     2.68   0.008     .0217182    .1415463
    year2002 |   .0865316   .0343926     2.52   0.012     .0188485    .1542147
    year2003 |   .0840866   .0360165     2.33   0.020     .0132077    .1549655
    year2004 |   .0791254   .0386172     2.05   0.041     .0031284    .1551223
    year2005 |   .0894012   .0425711     2.10   0.037      .005623    .1731793
    year2006 |   .0978549   .0452075     2.16   0.031     .0088885    .1868213
    year2007 |   .0967708   .0479233     2.02   0.044     .0024598    .1910818
    year2008 |   .0590172    .050452     1.17   0.243    -.0402701    .1583045
    year2009 |    .044976   .0643205     0.70   0.485    -.0816038    .1715559
    year2010 |   .0301227   .0647847     0.46   0.642    -.0973709    .1576162
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             15.718
                                                   Chi-sq(1) P-val =    0.0001
```

```
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              63.507
                         (Kleibergen-Paap rk Wald F statistic):        15.880
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):        0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                             12.582
                                                   Chi-sq(4) P-val =    0.0135
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A5.6.5.1 Model 1 - IV estimated results - ETEs

```
xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindN year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut
lnpatappr lnfdi =  lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==1,
fe endog (lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        10                    Obs per group: min =         7
                                                               avg =      13.4
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      134
                                                      F( 25,    99) =    11.74
                                                      Prob > F      =   0.0000
Total (centered) SS     =  5.640525131                Centered R2   =   0.7419
Total (uncentered) SS   =  5.640525131                Uncentered R2 =   0.7419
Residual SS             =  1.455955656                Root MSE      =    .1213

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |  -.3273341   .5054781    -0.65   0.519    -1.330312    .6756442
     lntedut |  -.4143736   .4251237    -0.97   0.332    -1.257911     .429164
   lnpatappr |   -.164355    .134384    -1.22   0.224    -.4310021     .102292
       lnfdi |    .012986   .0961767     0.14   0.893    -.1778493    .2038214
      lngdpc |   .8445394   .3331686     2.53   0.013     .1834607    1.505618
       lnpop |   2.071803   2.179402     0.95   0.344    -2.252604    6.396209
        unem |  -.0038394   .0021456    -1.79   0.077    -.0080967    .0004179
```

```
   lnecofree |  -.1440598   .4019605    -0.36   0.721    -.9416366     .653517
        serv |  -.0010653   .0107022    -0.10   0.921    -.0223008    .0201701
      lnrulc |   .2369057   .3116118     0.76   0.449    -.3813998    .8552112
   transindN |  -.5813905   .5496779    -1.06   0.293    -1.672071    .5092897
    year1996 |  -.1664378   .0767019    -2.17   0.032    -.3186311   -.0142446
    year1998 |   .0706213   .0494032     1.43   0.156    -.0274053     .168648
    year1999 |   .1120747   .0585709     1.91   0.059    -.0041426    .2282921
    year2000 |   .1616826   .0828292     1.95   0.054    -.0026685    .3260337
    year2001 |   .2342649    .099801     2.35   0.021      .036238    .4322918
    year2002 |   .3029415   .1451083     2.09   0.039     .0150151    .5908679
    year2003 |   .3004843   .1461273     2.06   0.042     .0105361    .5904325
    year2004 |   .3339416   .1676208     1.99   0.049     .0013457    .6665376
    year2005 |   .3621091   .1910513     1.90   0.061    -.0169781    .7411964
    year2006 |    .398762   .2083771     1.91   0.059    -.0147034    .8122275
    year2007 |   .4234231   .2238723     1.89   0.061    -.0207881    .8676342
    year2008 |   .3987454   .2367982     1.68   0.095    -.0711136    .8686043
    year2009 |    .436553   .2495723     1.75   0.083    -.0586525    .9317585
    year2010 |   .5066901   .2825293     1.79   0.076    -.0539093     1.06729
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.033
                                                   Chi-sq(1) P-val =    0.0003
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               13.582
                         (Kleibergen-Paap rk Wald F statistic):         11.159
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              11.135
                                                   Chi-sq(4) P-val =    0.0251
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindN year1996
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A5.6.5.2 Model 1 - IV estimated results – N-ETEs

```
xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (lnsedut lntedut lnpatappr
lnfdi =  lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog
(lnsedut lntedut lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =       17                   Obs per group: min =         3
                                                             avg =      12.6
                                                             max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
```

```
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      215
                                                      F( 24,   174) =    15.00
                                                      Prob > F      =   0.0000
Total (centered) SS     =  2.001896952                Centered R2   =   0.6574
Total (uncentered) SS   =  2.001896952                Uncentered R2 =   0.6574
Residual SS             =  .6858443115                Root MSE      =   .06278

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     lnsedut |   -.150169   .1205378    -1.25   0.215    -.3880735    .0877354
     lntedut |   .2399896   .1416539     1.69   0.092    -.0395915    .5195706
   lnpatappr |   .0845948   .0556865     1.52   0.131    -.0253131    .1945027
       lnfdi |   .0121554   .0050995     2.38   0.018     .0020905    .0222203
      lngdpc |   .0682884   .2588819     0.26   0.792    -.4426645    .5792414
       lnpop |   -1.52655   .4518352    -3.38   0.001    -2.418333   -.6347664
        unem |  -.0001901   .0007424    -0.26   0.798    -.0016554    .0012751
   lnecofree |   .3183276   .2227207     1.43   0.155    -.1212544    .7579096
        serv |   .0147342   .0071871     2.05   0.042     .0005491    .0289194
      lnrulc |   .1292573   .3356432     0.39   0.701    -.5331988    .7917134
    year1996 |  -.0565254    .019889    -2.84   0.005    -.0957801   -.0172707
    year1998 |   .0435167   .0214233     2.03   0.044     .0012338    .0857996
    year1999 |   .0904089   .0290204     3.12   0.002     .0331315    .1476863
    year2000 |     .05529   .0437456     1.26   0.208    -.0310504    .1416304
    year2001 |    .108466   .0444577     2.44   0.016     .0207203    .1962118
    year2002 |   .1123234   .0507265     2.21   0.028     .0122049    .2124418
    year2003 |   .1162226   .0520748     2.23   0.027     .0134431    .2190022
    year2004 |   .1242324   .0590455     2.10   0.037     .0076949      .24077
    year2005 |   .1506392   .0634745     2.37   0.019     .0253602    .2759182
    year2006 |   .1619086    .071519     2.26   0.025     .0207521    .3030651
    year2007 |   .1567471   .0773712     2.03   0.044     .0040402    .3094541
    year2008 |   .0975383   .0867873     1.12   0.263     -.073753    .2688296
    year2009 |   .0321895   .0922286     0.35   0.727    -.1498413    .2142204
    year2010 |   .0127991   .0873142     0.15   0.884    -.1595322    .1851304
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             10.068
                                                   Chi-sq(1) P-val =    0.0015
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               26.140
                         (Kleibergen-Paap rk Wald F statistic):          6.543
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              16.651
                                                   Chi-sq(4) P-val =    0.0023
Regressors tested:    lnsedut lntedut lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         lnsedut lntedut lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: lnsedutlag1 lntedutlag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
```

Table A5.7 Model 2 - Fixed effects estimated results

```
xtreg lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
note: cskills omitted because of collinearity
note: dist omitted because of collinearity
note: transdummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       366
Group variable: country                         Number of groups   =        27

R-sq:  within  = 0.6958                         Obs per group: min =         5
       between = 0.0114                                        avg =      13.6
       overall = 0.0238                                        max =        16

                                                F(25,314)          =     28.73
corr(u_i, Xb)  = -0.8772                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.1593657   .1580386    -1.01   0.314    -.4703142    .1515829
    sqravyrs |   .0034403   .0073173     0.47   0.639    -.0109568    .0178374
     cskills |  (omitted)
   lnpatappr |  -.0074042   .0217919    -0.34   0.734    -.0502809    .0354724
       lnfdi |   .0059188   .0040845     1.45   0.148    -.0021176    .0139552
      lngdpc |   .7137505    .091344     7.81   0.000     .5340268    .8934743
       lnpop |  -.3204504   .2690468    -1.19   0.235    -.8498127     .208912
        unem |  -.0000776   .0007428    -0.10   0.917     -.001539    .0013839
   lnecofree |   .0740471   .1390409     0.53   0.595    -.1995226    .3476167
      lnrulc |   .2804745   .1563722     1.79   0.074    -.0271954    .5881443
        serv |   .0080429   .0031063     2.59   0.010     .0019311    .0141547
        dist |  (omitted)
  transdummy |  (omitted)
    year1996 |    .065825   .0360379     1.83   0.069    -.0050813    .1367314
    year1997 |   .1457527   .0368188     3.96   0.000     .0733099    .2181954
    year1998 |   .1888673     .03741     5.05   0.000     .1152613    .2624733
    year1999 |   .2157788   .0389693     5.54   0.000     .1391049    .2924527
    year2000 |   .1954816   .0388442     5.03   0.000     .1190537    .2719095
    year2001 |   .2339885   .0400052     5.85   0.000     .1552764    .3127006
    year2002 |    .245107   .0424619     5.77   0.000     .1615611    .3286528
    year2003 |   .2449533   .0442748     5.53   0.000     .1578405     .332066
    year2004 |   .2498072   .0466433     5.36   0.000     .1580343      .34158
    year2005 |   .2642048   .0497699     5.31   0.000     .1662802    .3621294
    year2006 |   .2735693   .0527573     5.19   0.000     .1697668    .3773718
    year2007 |   .2716757   .0547426     4.96   0.000     .1639671    .3793843
    year2008 |   .2430929   .0557881     4.36   0.000     .1333271    .3528587
    year2009 |   .2388271    .055284     4.32   0.000     .1300531     .347601
    year2010 |   .2313475   .0570877     4.05   0.000     .1190247    .3436704
       _cons |    4.07845    3.33775     1.22   0.223    -2.488732    10.64563
-------------+----------------------------------------------------------------
     sigma_u |    .818763
     sigma_e |  .09563513
         rho |  .98654036   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(26, 314) =    91.30             Prob > F = 0.0000
```

Table A5.7.1 Model 2 - Diagnostic tests

Groupwise heteroskedasticity

```
xttest3
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (27)  =    3569.86
Prob>chi2 =      0.0000
```

Autocorrelation in panel data

```
xtserial lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      26) =     92.816
           Prob > F =      0.0000
```

Normality of residuals

```
pantest2 lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe
Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 59.305243
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 1.350e-14
LM5= 7.7009898
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 6.772e-15

Test for significance of fixed effects
F= 91.295041
Probability>F= 6.97e-130
Test for normality of residuals
                    Skewness/Kurtosis tests for Normality
                                                         ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |    366      0.0292         0.0000        30.23         0.0000
```

Table A5.7.2 Model 2 - Driscoll-Kraay estimated results

```
xtscc lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree lnrulc
serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001 year2002
year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, fe

Regression with Driscoll-Kraay standard errors   Number of obs     =       366
Method: Fixed-effects regression                 Number of groups  =        27
Group variable (i): country                      F( 28,     26)    = 186853.24
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.6958

------------------------------------------------------------------------------
             |             Drisc/Kraay
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.1593657   .2301521    -0.69   0.495      -.63245    .3137187
```

sqravyrs	.0034403	.0103278	0.33	0.742	-.0177887	.0246693
cskills	(omitted)					
lnpatappr	-.0074042	.0110645	-0.67	0.509	-.0301476	.0153392
lnfdi	.0059188	.0024847	2.38	0.025	.0008114	.0110262
lngdpc	.7137505	.0780245	9.15	0.000	.5533688	.8741322
lnpop	-.3204504	.1351481	-2.37	0.025	-.5982513	-.0426495
unem	-.0000776	.000361	-0.21	0.832	-.0008196	.0006645
lnecofree	.0740471	.1186551	0.62	0.538	-.169852	.3179461
lnrulc	.2804745	.1819007	1.54	0.135	-.0934277	.6543766
serv	.0080429	.0030664	2.62	0.014	.0017397	.014346
dist	.0039379	.002177	1.81	0.082	-.000537	.0084128
transdummy	(omitted)					
year1996	.065825	.0068459	9.62	0.000	.0517531	.079897
year1997	.1457527	.0129128	11.29	0.000	.1192101	.1722953
year1998	.1888673	.0151907	12.43	0.000	.1576424	.2200922
year1999	.2157788	.0204726	10.54	0.000	.1736968	.2578607
year2000	.1954816	.0204438	9.56	0.000	.1534587	.2375045
year2001	.2339885	.023402	10.00	0.000	.1858851	.2820919
year2002	.245107	.0276482	8.87	0.000	.1882753	.3019386
year2003	.2449533	.0313624	7.81	0.000	.1804869	.3094197
year2004	.2498072	.0360429	6.93	0.000	.17572	.3238943
year2005	.2642048	.0405768	6.51	0.000	.1807979	.3476117
year2006	.2735693	.0465467	5.88	0.000	.1778911	.3692474
year2007	.2716757	.0500357	5.43	0.000	.1688258	.3745256
year2008	.2430929	.0490614	4.95	0.000	.1422458	.34394
year2009	.2388271	.0423963	5.63	0.000	.1516802	.3259739
year2010	.2313475	.0457946	5.05	0.000	.1372153	.3254797
_cons	(omitted)					

Table A5.7.3 Model 2 - FEVD estimated results

```
. xtfevd lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010,
invariant (cskills dist transdummy)
panel fixed effects regression with vector decomposition

degrees of freedom fevd    =       311          number of obs       =       366
mean squared error         = .0078466          F( 30, 311)         = 6.128892
root mean squared error    = .0885812          Prob > F            = 3.18e-17
Residual Sum of Squares    = 2.871867          R-squared           = .9522925
Total Sum of Squares       = 60.19739          adj. R-squared      = .9440089
Estimation Sum of Squares  = 57.32552
```

lnEXPY	Coef.	fevd Std. Err.	t	P>|t|	[95% Conf.	Interval]
avyrs	-.1593657	1.735442	-0.09	0.927	-3.574058	3.255327
sqravyrs	.0034403	.0806881	0.04	0.966	-.1553233	.1622039
lnpatappr	-.0074042	.2121188	-0.03	0.972	-.4247737	.4099653
lnfdi	.0059188	.0245688	0.24	0.810	-.0424233	.0542609
lngdpc	.7137505	1.279509	0.56	0.577	-1.803838	3.231339
lnpop	-.3204504	.6807283	-0.47	0.638	-1.659866	1.018965
unem	-.0000776	.0042562	-0.02	0.985	-.0084522	.0082971
lnecofree	.074047	1.313449	0.06	0.955	-2.510322	2.658417
lnrulc	.2804744	1.081762	0.26	0.796	-1.848023	2.408972
serv	.0080429	.0240002	0.34	0.738	-.0391804	.0552662
year1996	.065825	.221578	0.30	0.767	-.3701566	.5018067
year1997	.1457527	.2927798	0.50	0.619	-.4303271	.7218324
year1998	.1888673	.2999011	0.63	0.529	-.4012244	.778959
year1999	.2157788	.2722041	0.79	0.429	-.3198158	.7513733

```
    year2000 |   .1954816   .2553564     0.77   0.445     -.306963    .6979262
    year2001 |   .2339885   .2860368     0.82   0.414    -.3288235    .7968005
    year2002 |    .245107   .2928377     0.84   0.403    -.3310868    .8213007
    year2003 |   .2449533   .3445339     0.71   0.478    -.4329589    .9228655
    year2004 |   .2498072   .3665422     0.68   0.496    -.4714089    .9710233
    year2005 |   .2642048   .4154607     0.64   0.525    -.5532645    1.081674
    year2006 |   .2735693   .4234358     0.65   0.519    -.5595919     1.10673
    year2007 |   .2716757    .498568     0.54   0.586    -.7093173    1.252669
    year2008 |   .2430929   .5062922     0.48   0.631    -.7530982    1.239284
    year2009 |   .2388271   .4486424     0.53   0.595    -.6439312    1.121585
    year2010 |   .2313475   .4537286     0.51   0.610    -.6614184    1.124113
     cskills |   .7207232   .9315926     0.77   0.440    -1.112298    2.553744
        dist |  -4.48e-06   .0006538    -0.01   0.995    -.0012909    .0012819
  transdummy |   .7744078   1.946938     0.40   0.691    -3.056428    4.605244
         eta |          1          .        .       .            .           .
       _cons |    .239579   17.27828     0.01   0.989    -33.75754     34.2367
------------------------------------------------------------------------------
```

Table A5.7.4 Model 2 - Hausman and Taylor estimated results

```
. xthtaylor lnEXPY avyrs sqravyrs cskills lnpatappr lnfdi lngdpc lnpop unem lnecofree
lnrulc serv dist transdummy year1996 year1997 year1998 year1999 year2000 year2001
year2002 year2003 year2004 year2005 year2006 year2007 year2008 year2009 year2010, endo
(avyrs sqravyrs cskills)

Hausman-Taylor estimation                       Number of obs      =       366
Group variable: country                         Number of groups   =        27

                                                Obs per group: min =         5
                                                               avg =      13.6
                                                               max =        16

Random effects u_i ~ i.i.d.                     Wald chi2(28)      =    752.56
                                                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      lnEXPY |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
TVexogenous  |
   lnpatappr |  -.0017438   .0209434    -0.08   0.934    -.0427922    .0393045
       lnfdi |   .0040817   .0038424     1.06   0.288    -.0034492    .0116126
      lngdpc |   .7765969   .0800993     9.70   0.000     .6196052    .9335887
       lnpop |   .1020146   .1119708     0.91   0.362    -.1174442    .3214734
        unem |   .0000693   .0007197     0.10   0.923    -.0013413    .0014798
   lnecofree |   .1177496   .1334748     0.88   0.378    -.1438562    .3793553
      lnrulc |   .2539865    .151917     1.67   0.095    -.0437654    .5517384
        serv |   .0077129   .0030039     2.57   0.010     .0018254    .0136004
    year1996 |   .0696941   .0350917     1.99   0.047     .0009157    .1384726
    year1997 |   .1469793   .0359113     4.09   0.000     .0765945    .2173641
    year1998 |    .190874   .0364675     5.23   0.000      .119399     .262349
    year1999 |   .2156843   .0379891     5.68   0.000     .1412269    .2901417
    year2000 |     .19282   .0378319     5.10   0.000     .1186708    .2669693
    year2001 |   .2277534   .0388266     5.87   0.000     .1516546    .3038521
    year2002 |   .2368221   .0411094     5.76   0.000     .1562491    .3173951
    year2003 |    .235601   .0428002     5.50   0.000     .1517141    .3194879
    year2004 |   .2357648   .0447177     5.27   0.000     .1481197    .3234099
    year2005 |   .2465096   .0473928     5.20   0.000     .1536213    .3393978
    year2006 |   .2507714   .0496836     5.05   0.000     .1533932    .3481495
    year2007 |   .2457914   .0511581     4.80   0.000     .1455235    .3460594
    year2008 |   .2154358   .0519015     4.15   0.000     .1137107     .317161
    year2009 |   .2174269    .052439     4.15   0.000     .1146483    .3202056
    year2010 |   .2066705   .0537941     3.84   0.000     .1012361    .3121049
TVendogenous |
```

```
       avyrs |  -.1509265   .1531854    -0.99   0.324    -.4511643    .1493113
    sqravyrs |   .0029791   .0070961     0.42   0.675    -.0109291    .0168873
TIexogenous  |
        dist |   .0001749    .000303     0.58   0.564    -.0004189    .0007687
  transdummy |   1.055614   .3468638     3.04   0.002     .3757733    1.735454
TIendogenous |
     cskills |   .4541542   1.062774     0.43   0.669    -1.628845    2.537154
             |
       _cons |  -3.296869   5.739779    -0.57   0.566    -14.54663     7.95289
-------------+----------------------------------------------------------------
     sigma_u |  .74799655
     sigma_e |  .09204123
         rho |  .98508445   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Note:  TV refers to time varying; TI refers to time invariant.
```

Table A5.7.5 Model 2 - IV estimated results

```
xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
= avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1), fe endog (avyrs sqravyrs lnpatappr
lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        27                    Obs per group: min =          3
                                                               avg =       12.9
                                                               max =         15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =       349
                                                      F( 24,    298) =    12.16
                                                      Prob > F      =    0.0000
Total (centered) SS     =  7.642422083                Centered R2   =    0.6683
Total (uncentered) SS   =  7.642422083                Uncentered R2 =    0.6683
Residual SS             =  2.535345782                Root MSE      =    .09224

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |  -.0418507   .2471238    -0.17   0.866    -.5281795    .4444781
    sqravyrs |  -.0012947   .0111172    -0.12   0.907    -.0231728    .0205835
   lnpatappr |  -.0201088   .0480746    -0.42   0.676    -.1147175    .0744998
       lnfdi |   .0065521   .0040659     1.61   0.108    -.0014494    .0145537
      lngdpc |   .7213378   .1335569     5.40   0.000     .4585037    .9841719
       lnpop |   -.498095   .4108821    -1.21   0.226    -1.306693    .3105032
        unem |  -.0001646   .0008626    -0.19   0.849    -.0018621    .0015329
   lnecofree |   .0165212   .2016106     0.08   0.935    -.3802396    .4132821
        serv |    .009224   .0055068     1.68   0.095    -.0016132    .0200611
      lnrulc |   .2271092   .2592658     0.88   0.382    -.2831145    .7373329
    year1996 |  -.0753466    .032655    -2.31   0.022    -.1396101    -.011083
```

```
    year1998 |   .0401857   .0218062     1.84   0.066     -.002728    .0830995
    year1999 |     .06586   .0266568     2.47   0.014     .0134006    .1183193
    year2000 |   .0418237   .0341921     1.22   0.222    -.0254648    .1091122
    year2001 |   .0808706   .0319424     2.53   0.012     .0180093    .1437319
    year2002 |   .0888471   .0353844     2.51   0.013     .0192122     .158482
    year2003 |   .0883282   .0361139     2.45   0.015     .0172576    .1593988
    year2004 |   .0867001    .039354     2.20   0.028     .0092531     .164147
    year2005 |    .098741   .0431323     2.29   0.023     .0138584    .1836235
    year2006 |   .1092549   .0468223     2.33   0.020     .0171107    .2013991
    year2007 |   .1087399   .0487433     2.23   0.026     .0128152    .2046645
    year2008 |   .0772435   .0509642     1.52   0.131    -.0230518    .1775388
    year2009 |    .074311   .0577254     1.29   0.199      -.03929    .1879121
    year2010 |   .0657972   .0599347     1.10   0.273    -.0521518    .1837461
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.908
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               63.634
                         (Kleibergen-Paap rk Wald F statistic):         14.385
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                              12.914
                                                   Chi-sq(4) P-val =    0.0117
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
------------------------------------------------------------------------------
```

Table A5.7.5.1 Model 2 - IV estimated results – ETEs

```
xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
transindN year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003
year2004 year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs
lnpatappr lnfdi =avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==1, fe
endog (avyrs sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        10                    Obs per group: min =         7
                                                               avg =      13.4
                                                               max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =      134
                                                      F( 25,     99) =    11.96
```

```
                                                      Prob > F      =   0.0000
Total (centered) SS     =  5.640525131                Centered R2   =   0.7563
Total (uncentered) SS   =  5.640525131                Uncentered R2 =   0.7563
Residual SS             =  1.374725097                Root MSE      =    .1178

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |     .89595   1.170925     0.77   0.446    -1.427419    3.219319
    sqravyrs |  -.0454034   .0470891    -0.96   0.337    -.1388384    .0480316
   lnpatappr |  -.0715456   .1726313    -0.41   0.679    -.4140836    .2709924
       lnfdi |   .0438141   .0794747     0.55   0.583    -.1138808    .2015091
      lngdpc |   .8266677   .3754223     2.20   0.030     .0817484    1.571587
       lnpop |   3.376687   2.972462     1.14   0.259    -2.521322    9.274695
        unem |  -.0035758   .0021383    -1.67   0.098    -.0078187    .0006671
   lnecofree |  -.2375639   .4168535    -0.57   0.570    -1.064692    .5895639
        serv |  -.0022184   .0098867    -0.22   0.823    -.0218356    .0173989
      lnrulc |   .2757247   .3062217     0.90   0.370    -.3318857     .883335
   transindN |  -.7009442   .5627996    -1.25   0.216    -1.817661    .4157723
    year1996 |  -.1623414   .0774778    -2.10   0.039    -.3160741   -.0086086
    year1998 |   .0742967   .0489493     1.52   0.132    -.0228294    .1714228
    year1999 |   .1266062   .0641011     1.98   0.051    -.0005843    .2537967
    year2000 |   .1851674   .0863715     2.14   0.034     .0137876    .3565473
    year2001 |   .2309543   .0963277     2.40   0.018     .0398191    .4220894
    year2002 |   .2748553   .1320831     2.08   0.040     .0127739    .5369368
    year2003 |   .2745178   .1258726     2.18   0.032     .0247593    .5242763
    year2004 |   .2914265   .1420164     2.05   0.043     .0096352    .5732178
    year2005 |   .3232388   .1574958     2.05   0.043      .010733    .6357446
    year2006 |   .3538498   .1777324     1.99   0.049     .0011901    .7065095
    year2007 |    .369433   .1903758     1.94   0.055     -.008314    .7471799
    year2008 |   .3425418   .1981646     1.73   0.087    -.0506597    .7357434
    year2009 |   .3668717   .2110077     1.74   0.085    -.0518133    .7855567
    year2010 |   .4315914   .2296205     1.88   0.063    -.0240255    .8872082
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.904
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               10.793
                         (Kleibergen-Paap rk Wald F statistic):          7.841
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                               3.812
                                                   Chi-sq(4) P-val =    0.4320
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc transindN year1996
                      year1998 year1999 year2000 year2001 year2002 year2003
                      year2004 year2005 year2006 year2007 year2008 year2009
                      year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
```

Table A5.7.5.2 Model 2 - IV estimated results – N-ETEs

```
. xtivreg2  lnEXPY cskills lngdpc lnpop unem lnecofree serv lnrulc dist transdummy
year1996 year1997 year1998 year1999 year2000 year2001 year2002 year2003 year2004
year2005 year2006 year2007 year2008 year2009 year2010  (avyrs sqravyrs lnpatappr lnfdi
=avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1) if transdummy==0, fe endog (avyrs
sqravyrs lnpatappr lnfdi) small robust bw(3)
Warning - collinearities detected
Vars dropped:  cskills dist transdummy year1997

FIXED EFFECTS ESTIMATION
------------------------
Number of groups =        17                   Obs per group: min =         3
                                                              avg =      12.6
                                                              max =        15

IV (2SLS) estimation
--------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and autocorrelation
  kernel=Bartlett; bandwidth=3
  time variable (t):  year
  group variable (i): country

                                                      Number of obs =       215
                                                      F( 24,    174) =    16.50
                                                      Prob > F      =    0.0000
Total (centered) SS     =  2.001896952                Centered R2   =    0.6651
Total (uncentered) SS   =  2.001896952                Uncentered R2 =    0.6651
Residual SS             =  .6703558375                Root MSE      =    .06207

------------------------------------------------------------------------------
             |               Robust
      lnEXPY |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       avyrs |   .2431545   .2060535     1.18   0.240    -.1635315    .6498405
    sqravyrs |  -.0126002    .009729    -1.30   0.197    -.0318022    .0066018
   lnpatappr |   .0375926   .0612589     0.61   0.540    -.0833135    .1584988
       lnfdi |   .0135888   .0045313     3.00   0.003     .0046454    .0225321
      lngdpc |   .0728258   .2870376     0.25   0.800     -.493698    .6393495
       lnpop |  -.9096391   .4321604    -2.10   0.037     -1.76259   -.0566878
        unem |   .0001249   .0007321     0.17   0.865      -.00132    .0015698
   lnecofree |   .2917025   .2301851     1.27   0.207    -.1626119    .7460169
        serv |   .0143883      .0069     2.09   0.039     .0007699    .0280067
      lnrulc |   .1946795   .3245619     0.60   0.549    -.4459056    .8352646
    year1996 |  -.0568894   .0192467    -2.96   0.004    -.0948764   -.0189025
    year1998 |   .0447257     .02176     2.06   0.041     .0017782    .0876731
    year1999 |   .0922679   .0293749     3.14   0.002     .0342909    .1502449
    year2000 |   .0662428   .0434924     1.52   0.130    -.0195978    .1520835
    year2001 |   .1180845   .0421644     2.80   0.006     .0348649    .2013041
    year2002 |   .1221263   .0489428     2.50   0.014     .0255283    .2187243
    year2003 |   .1236744   .0493053     2.51   0.013     .0263609    .2209879
    year2004 |   .1346271    .057246     2.35   0.020     .0216412    .2476131
    year2005 |    .163514   .0623864     2.62   0.010     .0403825    .2866455
    year2006 |   .1800764   .0707645     2.54   0.012     .0404091    .3197436
    year2007 |   .1806632   .0773433     2.34   0.021     .0280113    .3333151
    year2008 |    .132503   .0841958     1.57   0.117    -.0336735    .2986794
    year2009 |   .0746472   .0848309     0.88   0.380    -.0927829    .2420772
    year2010 |   .0604838   .0820159     0.74   0.462    -.1013902    .2223578
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):              9.218
                                                   Chi-sq(1) P-val =    0.0024
```

```
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):             24.189
                         (Kleibergen-Paap rk Wald F statistic):         5.675
Stock-Yogo weak ID test critical values:                       <not available>
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):        0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                             10.225
                                                   Chi-sq(4) P-val =    0.0368
Regressors tested:    avyrs sqravyrs lnpatappr lnfdi
------------------------------------------------------------------------------
Instrumented:         avyrs sqravyrs lnpatappr lnfdi
Included instruments: lngdpc lnpop unem lnecofree serv lnrulc year1996 year1998
                      year1999 year2000 year2001 year2002 year2003 year2004
                      year2005 year2006 year2007 year2008 year2009 year2010
Excluded instruments: avyrslag1 sqravyrslag1 lnpatapprlag1 lnfdilag1
Dropped collinear:    cskills dist transdummy year1997
----------------------------------------------------------------------------
```

Country level analysis

Table A5.8 Driscoll-Kraay and IV estimated results (export market share)

Tech intensity	Driscoll-Kraay medium	IV (xtivreg2) medium	Driscoll-Kraay medium	IV (xtivreg2) medium	Driscoll-Kraay high	IV (xtivreg2) high	Driscoll-Kraay high	IV (xtivreg2) high	Driscoll-Kraay Mid &high	IV (xtivreg2) Mid &high	Driscoll-Kraay Mid &high	IV (xtivreg2) Mid &high
Variables	lnmstechC	lnmstechC	lnmstechC	lnmstechC	lnhstechC	lnhstechC	lnhstechC	lnhstechC	lnmhstechC	lnmhstechC	lnmhstechC	lnmhstechC
lnSedut	-0.145	-0.0804			-0.177	0.0854			-0.227	-0.0918		
	(0.225)	(0.299)			(0.207)	(0.412)			(0.196)	(0.313)		
Lntedut	0.466***	0.530*			0.588**	0.714			0.536***	0.608*		
	(0.142)	(0.302)			(0.281)	(0.471)			(0.132)	(0.342)		
Avyrs			-1.155*	-1.010**			-1.827***	-1.660**			-1.542**	-1.376***
			(0.586)	(0.48)			(0.525)	(0.726)			(0.572)	(0.523)
Sqravyrs			0.0476*	0.0424*			0.0757***	0.0690**			0.0643**	0.0576**
			(0.0268)	(0.0217)			(0.0232)	(0.0335)			(0.026)	(0.0238)
Lnpatappr	0.0389	0.0762	0.0271	0.0628	0.00391	-0.0608	-0.00846	-0.079	0.016	-0.00215	0.00532	-0.0161
	(0.05)	(0.0892)	(0.0472)	(0.092)	(0.0312)	(0.137)	(0.0367)	(0.142)	(0.0327)	(0.0961)	(0.0309)	(0.0993)
Lnfdi	0.0201***	0.0257***	0.0293***	0.0375***	0.00623	0.00551	0.0196**	0.0234**	0.00993*	0.0115	0.0215***	0.0263***
	(0.00319)	(0.00748)	(0.0069)	(0.0082)	(0.0104)	(0.0139)	(0.00884)	(0.0115)	(0.00527)	(0.00873)	(0.0054)	(0.0073)
Lngdpc	1.829***	1.759***	2.111***	2.092***	1.721***	1.650***	2.062***	2.063***	1.809***	1.742***	2.129***	2.122***
	(0.131)	(0.335)	(0.18)	(0.248)	(0.263)	(0.391)	(0.315)	(0.269)	(0.145)	(0.32)	(0.212)	(0.216)
lnpop	-4.143***	-4.455***	-3.532***	-3.833***	-1.153**	-1.67	-0.41	-1.038	-2.251***	-2.659***	-1.512***	-1.956**
	(0.453)	(0.892)	(0.473)	(0.812)	(0.536)	(1.109)	(0.49)	(1.038)	(0.414)	(0.858)	(0.369)	(0.81)
Unem	0.00500***	0.00400**	0.00345***	0.00329*	0.00491***	0.00365	0.00226	0.00213	0.00454***	0.00333	0.00239***	0.00216
	(0.00154)	(0.00201)	(0.0005)	(0.00183)	(0.00155)	(0.00242)	(0.0016)	(0.00229)	(0.00155)	(0.00204)	(0.0008)	(0.0018)
Lnecofree	0.238	0.0963	0.192	0.127	-0.0209	-0.385	-0.0903	-0.28	0.16	-0.089	0.0836	-0.046
	(0.404)	(0.39)	(0.31)	(0.344)	(0.281)	(0.459)	(0.254)	(0.412)	(0.328)	(0.384)	(0.251)	(0.331)
Lnrulc	0.236	-0.0354	-0.0349	-0.186	0.17	0.0937	-0.254	-0.203	0.0544	-0.149	-0.293	-0.362

	(0.387)	(0.436)	(0.236)	(0.381)	(0.432)	(0.493)	(0.436)	(0.49)	(0.381)	(0.388)	(0.278)	(0.349)
Serv	-0.00231	-0.00148	0.00401	0.00338	-0.0224***	-0.0184	-0.0127*	-0.0112	-0.00787	-0.00528	0.00078	0.00135
	(0.0094)	(0.0125)	(0.0106)	(0.0126)	(0.0073)	(0.0116)	(0.00716)	(0.00926)	(0.00706)	(0.0112)	(0.0081)	(0.0101)
N	366	349	366	349	366	349	366	349	366	349	366	349
Year dummies included but not reported												
(Robust) standard errors in parentheses												
*** p<0.01, ** p<0.05, * p<0.1												

Table A5.8.1. Driscoll-Kraay and IV estimated results (relative export advantage, RXA)

Estimator	**Driscoll-Kraay**	**IV (xtivreg2)**	**Driscoll-Kraay**	**IV (xtivreg2)**	**Driscoll-Kraay**	**IV (xtivreg2)**	**Driscoll-Kraay**	**IV (xtivreg2)**	**Driscoll-Kraay**	**IV (xtivreg2)**	**Driscoll-Kraay**	**IV (xtivreg2)**
Tech intensity	medium	medum	medum	medum	high	high	high	high	mid&high	mid&high	mid&high	mid&high
	lnRXA	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**	**lnRXA**
Lnsedut	-0.193	-0.217			-0.278	-0.0317			-0.376***	-0.306		
	(0.163)	(0.247)			(0.187)	(0.332)			(0.134)	(0.23)		
Intedut	-0.124	-0.0214			0.0788	0.259			-0.0274	0.075		
	(0.231)	(0.257)			(0.255)	(0.36)			(0.097)	(0.227)		
avyrs			-0.118	0.00927			-0.825***	-0.696			-0.597**	-0.437
			(0.269)	(0.346)			(0.262)	(0.576)			(0.282)	(0.343)
sqravyrs			0.00205	-0.00235			0.0307***	0.0259			0.0214	0.015
			(0.0123)	(0.0157)			(0.011)	(0.0265)			(0.0126)	(0.0154)
lnpatappr	0.0234	0.0899	0.0208	0.085	-0.0111	-0.063	-0.0193	-0.0785	0.00206	-0.00768	-0.00279	-0.0169
	(0.0334)	(0.0733)	(0.0351)	(0.0763)	(0.0417)	(0.115)	(0.0467)	(0.116)	(0.0185)	(0.0624)	(0.0184)	(0.0608)
lnfdi	0.00562	0.00927	0.00522	0.00899	-0.00926	-0.0131	-0.00466	-0.00579	-0.00452	-0.00537	-0.00191	-0.00183
	(0.00516)	(0.00684)	(0.00407)	(0.00754)	(0.00973)	(0.0127)	(0.0083)	(0.0111)	(0.00505)	(0.00641)	(0.00326)	(0.00585)
lngdpc	0.921***	0.840***	0.920***	0.897***	0.667***	0.587**	0.795***	0.790***	0.821***	0.743***	0.907***	0.890***
	(0.186)	(0.311)	(0.103)	(0.256)	(0.225)	(0.293)	(0.204)	(0.223)	(0.123)	(0.242)	(0.0986)	(0.185)
		-	-	-								
lnpop	-2.434***	2.661***	2.330***	2.415***	0.839	0.385	1.230***	0.74	-0.394	-0.795	-0.0162	-0.346
	(0.463)	(0.652)	(0.296)	(0.58)	(0.51)	(0.901)	(0.351)	(0.822)	(0.402)	(0.583)	(0.241)	(0.585)

unem	0.00177*	0.00129	0.00135	0.00129	0.000804	6.40E-05	-0.00069	-0.00071	0.00109	0.000276	-6.99E-05	-0.0003
	(0.00104)	(0.00135)	(0.00091)	(0.00137)	(0.00096)	(0.00159)	(0.00137)	(0.00175)	(0.00117)	(0.00123)	(0.00078)	(0.00128)
lnecofree	0.219	0.289	0.198	0.258	-0.0871	-0.293	-0.134	-0.232	0.182	0.104	0.118	0.083
	(0.331)	(0.349)	(0.306)	(0.344)	(0.155)	(0.35)	(0.162)	(0.319)	(0.227)	(0.294)	(0.192)	(0.269)
lnrulc	0.586	0.313	0.596*	0.0109	0.394	0.398	0.244	-0.00788	0.245	0.0582	0.172	0.00704
	(0.387)	(0.501)	(0.338)	(0.00858)	(0.337)	(0.397)	(0.33)	(0.00918)	(0.338)	(0.352)	(0.268)	(0.00673)
					-							
serv	0.00838*	0.0102	0.00958*	0.359	0.0163**	-0.0109	-0.0113	0.288	-0.00017	0.00404	0.00421	0.0452
	(0.00476)	(0.00827)	(0.00489)	(0.483)	(0.00728)	(0.0105)	(0.00666)	(0.383)	(0.00404)	(0.00767)	(0.00382)	(0.319)
N	366	349	366	349	366	349	366	349	366	349	366	349

Year dummies included but not reported
(Robust) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Industry level analysis

Table A5.9 IV estimated results (medium-low, medium-high and high tech)

Estimator	**IV (xtivreg2)**	**IV (xtivreg2)**	**IV (xtivreg2)**	**IV (xtivreg2)**
Tech intensity	M. low/ M. high/ high	M. low/ M. high/ high	M. low/ M. high/ high	M. low/ M. high/ high
Variables	**lnemshind**	**lnemshind**	**lnrxa**	**lnrxa**
lnsedut	-0.0446		-0.187	
	(0.222)		(0.222)	
lntedut	0.524**		-0.0614	
	(0.242)		(0.238)	
avyrs	0.0564	-0.874**	0.0403	0.296
	(0.0681)	(0.385)	(0.065)	(0.37)
sqravyrs	-0.00292	0.0355**	-0.00035	-0.0171
	(0.0128)	(0.0176)	(0.0131)	(0.0171)

lnpatappr	1.608***	0.0383	0.720***	0.0267
	(0.248)	(0.069)	(0.261)	(0.0639)
lnfdi	-3.477***	0.00998	-0.988	-0.00197
	(0.722)	(0.0124)	(0.789)	(0.0128)
lngdpc	0.00228*	1.969***	-0.00013	0.791***
	(0.00133)	(0.183)	(0.0012)	(0.209)
lnpop	0.0493	-2.786***	0.0425	-0.721
	(0.272)	(0.683)	(0.275)	(0.744)
unem	0.0889	0.00178	0.295	0.000165
	(0.322)	(0.00118)	(0.338)	(0.00112)
lnecofree	-0.00516	0.1	-0.00041	0.0431
	(0.0084)	(0.266)	(0.00756)	(0.278)
lnrulc	-0.0446	-0.00121	-0.187	-0.00153
	(0.222)	(0.0083)	(0.222)	(0.00772)
serv	0.524**	-0.044	-0.0614	0.388
	(0.242)	(0.309)	(0.238)	(0.324)
N	1,035	1035	1,035	1,035

Year dummies included but not reported

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A5.9.1 FEVD & Hausman and Taylor estimated results (medium-low, medium-high and high tech)

Estimator	**FEVD**	**FEVD**	**HT**	**HT**	**FEVD**	**FEVD**	**HT**	**HT**
	MODEL 1	**Model 2**	**MODEL 1**	**Model 2**	**MODEL 1**	**Model 2**	**MODEL 1**	**Model 2**
Variables	**lnemshind**	**lnemshind**	**lnemshind**	**lnemshind**	**lnrxa**	**lnrxa**	**lnrxa**	**lnrxa**
cskills	-0.882	0.00264	0.156	0.909	-0.154	-0.0275	0.16	0.252
	(6.255)	(3.982)	(4.834)	(4.076)	(1.621)	(1.06)	(1.238)	(1.077)
dist	-0.00246	-0.00206	-0.00168	-0.00134	-0.00037	-0.00028	0.000246	0.000239
	(0.00527)	(0.00302)	(0.00136)	(0.00115)	(0.00137)	(0.00081)	(0.000355)	(0.00031)
transdummy	-1.055	-0.187	0.71	1.354	0.409	0.604	1.108***	1.178***
	(16.41)	(8.824)	(1.485)	(1.256)	(4.255)	(2.35)	(0.413)	(0.366)
N	1080	1080	1080	1080	1080	1080	1080	1080

Education attainment variables, controls and year dummies are included but not reported

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix – A6

Contents

Table A6.1 Descriptive statistics

Variable	n	Mean	S.D.	Min	Mdn	Max
exp_int	15708	0.06	0.20	0.00	0.00	1.00
emp_edu	15121	34.03	31.36	0.00	25.00	100.00
emp_trng	15668	0.38	0.48	0.00	0.00	1.00
manager_exp	15393	16.61	10.05	1.00	15.00	65.00
manager_edu_dummy	1299	0.47	0.50	0.00	0.00	1.00
skilled_emp	5880	58.44	24.36	0.00	61.54	100.00
lnavrg_tlc	11229	8.01	1.35	-6.18	8.11	21.33
RD_exp	15752	0.11	0.31	0.00	0.00	1.00
new_org_str	15795	0.21	0.41	0.00	0.00	1.00
new_prod_serv	15797	0.24	0.43	0.00	0.00	1.00
new_methods	15796	0.20	0.40	0.00	0.00	1.00
location	15883	0.21	0.41	0.00	0.00	1.00
lnsize	15795	2.96	1.28	0.00	2.71	9.35
lnsize_sqr	15795	10.42	9.33	0.00	7.33	87.42
lnage	15724	2.42	0.73	-0.69	2.56	5.16
lnage_sqr	15724	6.37	3.42	0.00	6.58	26.62
foreign_dummy	15721	0.04	0.21	0.00	0.00	1.00
state_dummy	15720	0.01	0.10	0.00	0.00	1.00
credit	15624	0.35	0.48	0.00	0.00	1.00
CEEC_dummy	15883	0.35	0.48	0.00	0.00	1.00
low_mlow_tech	15881	0.31	0.46	0.00	0.00	1.00
mhigh_tech	15881	0.07	0.25	0.00	0.00	1.00
high_tech	15881	0.02	0.13	0.00	0.00	1.00
f_inputs	6033	29.34	35.19	0.00	10.00	100.00
tech_dummy	1278	0.89	0.31	0.00	1.00	1.00
bus_assoc	753	0.59	0.49	0.00	1.00	1.00

Table A6.2 Correlation matrix

	emp_edu	emp_trng	manage~p	lnavrg~c	RD_exp	new_or~r	new_pr~v	new_me~s	location	lnsize	lnage	foreig~y	state_~y
emp_edu	1.0000												
emp_trng	0.0357	1.0000											
manager_exp	-0.1456	0.0771	1.0000										
lnavrg_tlc	-0.0289	0.1171	0.0862	1.0000									
RD_exp	0.0105	0.1977	0.0655	0.1059	1.0000								
new_org_str	0.0321	0.2650	0.0367	0.0863	0.3250	1.0000							
new_prod_s~v	0.0106	0.1910	0.0690	0.1124	0.3345	0.3745	1.0000						
new_methods	0.0140	0.2112	0.0450	0.0777	0.3483	0.4791	0.4888	1.0000					
location	0.1234	0.0034	-0.0238	-0.0227	0.0142	0.0414	0.0190	0.0110	1.0000				
lnsize	-0.1543	0.2280	0.1538	0.0287	0.1553	0.1393	0.1123	0.1184	-0.0134	1.0000			
lnage	-0.2151	0.0651	0.3955	0.0786	0.0643	0.0446	0.0711	0.0549	-0.0162	0.3133	1.0000		
foreign_du~y	0.0082	0.0919	-0.0349	0.0972	0.0692	0.0652	0.0718	0.0508	0.1157	0.1427	0.0083	1.0000	
state_dummy	-0.0263	0.0236	-0.0198	-0.0137	-0.0019	0.0021	-0.0076	0.0004	-0.0320	0.1359	0.0738	-0.0188	1.0000
credit	-0.1382	0.1179	0.0550	0.0773	0.1072	0.1326	0.1296	0.1228	-0.0008	0.1711	0.1148	-0.0023	0.0130
low_mlow_t~h	-0.1979	-0.0595	0.0303	-0.0506	0.0319	-0.0185	0.0740	0.0868	-0.0743	0.1714	0.0820	0.0140	-0.0097
mhigh_tech	-0.0069	0.0108	0.0802	0.0465	0.1182	0.0345	0.0950	0.0555	-0.0380	0.0951	0.0507	0.0272	-0.0055
high_tech	0.0622	0.0345	0.0463	0.0334	0.1067	0.0373	0.0780	0.0592	0.0128	0.0486	0.0349	0.0233	0.0063
CEEC_dummy	-0.3378	0.0531	0.1496	0.2502	0.0696	0.0838	0.1191	0.0560	0.0551	-0.0649	0.2091	0.1103	-0.0545

	credit	low_ml~h	mhigh~ch	high_t~h	CEEC_d~y
credit	1.0000				

low_mlow_t~h	0.0623	1.0000			
mhigh_tech	-0.0169	-0.1849	1.0000		
high_tech	-0.0215	-0.0887	-0.0362	1.0000	
CEEC_dummy	0.1952	-0.0457	-0.0462	-0.0233	1.0000

Estimated results: Export intensity

Table A6.3 Tobit Model - Full sample estimated results

```
tobit  exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,  ll ul
vce(robust) nolog
Tobit regression                                  Number of obs   =      14026
                                                  F(  46,  13980) =      44.73
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -4907.2106                 Pseudo R2       =     0.2348
```

exp_int	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0021013	.0003853	5.45	0.000	.0013461	.0028565
emp_trng	.0275278	.0196298	1.40	0.161	-.0109491	.0660047
manager_exp	.0006197	.0008994	0.69	0.491	-.0011433	.0023827
new_org_str	.0493851	.0234472	2.11	0.035	.0034253	.0953448
new_prod_s~v	.0530538	.0217337	2.44	0.015	.0104529	.0956547
new_methods	.0282516	.0248198	1.14	0.255	-.0203985	.0769017
location	-.0520632	.024132	-2.16	0.031	-.0993651	-.0047613
lnsize	.2028949	.0306217	6.63	0.000	.1428723	.2629174
lnsize_sqr	-.0087889	.003756	-2.34	0.019	-.0161511	-.0014266
lnage	.0488579	.0525003	0.93	0.352	-.0540498	.1517656
lnage_sqr	-.0159944	.0101772	-1.57	0.116	-.035943	.0039542
foreign_du~y	.375237	.0368696	10.18	0.000	.3029677	.4475063
state_dummy	-.1267879	.0868611	-1.46	0.144	-.2970472	.0434714
credit	.1078399	.0186855	5.77	0.000	.0712138	.144466
low_mlow_t~h	.3787365	.0208511	18.16	0.000	.3378655	.4196074
mhigh_tech	.5289483	.0279517	18.92	0.000	.4741592	.5837374
high_tech	.5360094	.0516404	10.38	0.000	.4347873	.6372315
dcountry1	.5516418	.0808891	6.82	0.000	.3930883	.7101952
dcountry2	.508845	.0591863	8.60	0.000	.3928319	.624858
dcountry3	.1856281	.0825016	2.25	0.024	.023914	.3473423
dcountry4	.113816	.0879959	1.29	0.196	-.0586678	.2862997
dcountry5	.7083855	.0385319	18.38	0.000	.6328579	.7839131
dcountry6	.1478636	.0433947	3.41	0.001	.0628041	.2329231
dcountry7	.0581609	.0846692	0.69	0.492	-.1078021	.2241238
dcountry9	.4978848	.0531995	9.36	0.000	.3936066	.602163
dcountry10	.5780022	.0504647	11.45	0.000	.4790847	.6769198
dcountry11	.7394862	.0511557	14.46	0.000	.6392142	.8397581
dcountry12	-.2787244	.082873	-3.36	0.001	-.4411666	-.1162823
dcountry13	.3263076	.0667645	4.89	0.000	.1954401	.457175
dcountry14	.6569483	.0548182	11.98	0.000	.5494972	.7643994
dcountry15	-.1992676	.1212336	-1.64	0.100	-.4369017	.0383665
dcountry16	.6596434	.0570845	11.56	0.000	.5477501	.7715367
dcountry17	.2483821	.0669597	3.71	0.000	.1171321	.379632
dcountry18	.2087097	.0797429	2.62	0.009	.0524029	.3650165
dcountry19	.0261929	.0959764	0.27	0.785	-.1619337	.2143195
dcountry20	.8825653	.0595676	14.82	0.000	.765805	.9993257
dcountry21	.4884932	.0722076	6.77	0.000	.3469565	.6300298
dcountry22	.8361702	.0559255	14.95	0.000	.7265487	.9457916
dcountry23	.4776285	.066304	7.20	0.000	.3476639	.6075931

```
  dcountry24 |   .8511971   .0614703    13.85   0.000     .7307071    .9716871
  dcountry25 |     .77429   .0623311    12.42   0.000     .6521128    .8964673
  dcountry26 |   .6929248   .0606978    11.42   0.000      .573949    .8119006
  dcountry27 |   1.038998   .0526759    19.72   0.000     .9357462     1.14225
  dcountry28 |   .6040559   .0661302     9.13   0.000     .4744318      .73368
  dcountry29 |   .7177246   .0528375    13.58   0.000      .614156    .8212931
  dcountry30 |   .4060361   .1067239     3.80   0.000     .1968429    .6152293
       _cons |  -1.989816   .0914924   -21.75   0.000    -2.169153   -1.810479
-------------+----------------------------------------------------------------
      /sigma |   .6385366   .0139726                      .6111485    .6659248
------------------------------------------------------------------------------
  Obs. summary:      11804  left-censored observations at exp_int<=0
                      2047     uncensored observations
                       175 right-censored observations at exp_int>=1
```

Table A6.3.1 Tobit Model - Industry estimated results

```
tobit   exp_int   emp_edu   emp_trng   manager_exp   int_edu_lowmlow   int_edu_mhightech
int_edu_hightech  int_trng_lowmlow  int_trng_mhigh  int_trng_high  int_mngexp_lowmlow
int_mngexp_mhigh  int_mngexp_high    new_org_str  new_prod_serv  new_methods  location
lnsize  lnsize_sqr  lnage  lnage_sqr  foreign_dummy  state_dummy  credit   low_mlow_tech
mhigh_tech  high_tech   dcountry1-dcountry7  dcountry9-dcountry30,  ll  ul  vce(robust)
nolog

Tobit regression                                  Number of obs   =      14026
                                                  F(  55,  13971) =      39.53
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -4872.0759                 Pseudo R2       =     0.2402

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0037382   .0004948     7.56   0.000     .0027684     .004708
    emp_trng |  -.0236993   .0298756    -0.79   0.428    -.0822595     .034861
 manager_exp |  -.0025531   .0015303    -1.67   0.095    -.0055527    .0004464
int_edu_lo~w |  -.0051116   .0007549    -6.77   0.000    -.0065913   -.0036318
int_edu_mh~h |  -.0025071   .0009734    -2.58   0.010    -.0044151   -.0005992
int_edu_h~ch |  -.0027965   .0016481    -1.70   0.090    -.0060271    .0004341
int_trng_l~w |   .0966031   .0389386     2.48   0.013     .0202782    .1729279
int_trng_m~h |   .1239344   .0527396     2.35   0.019     .0205578     .227311
int_trng_h~h |  -.0475329   .1000348    -0.48   0.635    -.2436144    .1485486
int_mngexp~w |   .0047606   .0019292     2.47   0.014     .0009791    .0085421
int_mn~mhigh |   .0043273   .0024969     1.73   0.083    -.0005669    .0092215
int_mn~_high |   .0077553   .0046792     1.66   0.097    -.0014165    .0169272
 new_org_str |   .0507253   .0233213     2.18   0.030     .0050125    .0964382
new_prod_s~v |   .0502781   .0217099     2.32   0.021     .0077238    .0928325
 new_methods |   .0286649   .0247615     1.16   0.247    -.0198709    .0772007
    location |  -.0470848   .0240704    -1.96   0.050     -.094266    .0000964
      lnsize |   .2047927    .030088     6.81   0.000     .1458162    .2637692
  lnsize_sqr |  -.0091499   .0036874    -2.48   0.013    -.0163777   -.0019221
       lnage |   .0609824   .0524259     1.16   0.245    -.0417793    .1637441
   lnage_sqr |  -.0177186   .0101368    -1.75   0.080    -.0375881    .0021509
foreign_du~y |   .3673346   .0363508    10.11   0.000     .2960822    .4385869
 state_dummy |  -.1319121   .0851242    -1.55   0.121    -.2987669    .0349427
      credit |   .1085244   .0185764     5.84   0.000     .0721122    .1449366
low_mlow_t~h |   .3816502   .0500812     7.62   0.000     .2834843    .4798161
  mhigh_tech |   .4770969    .068962     6.92   0.000     .3419221    .6122716
   high_tech |   .5193047   .1459421     3.56   0.000     .2332387    .8053707
   dcountry1 |   .5267486   .0795448     6.62   0.000     .3708302     .682667
   dcountry2 |   .5112482    .058327     8.77   0.000     .3969194     .625577
   dcountry3 |   .1865928     .08105     2.30   0.021      .027724    .3454615
```

```
   dcountry4 |   .1075846    .086338     1.25   0.213    -.0616494    .2768186
   dcountry5 |   .6687978   .0391281    17.09   0.000     .5921013    .7454942
   dcountry6 |   .1819951   .0427638     4.26   0.000     .0981724    .2658178
   dcountry7 |   .0545007   .0836193     0.65   0.515    -.1094044    .2184058
   dcountry9 |   .4856703    .052598     9.23   0.000     .3825712    .5887694
  dcountry10 |   .5703959   .0502734    11.35   0.000     .4718533    .6689386
  dcountry11 |   .7351974   .0508586    14.46   0.000     .6355077    .8348871
  dcountry12 |  -.2515079   .0815089    -3.09   0.002    -.4112762   -.0917396
  dcountry13 |   .3253493   .0667289     4.88   0.000     .1945516    .4561469
  dcountry14 |   .6559665   .0546442    12.00   0.000     .5488565    .7630766
  dcountry15 |  -.1979079   .1194173    -1.66   0.097    -.4319818    .0361659
  dcountry16 |   .6516843   .0572208    11.39   0.000     .5395239    .7638448
  dcountry17 |   .2407466   .0655432     3.67   0.000     .1122732      .36922
  dcountry18 |   .2170668   .0786896     2.76   0.006     .0628246    .3713091
  dcountry19 |   .0352353   .0945262     0.37   0.709    -.1500488    .2205193
  dcountry20 |   .8816456   .0588458    14.98   0.000        .7663    .9969912
  dcountry21 |   .4827525   .0723739     6.67   0.000       .34089     .624615
  dcountry22 |   .8169733   .0561188    14.56   0.000      .706973    .9269737
  dcountry23 |   .4827292   .0667805     7.23   0.000     .3518306    .6136279
  dcountry24 |   .8528684   .0606487    14.06   0.000     .7339888     .971748
  dcountry25 |   .7707249    .061112    12.61   0.000     .6509372    .8905126
  dcountry26 |   .6816106   .0608902    11.19   0.000     .5622575    .8009636
  dcountry27 |   1.048517   .0526152    19.93   0.000     .9453843     1.15165
  dcountry28 |   .6057215   .0661272     9.16   0.000     .4761034    .7353396
  dcountry29 |   .7215941   .0530843    13.59   0.000     .6175417    .8256465
  dcountry30 |   .4139284   .1062674     3.90   0.000     .2056301    .6222268
       _cons |  -1.979507   .0942939   -20.99   0.000    -2.164336   -1.794679
-------------+----------------------------------------------------------------
      /sigma |   .6326716   .0138427                      .6055381    .6598051
------------------------------------------------------------------------------
  Obs. summary:      11804  left-censored observations at exp_int<=0
                      2047     uncensored observations
                       175 right-censored observations at exp_int>=1
```

Table A6.3.2 Tobit Model - CEECs estimated results

```
tobit  exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==1,  ll ul vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       4836
                                                  F(  33,    4803) =      29.62
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -2377.1099                 Pseudo R2       =     0.1891

------------------------------------------------------------------------------
             |               Robust
```

exp_int	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0017532	.0005636	3.11	0.002	.0006483	.0028581
emp_trng	-.0324971	.0264824	-1.23	0.220	-.0844146	.0194205
manager_exp	.0006082	.0012479	0.49	0.626	-.0018383	.0030546
new_org_str	.0869656	.0316345	2.75	0.006	.0249475	.1489837
new_prod_s~v	.0307974	.0289979	1.06	0.288	-.0260517	.0876465
new_methods	.0655199	.0330533	1.98	0.048	.0007203	.1303194
location	-.0056078	.0293388	-0.19	0.848	-.0631252	.0519096
lnsize	.2777998	.0440798	6.30	0.000	.1913833	.3642163
lnsize_sqr	-.0217803	.0056854	-3.83	0.000	-.0329263	-.0106343
lnage	.0242115	.0829176	0.29	0.770	-.1383449	.186768
lnage_sqr	-.0156681	.0155338	-1.01	0.313	-.0461216	.0147853
foreign_du~y	.3668555	.0443757	8.27	0.000	.2798589	.4538522
state_dummy	-.2778723	.2056122	-1.35	0.177	-.6809664	.1252219
credit	.0987307	.0256243	3.85	0.000	.0484954	.148966
low_mlow_t~h	.4625178	.0269567	17.16	0.000	.4096704	.5153652
mhigh_tech	.5715936	.0402903	14.19	0.000	.4926062	.6505811
high_tech	.5886531	.0865465	6.80	0.000	.4189823	.758324
dcountry1	.1145976	.1244912	0.92	0.357	-.1294621	.3586573
dcountry2	(omitted)					
dcountry3	(omitted)					
dcountry4	(omitted)					
dcountry5	(omitted)					
dcountry6	(omitted)					
dcountry7	(omitted)					
dcountry9	.0996991	.110211	0.90	0.366	-.116365	.3157632
dcountry10	.1617454	.1087357	1.49	0.137	-.0514263	.3749172
dcountry11	.3164807	.1082036	2.92	0.003	.104352	.5286093
dcountry12	(omitted)					
dcountry13	(omitted)					
dcountry14	.2459439	.1103192	2.23	0.026	.0296678	.46222
dcountry15	(omitted)					
dcountry16	.2305278	.110866	2.08	0.038	.0131797	.4478759
dcountry17	(omitted)					
dcountry18	(omitted)					
dcountry19	(omitted)					
dcountry20	.454691	.1119281	4.06	0.000	.2352606	.6741214
dcountry21	.0487459	.1207189	0.40	0.686	-.1879183	.2854102
dcountry22	.4192487	.1114068	3.76	0.000	.2008404	.637657
dcountry23	.0632755	.1152812	0.55	0.583	-.1627284	.2892793
dcountry24	.4175321	.1132598	3.69	0.000	.1954909	.6395732
dcountry25	.3438159	.1148107	2.99	0.003	.1187344	.5688974
dcountry26	.2725167	.1136215	2.40	0.017	.0497666	.4952668
dcountry27	.6374784	.108886	5.85	0.000	.424012	.8509448
dcountry28	.1960315	.1157607	1.69	0.090	-.0309125	.4229754
dcountry29	.3016044	.1092903	2.76	0.006	.0873454	.5158634
dcountry30	(omitted)					
_cons	-1.582997	.1613637	-9.81	0.000	-1.899344	-1.266651
/sigma	.6016749	.0160044			.5702989	.6330508

```
Obs. summary:       3613  left-censored observations at exp_int<=0
                    1131     uncensored observations
                      92 right-censored observations at exp_int>=1
```

Table A6.3.3 Tobit Model - CEECs Industry estimated results

```
tobit  exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if CEEC_dummy==1, ll ul
vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       4836
                                                  F(  42,    4794) =      24.27
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -2362.8054                 Pseudo R2       =     0.1940

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0030961    .000664     4.66   0.000     .0017944    .0043977
    emp_trng |  -.0517673   .0363012    -1.43   0.154    -.1229343    .0193996
 manager_exp |  -.0004739   .0018206    -0.26   0.795     -.004043    .0030953
int_edu_lo~w |  -.0057615   .0012334    -4.67   0.000    -.0081795   -.0033435
int_edu_mh~h |  -.0033485   .0017132    -1.95   0.051    -.0067071    .0000101
int_edu_h~ch |    .000596   .0028763     0.21   0.836    -.0050429    .0062349
int_trng_l~w |   .0336226   .0516199     0.65   0.515    -.0675761    .1348213
int_trng_m~h |   .1720853   .0769356     2.24   0.025     .0212563    .3229143
int_trng_h~h |  -.2061601   .1675195    -1.23   0.219    -.5345752    .1222551
int_mngexp~w |   .0026528   .0025853     1.03   0.305    -.0024155    .0077211
int_mn~mhigh |   .0014242   .0039814     0.36   0.721    -.0063812    .0092296
int_mn~_high |   .0003958   .0082459     0.05   0.962    -.0157699    .0165616
 new_org_str |   .0866242   .0314509     2.75   0.006      .024966    .1482824
new_prod_s~v |   .0289286   .0289009     1.00   0.317    -.0277304    .0855877
 new_methods |   .0638984    .032838     1.95   0.052    -.0004792    .1282761
    location |  -.0032534   .0291908    -0.11   0.911    -.0604807     .053974
      lnsize |   .2760793   .0435128     6.34   0.000     .1907742    .3613845
  lnsize_sqr |   -.021612   .0056071    -3.85   0.000    -.0326045   -.0106194
       lnage |   .0240818   .0820082     0.29   0.769     -.136692    .1848555
   lnage_sqr |  -.0142432   .0153273    -0.93   0.353    -.0442917    .0158054
foreign_du~y |    .362505   .0440274     8.23   0.000      .276191    .4488189
 state_dummy |  -.2639488   .1912399    -1.38   0.168    -.6388668    .1109692
      credit |   .0978067   .0254898     3.84   0.000      .047835    .1477785
low_mlow_t~h |   .4863728   .0629876     7.72   0.000     .3628881    .6098575
  mhigh_tech |   .5384897   .1037077     5.19   0.000     .3351749    .7418044
   high_tech |    .658685   .2350555     2.80   0.005     .1978683    1.119502
   dcountry1 |   .0987869    .122517     0.81   0.420    -.1414027    .3389764
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
```

```
   dcountry7 |  (omitted)
   dcountry9 |   .0837101   .1090209     0.77   0.443    -.1300209     .297441
  dcountry10 |   .1480052   .1075934     1.38   0.169    -.0629272    .3589376
  dcountry11 |   .3062276   .1070172     2.86   0.004     .0964248    .5160305
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |   .2345306   .1092702     2.15   0.032     .0203108    .4487504
  dcountry15 |  (omitted)
  dcountry16 |    .216188   .1098373     1.97   0.049     .0008564    .4315196
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |    .443386   .1106004     4.01   0.000     .2265585    .6602135
  dcountry21 |   .0424388   .1197613     0.35   0.723    -.1923483    .2772259
  dcountry22 |    .387212   .1105545     3.50   0.000     .1704745    .6039496
  dcountry23 |   .0545317    .114598     0.48   0.634    -.1701329    .2791964
  dcountry24 |   .4195784   .1117518     3.75   0.000     .2004936    .6386632
  dcountry25 |   .3428672   .1131645     3.03   0.002     .1210127    .5647216
  dcountry26 |   .2579753     .11263     2.29   0.022     .0371688    .4787818
  dcountry27 |   .6257372   .1078801     5.80   0.000     .4142427    .8372317
  dcountry28 |   .1949825   .1146544     1.70   0.089    -.0297928    .4197578
  dcountry29 |    .287412   .1082906     2.65   0.008     .0751128    .4997113
  dcountry30 |  (omitted)
       _cons |  -1.574651   .1624217    -9.69   0.000    -1.893072    -1.25623
-------------+----------------------------------------------------------------
      /sigma |   .5971412   .0159697                      .5658334    .6284491
------------------------------------------------------------------------------
  Obs. summary:       3613  left-censored observations at exp_int<=0
                      1131     uncensored observations
                        92 right-censored observations at exp_int>=1
```

Table A6.3.4 Tobit Model - CIS estimated results

```
. tobit  exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==0,  ll ul vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       9190
                                                  F(  29,    9161) =      33.47
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -2490.2398                 Pseudo R2       =     0.2336

------------------------------------------------------------------------------
```

exp_int	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.002264	.0005278	4.29	0.000	.0012295	.0032985
emp_trng	.0868053	.0288929	3.00	0.003	.0301688	.1434418
manager_exp	.0001315	.001317	0.10	0.920	-.0024501	.0027131
new_org_str	.0186881	.0345545	0.54	0.589	-.0490464	.0864227
new_prod_s~v	.0756455	.0331704	2.28	0.023	.0106242	.1406668
new_methods	-.0193022	.0373934	-0.52	0.606	-.0926017	.0539972
location	-.0962103	.0415826	-2.31	0.021	-.1777214	-.0146991
lnsize	.1630033	.0439795	3.71	0.000	.0767936	.249213
lnsize_sqr	-.0015801	.0051825	-0.30	0.760	-.011739	.0085788
lnage	.0300916	.0696886	0.43	0.666	-.1065136	.1666968
lnage_sqr	-.007915	.0138183	-0.57	0.567	-.035002	.019172
foreign_du~y	.3959685	.0646083	6.13	0.000	.2693218	.5226152
state_dummy	-.1398187	.1003519	-1.39	0.164	-.3365308	.0568934
credit	.1168068	.0273406	4.27	0.000	.0632131	.1704005
low_mlow_t~h	.2666887	.0321517	8.29	0.000	.2036642	.3297133
mhigh_tech	.4582887	.0397428	11.53	0.000	.380384	.5361934
high_tech	.4696618	.0661209	7.10	0.000	.3400501	.5992735
dcountry1	(omitted)					
dcountry2	.5451942	.0636002	8.57	0.000	.4205235	.6698648
dcountry3	.216083	.0864483	2.50	0.012	.046625	.385541
dcountry4	.1326098	.0911185	1.46	0.146	-.0460027	.3112224
dcountry5	.7746827	.0468922	16.52	0.000	.6827637	.8666018
dcountry6	.2007343	.0460324	4.36	0.000	.1105004	.2909681
dcountry7	.0558818	.0925564	0.60	0.546	-.1255494	.2373131
dcountry9	(omitted)					
dcountry10	(omitted)					
dcountry11	(omitted)					
dcountry12	-.2872015	.0857447	-3.35	0.001	-.4552803	-.1191227
dcountry13	.3571798	.0698053	5.12	0.000	.2203459	.4940137
dcountry14	(omitted)					
dcountry15	-.1807628	.1284495	-1.41	0.159	-.4325524	.0710268
dcountry16	(omitted)					
dcountry17	.2849493	.0746472	3.82	0.000	.1386241	.4312745
dcountry18	.2383258	.0844307	2.82	0.005	.0728227	.4038288
dcountry19	.0566913	.100041	0.57	0.571	-.1394112	.2527939
dcountry20	(omitted)					
dcountry21	(omitted)					
dcountry22	(omitted)					
dcountry23	(omitted)					
dcountry24	(omitted)					
dcountry25	(omitted)					
dcountry26	(omitted)					
dcountry27	(omitted)					
dcountry28	(omitted)					
dcountry29	(omitted)					
dcountry30	(omitted)					
_cons	-1.978844	.1278762	-15.47	0.000	-2.22951	-1.728178
/sigma	.6741665	.0239597			.6272001	.7211328

```
  Obs. summary:       8191  left-censored observations at exp_int<=0
                       916     uncensored observations
                        83 right-censored observations at exp_int>=1
```

Table A6.3.5 Tobit Model - CIS Industry estimated results

```
. tobit  exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if CEEC_dummy==0, ll ul
vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       9190
                                                  F(  38,   9152) =      26.29
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -2477.6626                 Pseudo R2       =     0.2375

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0036068   .0007903     4.56   0.000     .0020575     .005156
    emp_trng |   .0211054   .0488556     0.43   0.666    -.0746624    .1168732
 manager_exp |  -.0047118   .0026653    -1.77   0.077    -.0099363    .0005128
int_edu_lo~w |  -.0036204   .0011114    -3.26   0.001     -.005799   -.0014418
int_edu_mh~h |  -.0010421   .0013411    -0.78   0.437    -.0036709    .0015868
int_edu_h~ch |  -.0036096   .0022663    -1.59   0.111    -.0080521    .0008329
int_trng_l~w |   .1198955   .0601901     1.99   0.046     .0019094    .2378816
int_trng_m~h |    .066289   .0759698     0.87   0.383    -.0826289    .2152068
int_trng_h~h |   .0647576    .131885     0.49   0.623    -.1937665    .3232817
int_mngexp~w |   .0060724    .003089     1.97   0.049     .0000173    .0121275
int_mn~mhigh |    .006007   .0036299     1.65   0.098    -.0011084    .0131223
int_mn~_high |   .0135548   .0060454     2.24   0.025     .0017045    .0254051
 new_org_str |   .0200867   .0346497     0.58   0.562    -.0478343    .0880078
new_prod_s~v |   .0766234   .0333005     2.30   0.021      .011347    .1418999
 new_methods |  -.0177255   .0376234    -0.47   0.638    -.0914758    .0560247
    location |  -.0976433   .0413402    -2.36   0.018    -.1786792   -.0166073
      lnsize |   .1677534   .0435283     3.85   0.000     .0824282    .2530786
  lnsize_sqr |  -.0023124   .0051261    -0.45   0.652    -.0123607     .007736
       lnage |   .0541005   .0705999     0.77   0.444    -.0842909     .192492
   lnage_sqr |  -.0126955   .0139814    -0.91   0.364    -.0401021    .0147112
foreign_du~y |   .3899163   .0638249     6.11   0.000     .2648052    .5150274
 state_dummy |   -.144939   .0996023    -1.46   0.146    -.3401817    .0503037
      credit |   .1197153     .02731     4.38   0.000     .0661817     .173249
low_mlow_t~h |    .249212   .0846175     2.95   0.003     .0833429    .4150811
  mhigh_tech |   .3929996   .1030005     3.82   0.000     .1910957    .5949036
   high_tech |    .370748   .1896847     1.95   0.051    -.0010764    .7425725
   dcountry1 |  (omitted)
   dcountry2 |   .5521004   .0633028     8.72   0.000     .4280128     .676188
```

```
   dcountry3 |   .2113035   .0865815     2.44   0.015     .0415843    .3810226
   dcountry4 |   .1289907    .090453     1.43   0.154    -.0483174    .3062989
   dcountry5 |   .7445066   .0480242    15.50   0.000     .6503683    .8386448
   dcountry6 |   .2160649   .0459677     4.70   0.000      .125958    .3061718
   dcountry7 |   .0606255   .0919718     0.66   0.510    -.1196598    .2409108
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |   -.272473   .0856229    -3.18   0.001     -.440313   -.1046331
  dcountry13 |   .3634396   .0702093     5.18   0.000     .2258136    .5010656
  dcountry14 |  (omitted)
  dcountry15 |  -.1743992    .127219    -1.37   0.170    -.4237769    .0749785
  dcountry16 |  (omitted)
  dcountry17 |   .2838327   .0742112     3.82   0.000     .1383622    .4293032
  dcountry18 |    .255614   .0843552     3.03   0.002     .0902589    .4209692
  dcountry19 |   .0701405   .0996781     0.70   0.482    -.1252507    .2655317
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -1.974351   .1389474   -14.21   0.000    -2.246719   -1.701984
-------------+----------------------------------------------------------------
      /sigma |   .6708007   .0238161                      .6241159    .7174855
------------------------------------------------------------------------------
  Obs. summary:       8191  left-censored observations at exp_int<=0
                       916     uncensored observations
                        83 right-censored observations at exp_int>=1
```

Table A6.3.6 Tobit vs Probit estimated results

VARIABLES	Tobit	Probit	Adjusted Tobit
emp_edu	0.00210***	0.00458***	0.00329***
emp_trng	0.0275	0.0790**	0.04304
manager_exp	0.00062	0.00154	0.00097
new_org_str	0.0494**	0.0847**	0.07731**
new_prod_serv	0.0531**	0.183***	0.08310
new_methods	0.0283	0.0403	0.04429
location	-0.0521**	-0.0328	-0.08153**
lnsize	0.203***	0.317***	0.31768***
lnsize_sqr	-0.00879**	-0.0111*	-0.01376**
lnage	0.0489	0.027	0.07653
lnage_sqr	-0.016	-0.00734	-0.02504
foreign_dummy	0.375***	0.552***	0.58685***
state_dummy	-0.127	-0.15	-0.19875
credit	0.108***	0.231***	0.16901***

low_mlow_tech	0.379***	0.630***	0.59311***
mhigh_tech	0.529***	0.959***	0.82786***
high_tech	0.536***	0.862***	0.83881***
Constant	-1.990***	-3.308***	-3.11424***
Sigma	**0.639**		
Observations	14,026	14,026	14,026

Table A6.3.7 Tobit Model - Full sample (imputed) estimated results

```
. mi estimate, cmdok: tobit  exp_int emp_edu  emp_trng manager_exp new_org_str
new_prod_serv new_methods  location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit   low_mlow_tech  mhigh_tech high_tech   dcountry1-dcountry7
dcountry9-dcountry30, ll ul nolog vce(robust)

Multiple-imputation estimates                   Imputations      =         22
Tobit regression                                Number of obs    =      15883
                                                Average RVI      =     0.0224
                                                Largest FMI      =     0.0951
                                                Complete DF      =      15837
DF adjustment:   Small sample                   DF:      min     =    2027.65
                                                         avg     =   11216.04
                                                         max     =   15792.24
Model F test:       Equal FMI                   F(  46,15704.8) =      48.16
Within VCE type:       Robust                   Prob > F         =     0.0000

------------------------------------------------------------------------------
     exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0018743   .0003827     4.90   0.000     .0011238    .0026248
    emp_trng |   .0388138   .0189589     2.05   0.041     .0016507    .0759769
 manager_exp |     .00014   .0008882     0.16   0.875    -.0016011    .0018812
 new_org_str |   .0367388    .022871     1.61   0.108    -.0080931    .0815708
new_prod_serv|   .0596503   .0210565     2.83   0.005     .0183767    .1009239
 new_methods |   .0288211   .0239593     1.20   0.229    -.0181424    .0757846
    location |  -.0351879   .0230811    -1.52   0.127    -.0804308    .0100549
      lnsize |   .1888744   .0284834     6.63   0.000     .1330429     .244706
  lnsize_sqr |  -.0080106   .0034718    -2.31   0.021    -.0148158   -.0012054
       lnage |   .0390085   .0514638     0.76   0.449    -.0618848    .1399017
   lnage_sqr |  -.0127993   .0099519    -1.29   0.198    -.0323098    .0067112
foreign_dummy|   .3941954   .0352308    11.19   0.000     .3251318     .463259
 state_dummy |  -.1246663   .0832323    -1.50   0.134    -.2878513    .0385187
      credit |   .1136705   .0182035     6.24   0.000     .0779851    .1493559
low_mlow_tech|   .3799313    .020178    18.83   0.000     .3403792    .4194833
  mhigh_tech |   .5348684   .0272644    19.62   0.000     .4814238     .588313
   high_tech |   .5351004   .0506824    10.56   0.000     .4357552    .6344457
   dcountry1 |   .4952345   .0723977     6.84   0.000     .3533115    .6371576
   dcountry2 |   .5119383    .056802     9.01   0.000     .4005997    .6232769
   dcountry3 |   .1462722   .0798665     1.83   0.067    -.0102752    .3028197
   dcountry4 |   .1363244     .08065     1.69   0.091    -.0217652    .2944141
   dcountry5 |   .7411219   .0373842    19.82   0.000     .6678435    .8144002
   dcountry6 |   .1519668   .0411646     3.69   0.000      .071278    .2326555
   dcountry7 |   .0537628   .0814327     0.66   0.509    -.1058547    .2133804
   dcountry9 |   .5326979   .0463803    11.49   0.000     .4417867     .623609
  dcountry10 |   .5864193   .0500643    11.71   0.000     .4882855     .684553
  dcountry11 |   .7269466   .0508215    14.30   0.000     .6273295    .8265636
  dcountry12 |  -.2479117   .0773326    -3.21   0.001    -.3994929   -.0963305
  dcountry13 |   .3574175   .0651646     5.48   0.000     .2296862    .4851488
  dcountry14 |   .6452783   .0545528    11.83   0.000     .5383467    .7522098
```

```
   dcountry15 |  -.2267146   .1056325    -2.15   0.032    -.4337665   -.0196628
   dcountry16 |   .6572503   .0569215    11.55   0.000     .5456762    .7688244
   dcountry17 |   .2497219   .0679295     3.68   0.000     .1165707     .382873
   dcountry18 |   .2042922    .079573     2.57   0.010       .04832    .3602643
   dcountry19 |   .0024389   .0963588     0.03   0.980    -.1864358    .1913136
   dcountry20 |   .8370378   .0575274    14.55   0.000     .7242764    .9497993
   dcountry21 |    .471005   .0727031     6.48   0.000     .3284982    .6135119
   dcountry22 |   .8198813   .0555642    14.76   0.000     .7109651    .9287975
   dcountry23 |   .5127301   .0627963     8.16   0.000     .3896298    .6358304
   dcountry24 |    .838501   .0556438    15.07   0.000     .7294276    .9475744
   dcountry25 |   .7903505   .0591082    13.37   0.000     .6744536    .9062473
   dcountry26 |   .6988788   .0579195    12.07   0.000     .5853485     .812409
   dcountry27 |   1.040239   .0519735    20.01   0.000     .9383615    1.142117
   dcountry28 |   .5931009   .0652869     9.08   0.000     .4651307    .7210711
   dcountry29 |   .7020224   .0523976    13.40   0.000     .5993144    .8047304
   dcountry30 |   .4140387   .0969025     4.27   0.000     .2240833    .6039942
        _cons |  -1.961091   .0877973   -22.34   0.000    -2.133202   -1.788979
-------------+----------------------------------------------------------------
       /sigma |   .6516277   .0133161    48.94   0.000     .6255264    .6777291
------------------------------------------------------------------------------
```

Table A6.3.8 Tobit (Augumented) Model - Full sample (imputed) estimated results (45)

```
mi estimate, cmdok: tobit  exp_int emp_edu  emp_trng manager_exp skilled_emp
manager_edu_dummy new_org_str new_prod_serv new_methods  location lnsize lnsize_sqr
lnage lnage_sqr foreign_dummy state_dummy credit  f_inputs tech_dummy bus_assoc
low_mlow_tech  mhigh_tech high_tech dcountry1-dcountry7 dcountry9-dcountry30, ll ul
nolog vce(robust)

Multiple-imputation estimates                  Imputations       =         45
Tobit regression                               Number of obs     =      15883
                                               Average RVI       =     0.4607
                                               Largest FMI       =     0.9117
                                               Complete DF       =      15832
DF adjustment:   Small sample                  DF:     min       =      51.43
                                                       avg       =    5095.66
                                                       max       =   15138.39
Model F test:       Equal FMI                  F(  51, 9197.7)  =      30.80
Within VCE type:       Robust                  Prob > F          =     0.0000

----------------------------------------------------------------------------------
          exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+---------------------------------------------------------------
          emp_edu |   .0013039    .000436     2.99   0.003     .0004474    .0021604
         emp_trng |   .0291583   .0196185     1.49   0.137    -.0093084     .067625
      manager_exp |   .0003093   .0009264     0.33   0.739    -.0015073    .0021259
      skilled_emp |   .0001035   .0005071     0.20   0.838    -.0008971    .0011041
manager_edu_dummy |   .0717926   .0395616     1.81   0.073    -.0069939    .1505791
      new_org_str |   .0245275   .0240417     1.02   0.308    -.0226228    .0716778
    new_prod_serv |   .0436343   .0221706     1.97   0.049     .0001598    .0871088
      new_methods |   .0236805   .0243734     0.97   0.331    -.0241009    .0714619
         location |  -.0718337   .0241826    -2.97   0.003    -.1192488   -.0244185
           lnsize |   .1765423   .0293479     6.02   0.000     .1190041    .2340805
       lnsize_sqr |  -.0072172   .0035479    -2.03   0.042    -.0141725   -.0002618
            lnage |   .0300557   .0522163     0.58   0.565    -.0723267     .132438
        lnage_sqr |  -.0106467    .010101    -1.05   0.292    -.0304523     .009159
    foreign_dummy |   .3467769   .0363961     9.53   0.000     .2754031    .4181508
      state_dummy |  -.1051221   .0859617    -1.22   0.221    -.2736936    .0634494
           credit |   .1129136   .0185274     6.09   0.000     .0765889    .1492382
```

```
    f_inputs |   .0025762   .0003617     7.12   0.000     .0018628    .0032895
  tech_dummy |    .071626    .066849     1.07   0.288    -.062175     .205427
   bus_assoc |  -.0103811   .0574783    -0.18   0.857    -.1257501    .1049878
low_mlow_tech |   .3771432   .0225195    16.75   0.000     .3329402    .4213463
  mhigh_tech |   .5102526   .0294463    17.33   0.000     .4524869    .5680183
   high_tech |   .4800699   .0520593     9.22   0.000     .3780038     .582136
   dcountry1 |   .4163387   .0747353     5.57   0.000     .2697837    .5628937
   dcountry2 |   .4511667   .0570368     7.91   0.000     .3393632    .5629702
   dcountry3 |   .1340331   .0807391     1.66   0.097    -.0242279    .2922942
   dcountry4 |   .1144456    .081774     1.40   0.162    -.045854     .2747452
   dcountry5 |   .7608336   .0382279    19.90   0.000     .6858936    .8357736
   dcountry6 |   .1600155    .041442     3.86   0.000     .0787801     .241251
   dcountry7 |   .0690198   .0816451     0.85   0.398    -.0910143     .229054
   dcountry9 |   .5462459   .0491306    11.12   0.000     .4498997    .6425922
  dcountry10 |   .5202572   .0504891    10.30   0.000     .4212802    .6192341
  dcountry11 |   .6982728   .0531515    13.14   0.000     .5940557    .8024898
  dcountry12 |  -.2767649   .0777356    -3.56   0.000    -.429138    -.1243919
  dcountry13 |    .356757   .0695001     5.13   0.000     .2204671     .493047
  dcountry14 |   .6126186   .0554604    11.05   0.000     .5038961    .7213411
  dcountry15 |  -.1773314   .1052613    -1.68   0.092    -.3836568     .028994
  dcountry16 |   .5890826   .0579765    10.16   0.000     .4754268    .7027385
  dcountry17 |   .1777972   .0683959     2.60   0.009     .0437248    .3118696
  dcountry18 |   .1753051   .0802618     2.18   0.029     .0179795    .3326308
  dcountry19 |   .0207517   .0955541     0.22   0.828    -.166547     .2080504
  dcountry20 |   .7271144   .0590511    12.31   0.000     .6113435    .8428854
  dcountry21 |   .3736768   .0751623     4.97   0.000     .2263382    .5210153
  dcountry22 |   .8003856   .0563109    14.21   0.000     .6899898    .9107814
  dcountry23 |   .5115324    .063782     8.02   0.000     .3864787     .636586
  dcountry24 |   .7828465   .0572188    13.68   0.000      .670662    .8950311
  dcountry25 |   .7318888   .0597808    12.24   0.000      .614676    .8491016
  dcountry26 |   .6706151   .0583667    11.49   0.000     .5562024    .7850278
  dcountry27 |   .9868168   .0534313    18.47   0.000     .8820563    1.091577
  dcountry28 |   .5556229   .0648087     8.57   0.000     .4285878    .6826581
  dcountry29 |   .6377109   .0535658    11.91   0.000     .5326918      .74273
  dcountry30 |   .3192309   .0994143     3.21   0.001     .1243205    .5141413
       _cons |  -2.044423   .1171574   -17.45   0.000     -2.27506   -1.813786
-------------+----------------------------------------------------------------
      /sigma |   .6405016   .0131529    48.70   0.000     .6147196    .6662837
------------------------------------------------------------------------------
```

Table A6.3.9 Tobit (Augumented) Model - Full sample (imputed) estimated results (95)

```
mi estimate, cmdok: tobit  exp_int emp_edu  emp_trng manager_exp skilled_emp
manager_edu_dummy new_org_str new_prod_serv new_methods  location lnsize lnsize_sqr
lnage lnage_sqr foreign_dummy state_dummy credit  f_inputs tech_dummy bus_assoc
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30, ll ul
nolog vce(robust)

Multiple-imputation estimates                   Imputations     =         95
Tobit regression                                Number of obs   =      15883
                                                Average RVI     =     0.4364
                                                Largest FMI     =     0.8971
                                                Complete DF     =      15832
DF adjustment:   Small sample                   DF:     min     =     109.52
                                                        avg     =    7025.30
                                                        max     =   15231.48
Model F test:       Equal FMI                   F(  51,12051.1) =      31.27
Within VCE type:       Robust                   Prob > F        =     0.0000

------------------------------------------------------------------------------
```

exp_int	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0013529	.0004277	3.16	0.002	.0005139	.0021919
emp_trng	.0300917	.0196805	1.53	0.126	-.0084906	.0686741
manager_exp	.000279	.0009182	0.30	0.761	-.001521	.0020791
skilled_emp	.0001141	.0004929	0.23	0.817	-.0008546	.0010828
manager_edu_dummy	.066526	.0389459	1.71	0.089	-.0103741	.1434262
new_org_str	.0245475	.0237026	1.04	0.300	-.0219204	.0710154
new_prod_serv	.0445758	.0218747	2.04	0.042	.0016936	.0874579
new_methods	.0236225	.0241406	0.98	0.328	-.0236977	.0709427
location	-.0713619	.0242238	-2.95	0.003	-.1188503	-.0238735
lnsize	.1785022	.0294024	6.07	0.000	.1208636	.2361408
lnsize_sqr	-.0073971	.0035623	-2.08	0.038	-.0143801	-.000414
lnage	.0307843	.0524358	0.59	0.557	-.0720137	.1335822
lnage_sqr	-.0108988	.0101226	-1.08	0.282	-.0307437	.008946
foreign_dummy	.3493532	.0362819	9.63	0.000	.2782229	.4204835
state_dummy	-.1077213	.084483	-1.28	0.202	-.2733395	.057897
credit	.1116801	.0186757	5.98	0.000	.0750679	.1482923
f_inputs	.0025567	.0003433	7.45	0.000	.0018822	.0032311
tech_dummy	.0628288	.0689401	0.91	0.364	-.0736983	.1993559
bus_assoc	-.0050476	.0537317	-0.09	0.925	-.1115365	.1014412
low_mlow_tech	.3786675	.0222972	16.98	0.000	.3349374	.4223975
mhigh_tech	.5109162	.0291844	17.51	0.000	.4536924	.56814
high_tech	.4802331	.0521153	9.21	0.000	.3780699	.5823963
dcountry1	.0944623	.1150777	0.82	0.412	-.1311215	.320046
dcountry2	.4533777	.0573382	7.91	0.000	.3409851	.5657704
dcountry3	.134024	.0807019	1.66	0.097	-.0241623	.2922103
dcountry4	.1140778	.0817645	1.40	0.163	-.0461966	.2743522
dcountry5	.7614621	.0381033	19.98	0.000	.6867718	.8361524
dcountry6	.159687	.0414252	3.85	0.000	.0784869	.2408871
dcountry7	.0693905	.0818233	0.85	0.396	-.090993	.229774
dcountry9	.2240659	.1038621	2.16	0.031	.0204579	.4276739
dcountry10	.1976396	.1033451	1.91	0.056	-.0049451	.4002243
dcountry11	.377671	.1040231	3.63	0.000	.1737542	.5815878
dcountry12	-.2764786	.0777414	-3.56	0.000	-.428862	-.1240952
dcountry13	.357973	.0695393	5.15	0.000	.2216381	.4943078
dcountry14	.2909514	.1054908	2.76	0.006	.084161	.4977417
dcountry15	-.1770782	.1053685	-1.68	0.093	-.3836133	.0294569
dcountry16	.2676142	.106143	2.52	0.012	.0595444	.4756839
dcountry17	.1802221	.0691716	2.61	0.009	.0446295	.3158147
dcountry18	.1738891	.0804654	2.16	0.031	.0161655	.3316126
dcountry19	.0218422	.0956661	0.23	0.819	-.1656753	.2093596
dcountry20	.4055503	.1061522	3.82	0.000	.1974645	.6136362
dcountry21	.0539928	.1166684	0.46	0.644	-.1747035	.2826891
dcountry22	.4771416	.1063156	4.49	0.000	.268733	.6855502
dcountry23	.1876846	.1104138	1.70	0.089	-.0287641	.4041332
dcountry24	.4605867	.1060946	4.34	0.000	.2526096	.6685639
dcountry25	.4089338	.1079628	3.79	0.000	.1972953	.6205724
dcountry26	.3498415	.1078076	3.25	0.001	.1385098	.5611732
dcountry27	.6667387	.1026775	6.49	0.000	.4654663	.8680111
dcountry28	.2352166	.111652	2.11	0.035	.0163497	.4540835
dcountry29	.3167577	.1044087	3.03	0.002	.1120846	.5214309
dcountry30	0	(omitted)				
_cons	-2.044163	.1175773	-17.39	0.000	-2.275111	-1.813214
/sigma	.6411101	.0131891	48.61	0.000	.6152574	.6669629

Table A6.4 Fractional Logit Model - Full sample estimated results

```
glm exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
```

```
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,  family
(binomial) link (logit) vce(robust) nolog
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =      14026
Optimization     : ML                              Residual df     =      13979
                                                   Scale parameter =          1
Deviance         =  3404.399884                    (1/df) Deviance =   .2435367
Pearson          =  11111.60402                    (1/df) Pearson  =   .7948783

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =   .3340025
Log pseudolikelihood = -2295.359377                BIC             =  -130076.4

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0027438   .0014501     1.89   0.058    -.0000982    .0055859
    emp_trng |    .021027   .0667267     0.32   0.753    -.1097549    .1518089
 manager_exp |   .0003349   .0030266     0.11   0.912    -.0055972     .006267
 new_org_str |    .134112   .0795538     1.69   0.092    -.0218105    .2900345
new_prod_s~v |  -.0908554   .0759251    -1.20   0.231    -.2396659    .0579552
 new_methods |   .1201731   .0861926     1.39   0.163    -.0487613    .2891076
    location |   -.306382   .0827391    -3.70   0.000    -.4685477   -.1442163
      lnsize |    .617263   .1068392     5.78   0.000     .4078621     .826664
  lnsize_sqr |  -.0306409   .0124116    -2.47   0.014    -.0549672   -.0063147
       lnage |   .1715372   .1730864     0.99   0.322    -.1677059    .5107802
   lnage_sqr |  -.0658054    .033514    -1.96   0.050    -.1314917   -.0001191
foreign_du~y |   1.037427   .1052409     9.86   0.000     .8311583    1.243695
 state_dummy |  -.7643528   .3174622    -2.41   0.016    -1.386567   -.1421383
      credit |   .1877893   .0626682     3.00   0.003     .0649619    .3106167
low_mlow_t~h |   1.176837   .0730739    16.10   0.000     1.033614    1.320059
  mhigh_tech |   1.497412   .0953806    15.70   0.000     1.310469    1.684354
   high_tech |   1.659743   .1687179     9.84   0.000     1.329062    1.990424
   dcountry1 |   2.128335   .2466171     8.63   0.000     1.644974    2.611695
   dcountry2 |   1.623519   .2184044     7.43   0.000     1.195454    2.051583
   dcountry3 |   1.013827    .320547     3.16   0.002     .3855664    1.642088
   dcountry4 |   .9823349    .303404     3.24   0.001     .3876741    1.576996
   dcountry5 |   2.141768   .1362351    15.72   0.000     1.874753    2.408784
   dcountry6 |   .7999487   .1610737     4.97   0.000     .4842501    1.115647
   dcountry7 |   .6793582   .3091109     2.20   0.028     .0735119    1.285204
   dcountry9 |   1.531628   .1982625     7.73   0.000     1.143041    1.920216
  dcountry10 |   2.106969   .1712329    12.30   0.000     1.771359     2.44258
  dcountry11 |   2.068155   .1940215    10.66   0.000     1.687879     2.44843
  dcountry12 |  -.5166834   .3774891    -1.37   0.171    -1.256549    .2231817
  dcountry13 |    1.03157   .2619943     3.94   0.000     .5180703    1.545069
  dcountry14 |   2.139024   .1945291    11.00   0.000     1.757754    2.520294
  dcountry15 |  -.4684652   .4926297    -0.95   0.342    -1.434002    .4970712
  dcountry16 |    2.13868   .2040712    10.48   0.000     1.738708    2.538653
  dcountry17 |    1.13357   .2618898     4.33   0.000     .6202758    1.646865
  dcountry18 |   1.188024   .2556076     4.65   0.000      .687042    1.689005
  dcountry19 |    .887503   .3245708     2.73   0.006     .2513559     1.52365
  dcountry20 |   2.794963   .1946146    14.36   0.000     2.413525    3.176401
  dcountry21 |   1.453751   .2882177     5.04   0.000     .8888543    2.018647
  dcountry22 |   2.546862   .1852243    13.75   0.000     2.183829    2.909895
  dcountry23 |   1.650954   .2368168     6.97   0.000     1.186802    2.115107
  dcountry24 |   2.784576    .199835    13.93   0.000     2.392907    3.176245
  dcountry25 |   2.560467   .2038771    12.56   0.000     2.160875    2.960059
  dcountry26 |   2.096936   .2110445     9.94   0.000     1.683296    2.510575
  dcountry27 |    2.91726    .187338    15.57   0.000     2.550085    3.284436
```

```
  dcountry28 |   2.219339   .2089809    10.62   0.000     1.809744    2.628934
  dcountry29 |   2.225024   .1943692    11.45   0.000     1.844067    2.605981
  dcountry30 |   1.385678   .3761382     3.68   0.000     .6484604    2.122895
       _cons |  -6.813577   .3095658   -22.01   0.000    -7.420315   -6.206839
------------------------------------------------------------------------------
```

Table A6.4.1 Fractional Logit Model - Industry estimated results

```
glm exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,  family (binomial)
link (logit) vce(robust) nolog
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =     14026
Optimization     : ML                              Residual df     =     13970
                                                   Scale parameter =         1
Deviance         =  3370.207044                    (1/df) Deviance =   .241246
Pearson          =  9970.442738                    (1/df) Pearson  =  .7137038

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =   .332848
Log pseudolikelihood = -2278.262957                BIC             = -130024.7

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0095017   .0020769     4.57   0.000     .0054311    .0135723
    emp_trng |  -.1888204   .1225146    -1.54   0.123    -.4289446    .0513039
 manager_exp |  -.0103258    .006261    -1.65   0.099     -.022597    .0019455
int_edu_lo~w |  -.0175806   .0029578    -5.94   0.000    -.0233778   -.0117835
int_edu_mh~h |  -.0080311   .0036907    -2.18   0.030    -.0152648   -.0007975
int_edu_h~ch |   -.004813   .0053015    -0.91   0.364    -.0152038    .0055777
int_trng_l~w |   .2779296   .1422523     1.95   0.051    -.0008798    .5567391
int_trng_m~h |   .5432421   .1859965     2.92   0.003     .1786957    .9077885
int_trng_h~h |   -.046364    .321518    -0.14   0.885    -.6765278    .5837997
int_mngexp~w |   .0131328   .0072534     1.81   0.070    -.0010837    .0273492
int_mn~mhigh |    .014489   .0090142     1.61   0.108    -.0031786    .0321566
int_mn~_high |   .0231996   .0166104     1.40   0.163    -.0093562    .0557554
 new_org_str |   .1334841   .0801744     1.66   0.096    -.0236549    .2906231
new_prod_s~v |  -.1054844    .076692    -1.38   0.169    -.2557981    .0448292
 new_methods |   .1288655   .0864763     1.49   0.136     -.040625     .298356
    location |  -.2920239   .0840998    -3.47   0.001    -.4568565   -.1271914
      lnsize |   .6311244   .1064993     5.93   0.000     .4223895    .8398593
  lnsize_sqr |  -.0317669   .0123398    -2.57   0.010    -.0559525   -.0075813
       lnage |    .199283   .1738829     1.15   0.252    -.1415212    .5400873
   lnage_sqr |  -.0683855   .0335623    -2.04   0.042    -.1341665   -.0026045
foreign_du~y |   1.036498   .1054705     9.83   0.000     .8297799    1.243217
 state_dummy |  -.7701926   .3147594    -2.45   0.014     -1.38711   -.1532755
      credit |   .1921232   .0629388     3.05   0.002     .0687655     .315481
low_mlow_t~h |   1.221717   .1821611     6.71   0.000     .8646881    1.578747
  mhigh_tech |   1.220163   .2423213     5.04   0.000     .7452215    1.695104
   high_tech |   1.391615   .4899842     2.84   0.005     .4312636    2.351966
   dcountry1 |    2.06457   .2458516     8.40   0.000      1.58271    2.546431
   dcountry2 |   1.644286   .2192695     7.50   0.000     1.214526    2.074046
   dcountry3 |   1.013096   .3233735     3.13   0.002     .3792953    1.646896
   dcountry4 |   .9823708   .3053495     3.22   0.001     .3838967    1.580845
```

```
   dcountry5 |   2.060892   .1408951    14.63   0.000     1.784743    2.337042
   dcountry6 |   .9057214   .1604495     5.64   0.000     .5912461    1.220197
   dcountry7 |   .6683748   .3114712     2.15   0.032     .0579025    1.278847
   dcountry9 |   1.492964   .1993947     7.49   0.000     1.102157     1.88377
  dcountry10 |   2.097426    .174082    12.05   0.000     1.756232    2.438621
  dcountry11 |   2.055384   .1953647    10.52   0.000     1.672476    2.438292
  dcountry12 |  -.4861534   .3765782    -1.29   0.197    -1.224233    .2519263
  dcountry13 |   1.020487    .263717     3.87   0.000     .5036107    1.537362
  dcountry14 |   2.135978   .1954581    10.93   0.000     1.752887    2.519069
  dcountry15 |  -.4832532    .494399    -0.98   0.328    -1.452257     .485751
  dcountry16 |   2.108962   .2056481    10.26   0.000       1.7059    2.512025
  dcountry17 |   1.108913   .2628147     4.22   0.000     .5938061    1.624021
  dcountry18 |   1.211718   .2562351     4.73   0.000     .7095062    1.713929
  dcountry19 |   .9173762   .3235677     2.84   0.005     .2831952    1.551557
  dcountry20 |   2.808926   .1953003    14.38   0.000     2.426144    3.191707
  dcountry21 |   1.463194   .2902215     5.04   0.000     .8943706    2.032018
  dcountry22 |   2.505846   .1883239    13.31   0.000     2.136738    2.874954
  dcountry23 |   1.657912   .2384759     6.95   0.000     1.190508    2.125316
  dcountry24 |   2.812505   .1993731    14.11   0.000     2.421741    3.203269
  dcountry25 |   2.571521   .2004568    12.83   0.000     2.178633    2.964409
  dcountry26 |   2.072395   .2133858     9.71   0.000     1.654167    2.490623
  dcountry27 |   2.958151   .1882912    15.71   0.000     2.589107    3.327195
  dcountry28 |   2.233142   .2119681    10.54   0.000     1.817692    2.648591
  dcountry29 |   2.232131   .1958595    11.40   0.000     1.848254    2.616009
  dcountry30 |   1.413336   .3730124     3.79   0.000     .6822451    2.144427
       _cons |  -6.829475   .3277246   -20.84   0.000    -7.471804   -6.187147
------------------------------------------------------------------------------
```

Table A6.4.2 Fractional Logit Model - CEECs Estimated results

```
. glm exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==1, family(binomial) link (logit) vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =      4836
Optimization     : ML                              Residual df     =      4802
                                                   Scale parameter =         1
Deviance         =   1687.75092                    (1/df) Deviance =  .3514683
Pearson          =  3299.257718                    (1/df) Pearson  =  .6870591

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =  .4927415
Log pseudolikelihood = -1157.448919                BIC             = -39051.66

------------------------------------------------------------------------------
```

exp_int	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
emp_edu	.0017613	.0021458	0.82	0.412	-.0024444	.0059669
emp_trng	-.1454	.0913475	-1.59	0.111	-.3244379	.0336379
manager_exp	-.000244	.0042074	-0.06	0.954	-.0084903	.0080023
new_org_str	.1846964	.1087626	1.70	0.089	-.0284744	.3978672
new_prod_s~v	-.1080164	.1000092	-1.08	0.280	-.3040309	.0879981
new_methods	.1590174	.1136494	1.40	0.162	-.0637314	.3817662
location	-.2001939	.1024986	-1.95	0.051	-.4010875	.0006998
lnsize	.8039626	.1514248	5.31	0.000	.5071754	1.10075
lnsize_sqr	-.0557085	.0184896	-3.01	0.003	-.0919475	-.0194694
lnage	-.0827023	.267509	-0.31	0.757	-.6070103	.4416057
lnage_sqr	-.0340269	.0504671	-0.67	0.500	-.1329407	.0648869
foreign_du~y	1.01841	.1303709	7.81	0.000	.7628877	1.273932
state_dummy	-2.490272	.5356572	-4.65	0.000	-3.54014	-1.440403
credit	.163795	.0875514	1.87	0.061	-.0078026	.3353927
low_mlow_t~h	1.410814	.0907471	15.55	0.000	1.232953	1.588675
mhigh_tech	1.670082	.1317273	12.68	0.000	1.411902	1.928263
high_tech	1.973209	.2382896	8.28	0.000	1.50617	2.440248
dcountry1	.6655137	.4174767	1.59	0.111	-.1527255	1.483753
dcountry2	(omitted)					
dcountry3	(omitted)					
dcountry4	(omitted)					
dcountry5	(omitted)					
dcountry6	(omitted)					
dcountry7	(omitted)					
dcountry9	.1997442	.3950651	0.51	0.613	-.5745692	.9740576
dcountry10	.7344388	.3807748	1.93	0.054	-.0118661	1.480744
dcountry11	.6805161	.3876536	1.76	0.079	-.079271	1.440303
dcountry12	(omitted)					
dcountry13	(omitted)					
dcountry14	.7855378	.3895881	2.02	0.044	.0219591	1.549116
dcountry15	(omitted)					
dcountry16	.7393048	.3913658	1.89	0.059	-.027758	1.506368
dcountry17	(omitted)					
dcountry18	(omitted)					
dcountry19	(omitted)					
dcountry20	1.421622	.3867192	3.68	0.000	.6636664	2.179578
dcountry21	.0092621	.4499003	0.02	0.984	-.8725263	.8910505
dcountry22	1.20316	.3883132	3.10	0.002	.4420805	1.96424
dcountry23	.24344	.4096864	0.59	0.552	-.5595305	1.046411
dcountry24	1.385502	.3919257	3.54	0.000	.617342	2.153663
dcountry25	1.163118	.3994276	2.91	0.004	.3802546	1.945982
dcountry26	.730379	.4022521	1.82	0.069	-.0580206	1.518779
dcountry27	1.619657	.3840092	4.22	0.000	.867013	2.372301
dcountry28	.8665313	.3974431	2.18	0.029	.0875571	1.645505
dcountry29	.8696635	.3878155	2.24	0.025	.1095591	1.629768
dcountry30	(omitted)					
_cons	-5.366953	.5525822	-9.71	0.000	-6.449994	-4.283912

Table A6.4.3 Fractional Logit Model - CEECs Industry estimated results

```
. glm exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if CEEC_dummy==1,
family (binomial) link (logit) vce(robust) nolog
note: dcountry2 omitted because of collinearity
```

```
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =       4836
Optimization     : ML                              Residual df     =       4793
                                                   Scale parameter =          1
Deviance         =  1668.404801                    (1/df) Deviance =    .348092
Pearson          =  3269.704952                    (1/df) Pearson  =   .6821834

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =   .4924631
Log pseudolikelihood = -1147.775859                BIC             =  -38994.66

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0080857   .0027859     2.90   0.004     .0026255    .0135459
    emp_trng |  -.2775184   .1517203    -1.83   0.067    -.5748848    .0198481
 manager_exp |  -.0061076   .0074423    -0.82   0.412    -.0206943    .0084791
int_edu_lo~w |  -.0206273   .0045226    -4.56   0.000    -.0294914   -.0117631
int_edu_mh~h |  -.0123853   .0064416    -1.92   0.055    -.0250106      .00024
int_edu_h~ch |   .0061983   .0074179     0.84   0.403    -.0083405     .020737
int_trng_l~w |   .1646195   .1835664     0.90   0.370    -.1951641     .524403
int_trng_m~h |   .6271344   .2638085     2.38   0.017     .1100793     1.14419
int_trng_h~h |  -.3712553   .4546001    -0.82   0.414    -1.262255    .5197446
int_mngexp~w |   .0101251   .0092473     1.09   0.274    -.0079993    .0282494
int_mn~mhigh |   .0062718   .0137404     0.46   0.648    -.0206589    .0332026
int_mn~_high |   .0069807   .0227764     0.31   0.759    -.0376603    .0516216
 new_org_str |   .1811958   .1093046     1.66   0.097    -.0330373    .3954289
new_prod_s~v |  -.1152542   .1004567    -1.15   0.251    -.3121456    .0816372
 new_methods |   .1615438   .1137789     1.42   0.156    -.0614588    .3845464
    location |  -.1859622   .1029417    -1.81   0.071    -.3877242    .0157998
      lnsize |   .8121207   .1516285     5.36   0.000     .5149343    1.109307
  lnsize_sqr |  -.0562215   .0185138    -3.04   0.002    -.0925078   -.0199351
       lnage |  -.0860112   .2654075    -0.32   0.746    -.6062004     .434178
   lnage_sqr |  -.0288862    .050031    -0.58   0.564    -.1269452    .0691727
foreign_du~y |   1.020921   .1304144     7.83   0.000     .7653131    1.276528
 state_dummy |  -2.346172   .5238666    -4.48   0.000    -3.372932   -1.319413
      credit |     .16647   .0879022     1.89   0.058    -.0058151    .3387552
low_mlow_t~h |   1.474692    .222257     6.64   0.000     1.039077    1.910308
  mhigh_tech |     1.5305   .3468738     4.41   0.000     .8506394     2.21036
   high_tech |   1.810751    .642195     2.82   0.005     .5520717     3.06943
   dcountry1 |    .620355   .4100339     1.51   0.130    -.1832966    1.424007
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
```

```
    dcountry9 |   .1371329   .3905636     0.35   0.726    -.6283576    .9026234
   dcountry10 |   .7054218   .3747196     1.88   0.060    -.0290153    1.439859
   dcountry11 |   .6512207   .3810676     1.71   0.087     -.095658    1.398099
   dcountry12 |  (omitted)
   dcountry13 |  (omitted)
   dcountry14 |   .7471212   .3840393     1.95   0.052    -.0055821    1.499824
   dcountry15 |  (omitted)
   dcountry16 |   .6913543   .3864028     1.79   0.074    -.0659812     1.44869
   dcountry17 |  (omitted)
   dcountry18 |  (omitted)
   dcountry19 |  (omitted)
   dcountry20 |   1.402797   .3801983     3.69   0.000      .657622    2.147972
   dcountry21 |   .0053183   .4460561     0.01   0.990    -.8689355    .8795722
   dcountry22 |   1.105441   .3830959     2.89   0.004     .3545871    1.856295
   dcountry23 |   .2132465   .4043682     0.53   0.598    -.5793006    1.005794
   dcountry24 |   1.407361   .3845353     3.66   0.000     .6536858    2.161036
   dcountry25 |   1.171204   .3910023     3.00   0.003     .4048539    1.937555
   dcountry26 |   .6863615   .3966408     1.73   0.084    -.0910403    1.463763
   dcountry27 |   1.596139   .3782593     4.22   0.000     .8547644    2.337514
   dcountry28 |   .8720452   .3923906     2.22   0.026     .1029737    1.641117
   dcountry29 |   .8254672   .3817831     2.16   0.031     .0771861    1.573748
   dcountry30 |  (omitted)
        _cons |  -5.370946   .5652269    -9.50   0.000     -6.47877   -4.263121
------------------------------------------------------------------------------
```

Table A6.4.4 Fractional Logit Model - CIS estimated results

```
. glm exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==0, family(binomial) link (logit) vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =       9190
Optimization     : ML                              Residual df     =       9160
                                                   Scale parameter =          1
Deviance         =  1688.449297                    (1/df) Deviance =   .1843285
Pearson          =  6739.378672                    (1/df) Pearson  =     .73574

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =   .2511013
Log pseudolikelihood = -1123.810624                BIC             =  -81904.53
```

```
------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0032442   .0019962     1.63   0.104    -.0006683    .0071568
    emp_trng |   .2317898    .100039     2.32   0.021      .035717    .4278625
 manager_exp |  -.0002822   .0044592    -0.06   0.950     -.009022    .0084576
 new_org_str |   .1007015   .1133162     0.89   0.374    -.1213943    .3227972
 new_prod_s~v |  -.0804533    .119782    -0.67   0.502    -.3152218    .1543152
 new_methods |   .0496682   .1304808     0.38   0.703    -.2060694    .3054058
    location |  -.4150873   .1423359    -2.92   0.004    -.6940606   -.1361139
      lnsize |   .4741469   .1572272     3.02   0.003     .1659872    .7823067
  lnsize_sqr |  -.0133453    .017351    -0.77   0.442    -.0473526     .020662
       lnage |   .2946307   .2374599     1.24   0.215    -.1707821    .7600435
   lnage_sqr |   -.070574   .0468087    -1.51   0.132    -.1623173    .0211692
foreign_du~y |   1.128523   .1870261     6.03   0.000      .761959    1.495088
 state_dummy |  -.6516135   .3448879    -1.89   0.059    -1.327581    .0243545
      credit |   .2076685   .0911697     2.28   0.023     .0289793    .3863578
low_mlow_t~h |    .728679   .1172268     6.22   0.000     .4989187    .9584393
  mhigh_tech |   1.097688   .1396414     7.86   0.000     .8239963     1.37138
   high_tech |    1.09276   .2327222     4.70   0.000     .6366328    1.548887
   dcountry1 |  (omitted)
   dcountry2 |   1.608128   .2259552     7.12   0.000     1.165264    2.050993
   dcountry3 |   1.084192    .325146     3.33   0.001     .4469171    1.721466
   dcountry4 |   1.009798   .3052487     3.31   0.001     .4115212    1.608074
   dcountry5 |   2.235528   .1488395    15.02   0.000     1.943808    2.527248
   dcountry6 |   .9379206   .1634239     5.74   0.000     .6176155    1.258226
   dcountry7 |    .677846   .3311272     2.05   0.041     .0288487    1.326843
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -.5145481   .3736964    -1.38   0.169     -1.24698    .2178835
  dcountry13 |   1.048227   .2657146     3.94   0.000     .5274361    1.569018
  dcountry14 |  (omitted)
  dcountry15 |  -.4185436   .5027121    -0.83   0.405    -1.403841    .5667541
  dcountry16 |  (omitted)
  dcountry17 |   1.174831   .2783516     4.22   0.000     .6292719     1.72039
  dcountry18 |   1.191434   .2663903     4.47   0.000     .6693181    1.713549
  dcountry19 |    .894545   .3241381     2.76   0.006     .2592459    1.529844
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -6.634003   .4166082   -15.92   0.000     -7.45054   -5.817466
```

Table A6.4.5 Fractional Logit Model - CIS Industry estimated results

```
. glm exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
```

```
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if CEEC_dummy==0,
family (binomial) link (logit) vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_int has noninteger values

Generalized linear models                          No. of obs      =      9190
Optimization     : ML                              Residual df     =      9151
                                                   Scale parameter =         1
Deviance         =  1679.196327                    (1/df) Deviance =  .1834987
Pearson          =   6309.12407                    (1/df) Pearson  =  .6894464

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =  .2520531
Log pseudolikelihood = -1119.184139                BIC             = -81831.65

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0079324   .0034204     2.32   0.020     .0012285    .0146362
    emp_trng |   .0231223   .2047002     0.11   0.910    -.3780827    .4243273
 manager_exp |  -.0130852   .0110485    -1.18   0.236    -.0347398    .0085695
int_edu_lo~w |  -.0115447   .0044516    -2.59   0.010    -.0202696   -.0028197
int_edu_mh~h |   -.001142   .0050357    -0.23   0.821    -.0110117    .0087278
int_edu_h~ch |  -.0075098   .0072776    -1.03   0.302    -.0217735     .006754
int_trng_l~w |   .2587803   .2295431     1.13   0.260     -.191116    .7086765
int_trng_m~h |   .3416354   .2759935     1.24   0.216    -.1993019    .8825726
int_trng_h~h |   .4195331   .4591534     0.91   0.361    -.4803909    1.319457
int_mngexp~w |    .012931   .0120724     1.07   0.284    -.0107304    .0365925
int_mn~mhigh |    .019221   .0134074     1.43   0.152     -.007057     .045499
int_mn~_high |   .0360097   .0240141     1.50   0.134    -.0110569    .0830764
 new_org_str |   .0961799   .1147002     0.84   0.402    -.1286283    .3209882
new_prod_s~v |  -.0852325   .1216713    -0.70   0.484    -.3237038    .1532388
 new_methods |   .0628691   .1318728     0.48   0.634    -.1955969    .3213351
    location |  -.4167678   .1447772    -2.88   0.004    -.7005259   -.1330098
      lnsize |   .4885961   .1576886     3.10   0.002     .1795321    .7976601
  lnsize_sqr |    -.01482    .017396    -0.85   0.394    -.0489154    .0192755
       lnage |   .3528084   .2417289     1.46   0.144    -.1209716    .8265884
   lnage_sqr |  -.0812144    .047601    -1.71   0.088    -.1745107    .0120819
foreign_du~y |   1.129043   .1873205     6.03   0.000     .7619017    1.496185
 state_dummy |  -.6689112    .330178    -2.03   0.043    -1.316048   -.0217743
      credit |   .2149451   .0911951     2.36   0.018     .0362059    .3936843
low_mlow_t~h |   .7854361    .328387     2.39   0.017     .1418095    1.429063
  mhigh_tech |   .7184119    .375598     1.91   0.056    -.0177467     1.45457
```

```
   high_tech |   .5499959   .7122304     0.77   0.440      -.84595    1.945942
   dcountry1 |  (omitted)
   dcountry2 |   1.634832   .2272724     7.19   0.000     1.189386    2.080277
   dcountry3 |   1.064561   .3322871     3.20   0.001     .4132905    1.715832
   dcountry4 |   1.020354    .306811     3.33   0.001     .4190159    1.621693
   dcountry5 |   2.191189   .1582912    13.84   0.000     1.880944    2.501434
   dcountry6 |   .9861395   .1638762     6.02   0.000     .6649481    1.307331
   dcountry7 |   .7023536   .3344004     2.10   0.036     .0469408    1.357766
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -.4955244   .3753842    -1.32   0.187    -1.231264    .2402152
  dcountry13 |   1.071351    .268342     3.99   0.000     .5454099    1.597291
  dcountry14 |  (omitted)
  dcountry15 |   -.398823   .5030811    -0.79   0.428    -1.384844    .5871979
  dcountry16 |  (omitted)
  dcountry17 |   1.169319   .2821149     4.14   0.000     .6163839    1.722254
  dcountry18 |   1.245564   .2684347     4.64   0.000     .7194413    1.771686
  dcountry19 |   .9456964   .3245551     2.91   0.004       .30958    1.581813
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -6.672655    .474817   -14.05   0.000    -7.603279    -5.74203
------------------------------------------------------------------------------
```

Table A6.4.6 Fractional Logit Model - Full sample (imputed) estimated results

```
. mi estimate, cmdok: glm exp_int emp_edu  emp_trng manager_exp new_org_str
new_prod_serv new_methods  location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit   low_mlow_tech  mhigh_tech high_tech   dcountry1-dcountry7
dcountry9-dcountry30, family(binomial) link (logit) nolog vce(robust)

Multiple-imputation estimates                   Imputations     =         22
Generalized linear models                       Number of obs   =      15883
                                                Average RVI     =     0.0263
                                                Largest FMI     =     0.1191
DF adjustment:   Large sample                   DF:      min    =    1509.34
                                                         avg    = 1030911.15
                                                         max    =   1.74e+07
Model F test:       Equal FMI                   F(  46, 1.4e+06)=      36.91
Within VCE type:       Robust                   Prob > F        =     0.0000

------------------------------------------------------------------------------
      exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
      emp_edu |   .0020798   .0014111     1.47   0.141    -.0006879    .0048475
     emp_trng |   .0404873   .0635058     0.64   0.524    -.0839947    .1649693
  manager_exp |  -.0011939   .0029071    -0.41   0.681    -.0068922    .0045045
  new_org_str |   .0966521   .0759569     1.27   0.203    -.0522319    .2455361
new_prod_serv |  -.0794244   .0721101    -1.10   0.271    -.2207599    .0619112
  new_methods |   .1549107   .0806776     1.92   0.055     -.003216    .3130374
     location |  -.2510777   .0773108    -3.25   0.001    -.4026096   -.0995458
       lnsize |   .5475406   .0968486     5.65   0.000     .3577174    .7373637
   lnsize_sqr |  -.0259259   .0112198    -2.31   0.021    -.0479168   -.0039351
```

```
         lnage |   .1541692   .1722761     0.89   0.371    -.1836192    .4919577
     lnage_sqr |  -.0563979   .0332776    -1.69   0.090    -.1216512    .0088553
 foreign_dummy |   1.060789   .0989622    10.72   0.000        .8668    1.254778
   state_dummy |   -.567039   .2896199    -1.96   0.050    -1.135139     .001061
        credit |   .1961067   .0596436     3.29   0.001     .0791911    .3130223
 low_mlow_tech |   1.133575   .0687367    16.49   0.000     .9988523    1.268298
    mhigh_tech |   1.468065   .0907017    16.19   0.000     1.290281    1.645849
     high_tech |   1.588617   .1612006     9.85   0.000     1.272661    1.904573
     dcountry1 |    1.89705   .2286038     8.30   0.000     1.448948    2.345152
     dcountry2 |   1.627445   .2040755     7.97   0.000     1.227464    2.027427
     dcountry3 |   .8788474   .3072469     2.86   0.004     .2766545     1.48104
     dcountry4 |   .9798362   .2746442     3.57   0.000     .4415386    1.518134
     dcountry5 |   2.203165   .1273016    17.31   0.000     1.953655    2.452675
     dcountry6 |   .7610562   .1513907     5.03   0.000     .4643295    1.057783
     dcountry7 |   .6171069   .2907582     2.12   0.034     .0472305    1.186983
     dcountry9 |   1.575112   .1702452     9.25   0.000     1.241437    1.908787
    dcountry10 |   2.096529   .1642024    12.77   0.000     1.774692    2.418366
    dcountry11 |   1.969772   .1878215    10.49   0.000     1.601646    2.337897
    dcountry12 |  -.4563859   .3426784    -1.33   0.183    -1.128024    .2152524
    dcountry13 |   1.159093    .247312     4.69   0.000     .6743686    1.643818
    dcountry14 |    2.05887    .188863    10.90   0.000     1.688702    2.429037
    dcountry15 |  -.7296794   .4521907    -1.61   0.107    -1.615957    .1565982
    dcountry16 |   2.095919   .1961995    10.68   0.000     1.711373    2.480464
    dcountry17 |   1.136797   .2559109     4.44   0.000     .6352195    1.638375
    dcountry18 |   1.166341   .2495385     4.67   0.000     .6772544    1.655428
    dcountry19 |   .8005791    .320607     2.50   0.013     .1722002    1.428958
    dcountry20 |   2.587127   .1846981    14.01   0.000     2.225124    2.949131
    dcountry21 |   1.361159   .2853935     4.77   0.000     .8017974     1.92052
    dcountry22 |    2.44943   .1800125    13.61   0.000     2.096595    2.802264
    dcountry23 |   1.680224   .2173976     7.73   0.000     1.254102    2.106345
    dcountry24 |    2.64075   .1803224    14.64   0.000     2.287316    2.994183
    dcountry25 |    2.57224   .1855756    13.86   0.000     2.208436    2.936044
    dcountry26 |   2.091844   .1945615    10.75   0.000     1.710508     2.47318
    dcountry27 |   2.855409   .1802659    15.84   0.000     2.502085    3.208732
    dcountry28 |   2.151636   .2017708    10.66   0.000      1.75617    2.547101
    dcountry29 |    2.12955   .1877747    11.34   0.000     1.761512    2.497588
    dcountry30 |   1.409625   .3167513     4.45   0.000      .788755    2.030496
         _cons |  -6.573009   .2934331   -22.40   0.000    -7.148183   -5.997836
------------------------------------------------------------------------------
```

Table A6.4.7 Fractional Logit (Augumented) Model - Full sample (imputed) estimated results (45)

```
mi estimate, cmdok: glm  exp_int emp_edu  emp_trng manager_exp skilled_emp
manager_edu_dummy new_org_str new_prod_serv new_methods  location lnsize lnsize_sqr
lnage lnage_sqr foreign_dummy state_dummy credit  f_inputs tech_dummy bus_assoc
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
family(binomial) link (logit) nolog vce(robust)

Multiple-imputation estimates                   Imputations     =         45
Generalized linear models                       Number of obs   =      15883
                                                Average RVI     =     0.5753
                                                Largest FMI     =     0.9295
DF adjustment:   Large sample                   DF:     min     =      51.22
                                                        avg     =   52034.33
                                                        max     = 1032614.00
Model F test:       Equal FMI                   F(  51,16572.9) =      23.57
Within VCE type:       Robust                   Prob > F        =     0.0000

----------------------------------------------------------------------------------
```

exp_int	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0003259	.001604	0.20	0.839	-.0028242	.0034761
emp_trng	.0091563	.0670405	0.14	0.891	-.1222953	.140608
manager_exp	-.0011576	.0030837	-0.38	0.707	-.0072036	.0048884
skilled_emp	.0014431	.0016479	0.88	0.382	-.0018056	.0046919
manager_edu_dummy	.2430277	.1397042	1.74	0.086	-.0355192	.5215747
new_org_str	.0630101	.0813389	0.77	0.439	-.0965113	.2225314
new_prod_serv	-.133034	.0770572	-1.73	0.084	-.2841287	.0180608
new_methods	.1366219	.0840243	1.63	0.104	-.0280918	.3013356
location	-.3672119	.0822358	-4.47	0.000	-.5284476	-.2059763
lnsize	.5027445	.1023061	4.91	0.000	.3021746	.7033143
lnsize_sqr	-.023026	.0118585	-1.94	0.052	-.0462738	.0002217
lnage	.1130181	.1772855	0.64	0.524	-.234588	.4606241
lnage_sqr	-.0463032	.0343195	-1.35	0.177	-.1135996	.0209931
foreign_dummy	.9216534	.1078802	8.54	0.000	.7100359	1.133271
state_dummy	-.513116	.2989287	-1.72	0.086	-1.099422	.0731895
credit	.2054526	.0621142	3.31	0.001	.0836712	.3272339
f_inputs	.0089324	.0011624	7.68	0.000	.0066416	.0112233
tech_dummy	.2706979	.255887	1.06	0.295	-.2419962	.783392
bus_assoc	-.0322826	.2124458	-0.15	0.880	-.4587403	.3941752
low_mlow_tech	1.135919	.0778912	14.58	0.000	.9830445	1.288794
mhigh_tech	1.405501	.1014561	13.85	0.000	1.206434	1.604568
high_tech	1.40841	.1714351	8.22	0.000	1.07227	1.744549
dcountry1	1.624611	.24174	6.72	0.000	1.150547	2.098674
dcountry2	1.424195	.2071967	6.87	0.000	1.018088	1.830302
dcountry3	.8120408	.3121394	2.60	0.009	.2002497	1.423832
dcountry4	.9005636	.283028	3.18	0.001	.3458128	1.455314
dcountry5	2.314496	.1321697	17.51	0.000	2.055411	2.573581
dcountry6	.7819036	.1542417	5.07	0.000	.4795831	1.084224
dcountry7	.660658	.2973905	2.22	0.026	.077782	1.243534
dcountry9	1.632481	.1823785	8.95	0.000	1.274899	1.990063
dcountry10	1.867783	.1683486	11.09	0.000	1.537799	2.197767
dcountry11	1.882319	.1990202	9.46	0.000	1.492137	2.272502
dcountry12	-.5921861	.345023	-1.72	0.086	-1.268422	.0840494
dcountry13	1.145231	.2633692	4.35	0.000	.6288613	1.6616
dcountry14	1.956453	.1943081	10.07	0.000	1.57558	2.337326
dcountry15	-.5459727	.456211	-1.20	0.231	-1.440131	.3481855
dcountry16	1.854229	.2039785	9.09	0.000	1.454392	2.254066
dcountry17	.9080919	.2611775	3.48	0.001	.396168	1.420016
dcountry18	1.049974	.2556707	4.11	0.000	.5488577	1.551091
dcountry19	.8667762	.3221062	2.69	0.007	.2354567	1.498096
dcountry20	2.226989	.1930905	11.53	0.000	1.84848	2.605499
dcountry21	1.021743	.2949117	3.46	0.001	.4437103	1.599775
dcountry22	2.415833	.1849648	13.06	0.000	2.053262	2.778404
dcountry23	1.678916	.2255597	7.44	0.000	1.236726	2.121106
dcountry24	2.462324	.1906101	12.92	0.000	2.088649	2.835998
dcountry25	2.384563	.1925896	12.38	0.000	2.007026	2.762101
dcountry26	2.020744	.1982717	10.19	0.000	1.632125	2.409362
dcountry27	2.704158	.1883631	14.36	0.000	2.334917	3.073399
dcountry28	2.015692	.2060533	9.78	0.000	1.611825	2.419558
dcountry29	1.920396	.1930582	9.95	0.000	1.541961	2.298831
dcountry30	1.076325	.3243124	3.32	0.001	.4405513	1.712098
_cons	-7.021303	.4172112	-16.83	0.000	-7.843822	-6.198784

Table A6.4.8 Fractional Logit (Augumented) Model - Full sample (imputed) estimated results (95)

```
mi   estimate,   cmdok:   glm     exp_int   emp_edu     emp_trng   manager_exp   skilled_emp
manager_edu_dummy  new_org_str  new_prod_serv  new_methods   location  lnsize  lnsize_sqr
lnage   lnage_sqr   foreign_dummy   state_dummy   credit    f_inputs   tech_dummy   bus_assoc
```

```
low_mlow_tech   mhigh_tech   high_tech    dcountry1-dcountry7  dcountry9-dcountry30,
family (binomial) link (logit) nolog vce(robust)

Multiple-imputation estimates                   Imputations     =         95
Generalized linear models                       Number of obs   =      15883
                                                Average RVI     =     0.5456
                                                Largest FMI     =     0.9159
DF adjustment:   Large sample                   DF:     min     =     112.42
                                                        avg     =  103225.22
                                                        max     = 2458802.26
Model F test:       Equal FMI                   F(  51,37993.4) =      23.92
Within VCE type:       Robust                   Prob > F        =     0.0000
```

exp_int	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0005228	.0015764	0.33	0.740	-.0025693	.0036149
emp_trng	.0131093	.0670161	0.20	0.845	-.1182654	.1444839
manager_exp	-.0012655	.0030715	-0.41	0.680	-.0072864	.0047554
skilled_emp	.0014472	.0015883	0.91	0.363	-.001673	.0045674
manager_edu_dummy	.2194324	.1365577	1.61	0.110	-.0503056	.4891705
new_org_str	.0628981	.0798622	0.79	0.431	-.0936579	.2194542
new_prod_serv	-.1294353	.0760857	-1.70	0.089	-.2785811	.0197104
new_methods	.13745	.0830609	1.65	0.098	-.0253538	.3002538
location	-.3650313	.0818787	-4.46	0.000	-.5255325	-.2045302
lnsize	.5105788	.1024652	4.98	0.000	.3097243	.7114332
lnsize_sqr	-.0237944	.0119055	-2.00	0.046	-.0471317	-.0004571
lnage	.1115427	.1764023	0.63	0.527	-.2342511	.4573364
lnage_sqr	-.0462473	.0340073	-1.36	0.174	-.1129113	.0204168
foreign_dummy	.9292855	.1067536	8.70	0.000	.7199863	1.138585
state_dummy	-.5181344	.2945668	-1.76	0.079	-1.095608	.0593397
credit	.2012658	.0627031	3.21	0.001	.0783448	.3241868
f_inputs	.0088463	.0011317	7.82	0.000	.0066233	.0110693
tech_dummy	.2314016	.2653128	0.87	0.385	-.2940856	.7568888
bus_assoc	-.0141266	.1962359	-0.07	0.943	-.4029271	.3746739
low_mlow_tech	1.140571	.0773177	14.75	0.000	.9889428	1.292198
mhigh_tech	1.406691	.0995752	14.13	0.000	1.211454	1.601927
high_tech	1.409251	.1700093	8.29	0.000	1.075992	1.742511
dcountry1	.5374147	.360438	1.49	0.136	-.169103	1.243932
dcountry2	1.428276	.208482	6.85	0.000	1.019651	1.8369
dcountry3	.8110591	.3117195	2.60	0.009	.2000974	1.422021
dcountry4	.8980107	.2824347	3.18	0.001	.344438	1.451583
dcountry5	2.313015	.1314167	17.60	0.000	2.055431	2.5706
dcountry6	.7833607	.1542984	5.08	0.000	.4809357	1.085786
dcountry7	.660983	.2979097	2.22	0.027	.07709	1.244876
dcountry9	.541371	.3368982	1.61	0.108	-.119034	1.201776
dcountry10	.7804516	.3259212	2.39	0.017	.1415958	1.419307
dcountry11	.7978413	.3391758	2.35	0.019	.1329931	1.46269
dcountry12	-.5911176	.3452225	-1.71	0.087	-1.267743	.0855077
dcountry13	1.144793	.2630451	4.35	0.000	.6291541	1.660433
dcountry14	.8694505	.3381875	2.57	0.010	.2065567	1.532344
dcountry15	-.5425223	.4561759	-1.19	0.234	-1.436611	.3515665
dcountry16	.7714738	.3394643	2.27	0.023	.1060741	1.436874
dcountry17	.9170582	.2618486	3.50	0.000	.403829	1.430287
dcountry18	1.045305	.2563339	4.08	0.000	.5428925	1.547717
dcountry19	.8687564	.3220858	2.70	0.007	.2374786	1.500034
dcountry20	1.142503	.331376	3.45	0.001	.4929635	1.792042
dcountry21	-.0590934	.4029231	-0.15	0.883	-.8488387	.7306518
dcountry22	1.321655	.3360691	3.93	0.000	.6628984	1.980411
dcountry23	.5919069	.3547446	1.67	0.095	-.1034505	1.287264
dcountry24	1.375574	.3334762	4.12	0.000	.7219038	2.029245
dcountry25	1.29594	.3366948	3.85	0.000	.6359773	1.955902
dcountry26	.9375237	.3433481	2.73	0.006	.264519	1.610528

```
   dcountry27 |   1.622274   .3277321     4.95   0.000     .9798894    2.264659
   dcountry28 |   .9338835   .3471928     2.69   0.007     .2533414    1.614426
   dcountry29 |    .838123   .3356191     2.50   0.013     .1802568    1.495989
   dcountry30 |          0  (omitted)
        _cons |   -7.00068   .4201557   -16.66   0.000    -7.826486   -6.174874
------------------------------------------------------------------------------
```

Table A6.5 Poisson Model - Full sample estimated results

```
poisson exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                                Number of obs   =      14026
                                                  Wald chi2(46)   =    2245.61
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -2520.1083                 Pseudo R2       =     0.1855

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0022557   .0012522     1.80   0.072    -.0001986    .0047101
    emp_trng |   .0200165   .0554383     0.36   0.718    -.0886406    .1286736
 manager_exp |    .000325   .0024152     0.13   0.893    -.0044087    .0050588
 new_org_str |   .1035377   .0628404     1.65   0.099    -.0196272    .2267027
new_prod_s~v |  -.0697833   .0609258    -1.15   0.252    -.1891956    .0496291
 new_methods |   .0928956   .0682412     1.36   0.173    -.0408548    .2266459
    location |  -.2228706   .0685636    -3.25   0.001    -.3572528   -.0884884
      lnsize |   .5746026   .0893675     6.43   0.000     .3994455    .7497597
  lnsize_sqr |  -.0334998   .0100783    -3.32   0.001    -.0532529   -.0137466
       lnage |   .1238847   .1434186     0.86   0.388    -.1572106      .40498
   lnage_sqr |   -.050618    .026992    -1.88   0.061    -.1035213    .0022853
foreign_du~y |   .7219829   .0741866     9.73   0.000     .5765798    .8673861
 state_dummy |  -.6529478   .2914121    -2.24   0.025    -1.224105   -.0817906
      credit |   .1643412   .0512472     3.21   0.001     .0638985    .2647839
low_mlow_t~h |   1.031297   .0636236    16.21   0.000     .9065971    1.155997
  mhigh_tech |    1.26174   .0775021    16.28   0.000     1.109838    1.413641
   high_tech |     1.3885   .1270123    10.93   0.000     1.139561     1.63744
   dcountry1 |   1.900665   .2121627     8.96   0.000     1.484834    2.316496
   dcountry2 |   1.503755   .1891083     7.95   0.000      1.13311      1.8744
   dcountry3 |   .9060238   .3002131     3.02   0.003      .317617    1.494431
   dcountry4 |    .888473   .2850545     3.12   0.002     .3297765    1.447169
   dcountry5 |   1.930256   .1220996    15.81   0.000     1.690946    2.169567
   dcountry6 |   .7659179   .1508674     5.08   0.000     .4702232    1.061613
   dcountry7 |   .6697388   .2790293     2.40   0.016     .1228514    1.216626
   dcountry9 |   1.410234   .1732337     8.14   0.000     1.070702    1.749766
  dcountry10 |   1.907169    .146021    13.06   0.000     1.620973    2.193365
  dcountry11 |    1.86365   .1680357    11.09   0.000     1.534306    2.192993
  dcountry12 |  -.4929315   .3726762    -1.32   0.186    -1.223363    .2375003
  dcountry13 |   .9193422   .2455131     3.74   0.000     .4381453    1.400539
  dcountry14 |   1.928763   .1674806    11.52   0.000     1.600507    2.257019
  dcountry15 |  -.5932531   .4878533    -1.22   0.224    -1.549428    .3629218
  dcountry16 |   1.923718    .177526    10.84   0.000     1.575774    2.271663
  dcountry17 |   1.027864   .2410654     4.26   0.000     .5553847    1.500344
  dcountry18 |   1.122011   .2318627     4.84   0.000     .6675687    1.576454
  dcountry19 |   .7900767   .3063391     2.58   0.010     .1896631     1.39049
  dcountry20 |   2.401858   .1552764    15.47   0.000     2.097522    2.706194
  dcountry21 |   1.311741   .2655366     4.94   0.000     .7912989    1.832183
  dcountry22 |   2.226036     .14894    14.95   0.000     1.934119    2.517953
```

```
  dcountry23 |   1.498437   .2044936     7.33   0.000     1.097637    1.899237
  dcountry24 |   2.432801    .161816    15.03   0.000     2.115647    2.749954
  dcountry25 |   2.239727   .1642114    13.64   0.000     1.917879    2.561576
  dcountry26 |   1.881865   .1763963    10.67   0.000     1.536135    2.227595
  dcountry27 |   2.515855   .1511786    16.64   0.000      2.21955     2.81216
  dcountry28 |    1.97308   .1751758    11.26   0.000     1.629742    2.316419
  dcountry29 |   1.999796   .1657355    12.07   0.000      1.67496    2.324631
  dcountry30 |   1.245418   .3495428     3.56   0.000     .5603264    1.930509
       _cons |  -6.434522   .2633506   -24.43   0.000     -6.95068   -5.918365
------------------------------------------------------------------------------
```

Table A6.5.1 Poisson Model - Industry estimated results

```
. poisson exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                                Number of obs   =      14026
                                                  Wald chi2(55)   =    2472.40
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -2507.1249                 Pseudo R2       =     0.1897

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .007844   .0019007     4.13   0.000     .0041187    .0115693
    emp_trng |  -.1089038    .111664    -0.98   0.329    -.3277613    .1099537
 manager_exp |  -.0098884   .0057702    -1.71   0.087    -.0211979    .0014211
int_edu_lo~w |  -.0145793   .0026266    -5.55   0.000    -.0197273   -.0094312
int_edu_mh~h |  -.0054911   .0030626    -1.79   0.073    -.0114937    .0005115
int_edu_h~ch |  -.0028801   .0040848    -0.71   0.481    -.0108862     .005126
int_trng_l~w |   .1663245   .1244386     1.34   0.181    -.0775706    .4102196
int_trng_m~h |   .3334159   .1512503     2.20   0.027     .0369708     .629861
int_trng_h~h |  -.0882541   .2439875    -0.36   0.718    -.5664609    .3899527
int_mngexp~w |   .0120067   .0064188     1.87   0.061     -.000574    .0245874
int_mn~mhigh |   .0129095   .0073939     1.75   0.081    -.0015822    .0274012
int_mn~_high |   .0216382   .0125821     1.72   0.085    -.0030223    .0462988
 new_org_str |   .0983088   .0630382     1.56   0.119    -.0252438    .2218615
new_prod_s~v |  -.0793509   .0609867    -1.30   0.193    -.1988827    .0401808
 new_methods |   .1005003   .0678776     1.48   0.139    -.0325373    .2335379
    location |   -.210965   .0695293    -3.03   0.002    -.3472399   -.0746901
      lnsize |   .5860219   .0895574     6.54   0.000     .4104926    .7615513
  lnsize_sqr |  -.0346137   .0100931    -3.43   0.001    -.0543959   -.0148315
       lnage |   .1479117   .1432446     1.03   0.302    -.1328425    .4286658
   lnage_sqr |  -.0526226   .0268082    -1.96   0.050    -.1051658   -.0000794
foreign_du~y |   .7155492   .0740367     9.66   0.000     .5704399    .8606585
 state_dummy |  -.6542472   .2862839    -2.29   0.022    -1.215353   -.0931411
      credit |   .1664977   .0511469     3.26   0.001     .0662516    .2667439
low_mlow_t~h |   1.069818   .1617745     6.61   0.000     .7527461    1.386891
  mhigh_tech |   1.038118   .1987595     5.22   0.000     .6485563    1.427679
   high_tech |   1.120333   .3461387     3.24   0.001     .4419139    1.798753
   dcountry1 |   1.856101   .2116594     8.77   0.000     1.441256    2.270946
   dcountry2 |   1.531102   .1901322     8.05   0.000     1.158449    1.903754
   dcountry3 |   .9151854   .3049194     3.00   0.003     .3175543    1.512816
   dcountry4 |   .8987536   .2898743     3.10   0.002     .3306105    1.466897
   dcountry5 |   1.881748   .1256473    14.98   0.000     1.635484    2.128012
   dcountry6 |   .8597568   .1502727     5.72   0.000     .5652278    1.154286
```

```
    dcountry7 |   .6737894   .2797342     2.41   0.016     .1255204    1.222058
    dcountry9 |    1.39127   .1731621     8.03   0.000     1.051878    1.730661
   dcountry10 |   1.907891   .1480021    12.89   0.000     1.617812     2.19797
   dcountry11 |   1.862868   .1683553    11.07   0.000     1.532898    2.192838
   dcountry12 |  -.4651766    .372915    -1.25   0.212    -1.196077    .2657233
   dcountry13 |   .9223874   .2454305     3.76   0.000     .4413524    1.403422
   dcountry14 |   1.932646   .1669737    11.57   0.000     1.605384    2.259908
   dcountry15 |  -.6035314   .4893711    -1.23   0.217    -1.562681    .3556183
   dcountry16 |   1.908992   .1776927    10.74   0.000     1.560721    2.257263
   dcountry17 |    1.01553   .2435208     4.17   0.000      .538238    1.492822
   dcountry18 |   1.156053   .2312632     5.00   0.000     .7027851     1.60932
   dcountry19 |   .8257436   .3061708     2.70   0.007       .22566    1.425827
   dcountry20 |   2.414408   .1560004    15.48   0.000     2.108652    2.720163
   dcountry21 |   1.334278   .2656812     5.02   0.000     .8135524    1.855004
   dcountry22 |   2.194241   .1509099    14.54   0.000     1.898463    2.490019
   dcountry23 |   1.522761   .2051236     7.42   0.000     1.120726    1.924796
   dcountry24 |   2.463621   .1617888    15.23   0.000      2.14652    2.780721
   dcountry25 |   2.256666    .160697    14.04   0.000     1.941706    2.571626
   dcountry26 |   1.873583   .1766953    10.60   0.000     1.527266    2.219899
   dcountry27 |    2.53846   .1512369    16.78   0.000     2.242041    2.834879
   dcountry28 |   1.989098   .1767126    11.26   0.000     1.642747    2.335448
   dcountry29 |   2.008075   .1658121    12.11   0.000      1.68309    2.333061
   dcountry30 |   1.281656   .3472755     3.69   0.000      .601009    1.962304
        _cons |  -6.451327   .2826711   -22.82   0.000    -7.005352   -5.897301
```

Table A6.5.2 Poisson Model - CEECs estimated results

```
poisson exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==1, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       4836
                                                  Wald chi2(33)   =    1102.33
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1293.2435                 Pseudo R2       =     0.1515

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0016805   .0017393     0.97   0.334    -.0017284    .0050894
    emp_trng |  -.1097097   .0715902    -1.53   0.125     -.250024    .0306046
 manager_exp |  -.0005614   .0031547    -0.18   0.859    -.0067445    .0056217
 new_org_str |   .1407952   .0809603     1.74   0.082    -.0178841    .2994746
new_prod_s~v |    -.08345   .0752786    -1.11   0.268    -.2309934    .0640934
 new_methods |   .1171414    .084548     1.39   0.166    -.0485697    .2828525
```

```
    location |  -.1250314   .0802236    -1.56   0.119    -.2822667    .0322039
      lnsize |   .7221791   .1245767     5.80   0.000     .4780133    .9663448
  lnsize_sqr |  -.0552931   .0148142    -3.73   0.000    -.0843285   -.0262578
       lnage |  -.1168433   .2044778    -0.57   0.568    -.5176123    .2839258
   lnage_sqr |  -.0173422   .0377782    -0.46   0.646    -.0913861    .0567018
foreign_du~y |   .6702817   .0869567     7.71   0.000     .4998498    .8407137
 state_dummy |   -2.29632   .5665298    -4.05   0.000    -3.406698   -1.185942
      credit |   .1353399    .067375     2.01   0.045     .0032874    .2673924
low_mlow_t~h |   1.203199   .0764156    15.75   0.000     1.053428    1.352971
  mhigh_tech |   1.356341   .0990139    13.70   0.000     1.162278    1.550405
   high_tech |   1.558707   .1561768     9.98   0.000     1.252606    1.864808
   dcountry1 |   .5803262   .3773428     1.54   0.124    -.1592522    1.319905
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |   .2302949   .3596632     0.64   0.522    -.4746321    .9352218
  dcountry10 |   .6806555   .3464065     1.96   0.049     .0017113      1.3596
  dcountry11 |    .627615   .3534245     1.78   0.076    -.0650842    1.320314
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |   .7111577   .3546729     2.01   0.045     .0160116    1.406304
  dcountry15 |  (omitted)
  dcountry16 |   .6656907   .3576374     1.86   0.063    -.0352657    1.366647
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |   1.164718   .3479246     3.35   0.001     .4827985    1.846638
  dcountry21 |   .0183054   .4137382     0.04   0.965    -.7926067    .8292174
  dcountry22 |   1.043901   .3494717     2.99   0.003     .3589486    1.728852
  dcountry23 |   .2603178   .3717199     0.70   0.484    -.4682398    .9888754
  dcountry24 |   1.157457   .3510538     3.30   0.001     .4694046     1.84551
  dcountry25 |   .9841151    .358568     2.74   0.006     .2813348    1.686895
  dcountry26 |   .6760311   .3622513     1.87   0.062    -.0339683     1.38603
  dcountry27 |   1.354629   .3464829     3.91   0.000     .6755345    2.033723
  dcountry28 |    .775736   .3586035     2.16   0.031     .0728861    1.478586
  dcountry29 |   .7920154   .3532429     2.24   0.025      .099672    1.484359
  dcountry30 |  (omitted)
       _cons |  -5.050132   .4728837   -10.68   0.000    -5.976967   -4.123297
------------------------------------------------------------------------------
```

Table A6.5.3 Poisson Model - CEECs Industry estimated results

```
. poisson exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if CEEC_dummy==1,
vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
```

```
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       4836
                                                  Wald chi2(42)   =    1164.39
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood =  -1285.732                 Pseudo R2       =     0.1565

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0071885   .0024529     2.93   0.003     .0023809     .011996
    emp_trng |  -.1741951   .1351431    -1.29   0.197    -.4390708    .0906806
 manager_exp |  -.0076104   .0067573    -1.13   0.260    -.0208544    .0056336
int_edu_lo~w |  -.0168966   .0037719    -4.48   0.000    -.0242895   -.0095038
int_edu_mh~h |  -.0091531   .0048213    -1.90   0.058    -.0186025    .0002964
int_edu_h~ch |   .0033565   .0047299     0.71   0.478     -.005914     .012627
int_trng_l~w |   .0718842   .1532624     0.47   0.639    -.2285046     .372273
int_trng_m~h |   .3513763    .191555     1.83   0.067    -.0240647    .7268173
int_trng_h~h |  -.2605988    .298056    -0.87   0.382    -.8447779    .3235802
int_mngexp~w |   .0102561   .0077849     1.32   0.188    -.0050019    .0255141
int_mn~mhigh |   .0075034   .0096856     0.77   0.439    -.0114801    .0264869
int_mn~_high |   .0121209   .0150946     0.80   0.422     -.017464    .0417059
 new_org_str |   .1364723   .0813894     1.68   0.094    -.0230481    .2959927
new_prod_s~v |  -.0876064   .0749638    -1.17   0.243    -.2345329      .05932
 new_methods |   .1172158   .0838928     1.40   0.162    -.0472111    .2816427
    location |  -.1134712   .0804678    -1.41   0.158    -.2711851    .0442427
      lnsize |   .7332622   .1251804     5.86   0.000     .4879131    .9786114
  lnsize_sqr |  -.0565909   .0148573    -3.81   0.000    -.0857106   -.0274712
       lnage |  -.1137501   .2005242    -0.57   0.571    -.5067702    .2792701
   lnage_sqr |  -.0136267   .0368971    -0.37   0.712    -.0859438    .0586903
foreign_du~y |   .6720874   .0870551     7.72   0.000     .5014625    .8427123
 state_dummy |  -2.187547    .550569    -3.97   0.000    -3.266642   -1.108451
      credit |   .1357401   .0671234     2.02   0.043     .0041806    .2672995
low_mlow_t~h |    1.25123   .1884041     6.64   0.000     .8819646    1.620495
  mhigh_tech |   1.245299   .2508095     4.97   0.000     .7537211    1.736876
   high_tech |   1.334011    .388559     3.43   0.001     .5724499    2.095573
   dcountry1 |   .5297683   .3726816     1.42   0.155    -.2006741    1.260211
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |   .1821998   .3562734     0.51   0.609    -.5160831    .8804828
  dcountry10 |   .6543813   .3429352     1.91   0.056    -.0177594    1.326522
  dcountry11 |   .6013315   .3490099     1.72   0.085    -.0827153    1.285378
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |   .6788751   .3508555     1.93   0.053     -.008789    1.366539
  dcountry15 |  (omitted)
  dcountry16 |   .6221663   .3541508     1.76   0.079    -.0719566    1.316289
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |   1.139447   .3439825     3.31   0.001     .4652538     1.81364
  dcountry21 |    .015766   .4109439     0.04   0.969    -.7896692    .8212013
  dcountry22 |   .9611045   .3454285     2.78   0.005      .284077    1.638132
  dcountry23 |   .2432928     .36831     0.66   0.509    -.4785815    .9651671
  dcountry24 |    1.16792   .3463411     3.37   0.001      .489104    1.846736
  dcountry25 |    .985349   .3536538     2.79   0.005     .2922003    1.678498
```

```
  dcountry26 |   .6399381   .3580621     1.79   0.074    -.0618507    1.341727
  dcountry27 |   1.323129   .3425999     3.86   0.000     .6516452    1.994612
  dcountry28 |    .772785   .3553616     2.17   0.030      .076289    1.469281
  dcountry29 |    .751812   .3492106     2.15   0.031     .0673717    1.436252
  dcountry30 |  (omitted)
       _cons |  -5.051748   .4861889   -10.39   0.000    -6.004661   -4.098835
------------------------------------------------------------------------------
```

Table A6.5.4 Poisson Model - CIS estimated results

```
. poisson exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 if
CEEC_dummy==0, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       9190
                                                  Wald chi2(29)   =    1160.45
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1215.8352                 Pseudo R2       =     0.1792

------------------------------------------------------------------------------
             |               Robust
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0025299   .0018221     1.39   0.165    -.0010414    .0061012
    emp_trng |   .1930226    .088115     2.19   0.028     .0203204    .3657247
 manager_exp |  -.0002144   .0037651    -0.06   0.955    -.0075939    .0071652
 new_org_str |   .0960034    .094437     1.02   0.309    -.0890897    .2810965
new_prod_s~v |  -.0512139   .1027241    -0.50   0.618    -.2525494    .1501216
 new_methods |   .0452454   .1116593     0.41   0.685    -.1736027    .2640935
    location |  -.3497714    .129555    -2.70   0.007    -.6036944   -.0958483
      lnsize |   .4956735   .1386699     3.57   0.000     .2238855    .7674616
  lnsize_sqr |  -.0221618   .0147887    -1.50   0.134     -.051147    .0068235
       lnage |   .2628063    .211962     1.24   0.215    -.1526317    .6782443
   lnage_sqr |  -.0632003   .0409742    -1.54   0.123    -.1435083    .0171078
foreign_du~y |   .9034801   .1436941     6.29   0.000      .621845    1.185115
 state_dummy |  -.5489228   .3117908    -1.76   0.078    -1.160022     .062176
      credit |    .175415   .0793095     2.21   0.027     .0199712    .3308587
low_mlow_t~h |   .6948214    .110604     6.28   0.000     .4780417    .9116012
  mhigh_tech |   .9970857    .126728     7.87   0.000     .7487034    1.245468
   high_tech |   1.024487   .2072717     4.94   0.000     .6182421    1.430732
   dcountry1 |  (omitted)
   dcountry2 |   1.480617   .2010523     7.36   0.000     1.086562    1.874673
```

```
   dcountry3 |    1.00195   .3063613     3.27   0.001     .4014926    1.602407
   dcountry4 |   .9278343   .2841272     3.27   0.001     .3709553    1.484713
   dcountry5 |    1.99836   .1342458    14.89   0.000     1.735243    2.261477
   dcountry6 |   .8765905   .1522136     5.76   0.000     .5782573    1.174924
   dcountry7 |   .6610218   .3013357     2.19   0.028     .0704146    1.251629
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -.4927885   .3689626    -1.34   0.182    -1.215942    .2303649
  dcountry13 |   .9535532   .2502498     3.81   0.000     .4630725    1.444034
  dcountry14 |  (omitted)
  dcountry15 |  -.5049491   .4968254    -1.02   0.309    -1.478709    .4688107
  dcountry16 |  (omitted)
  dcountry17 |   1.099709   .2573667     4.27   0.000     .5952801    1.604139
  dcountry18 |   1.125935   .2419551     4.65   0.000     .6517121    1.600159
  dcountry19 |    .824473   .3092019     2.67   0.008     .2184484    1.430498
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -6.464829   .3770373   -17.15   0.000    -7.203808   -5.725849
```

Table A6.5.5 Poisson Model - CIS Industry estimated results

```
. poisson exp_int emp_edu emp_trng manager_exp int_edu_lowmlow int_edu_mhightech
int_edu_hightech int_trng_lowmlow int_trng_mhigh int_trng_high int_mngexp_lowmlow
int_mngexp_mhigh int_mngexp_high  new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30if CEEC_dummy==0,
vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       9190
                                                  Wald chi2(38)   =    1229.10
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1211.9474                 Pseudo R2       =     0.1818
```

exp_int	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
emp_edu	.0069373	.0032991	2.10	0.035	.0004712	.0134035
emp_trng	.0460615	.1957819	0.24	0.814	-.337664	.4297871
manager_exp	-.0117889	.0105739	-1.11	0.265	-.0325133	.0089356
int_edu_lo~w	-.0105735	.0042003	-2.52	0.012	-.0188059	-.002341
int_edu_mh~h	-.0009459	.004627	-0.20	0.838	-.0100146	.0081227
int_edu_h~ch	-.0064743	.0067795	-0.95	0.340	-.0197618	.0068132
int_trng_l~w	.1812562	.2145869	0.84	0.398	-.2393264	.6018388
int_trng_m~h	.2154623	.2504485	0.86	0.390	-.2754078	.7063323
int_trng_h~h	.3354867	.4197031	0.80	0.424	-.4871163	1.15809
int_mngexp~w	.0116675	.0112987	1.03	0.302	-.0104776	.0338126
int_mn~mhigh	.0159915	.0122118	1.31	0.190	-.0079433	.0399262
int_mn~_high	.0301622	.0211679	1.42	0.154	-.0113261	.0716505
new_org_str	.088324	.0956174	0.92	0.356	-.0990827	.2757307
new_prod_s~v	-.056822	.1041247	-0.55	0.585	-.2609027	.1472586
new_methods	.061727	.1129057	0.55	0.585	-.1595642	.2830181
location	-.3564296	.1321562	-2.70	0.007	-.6154511	-.0974082
lnsize	.5128333	.1390417	3.69	0.000	.2403165	.78535
lnsize_sqr	-.0239544	.0147919	-1.62	0.105	-.052946	.0050371
lnage	.3166286	.215485	1.47	0.142	-.1057143	.7389715
lnage_sqr	-.0732431	.0415666	-1.76	0.078	-.154712	.0082259
foreign_du~y	.900634	.1444414	6.24	0.000	.617534	1.183734
state_dummy	-.5557311	.2962438	-1.88	0.061	-1.136358	.0248961
credit	.1795904	.0792972	2.26	0.024	.0241708	.3350101
low_mlow_t~h	.7748192	.3097719	2.50	0.012	.1676773	1.381961
mhigh_tech	.7347891	.3447515	2.13	0.033	.0590887	1.41049
high_tech	.5756526	.6338396	0.91	0.364	-.6666501	1.817955
dcountry1	(omitted)					
dcountry2	1.499616	.2021744	7.42	0.000	1.103362	1.895871
dcountry3	.9928646	.3133028	3.17	0.002	.3788025	1.606927
dcountry4	.9445515	.2877225	3.28	0.001	.3806258	1.508477
dcountry5	1.960499	.1427314	13.74	0.000	1.68075	2.240247
dcountry6	.9180346	.1526315	6.01	0.000	.6188823	1.217187
dcountry7	.6863155	.3038116	2.26	0.024	.0908558	1.281775
dcountry9	(omitted)					
dcountry10	(omitted)					
dcountry11	(omitted)					
dcountry12	-.4756689	.3704722	-1.28	0.199	-1.201781	.2504433
dcountry13	.9781472	.2507533	3.90	0.000	.4866797	1.469615
dcountry14	(omitted)					
dcountry15	-.4847058	.4972527	-0.97	0.330	-1.459303	.4898915
dcountry16	(omitted)					
dcountry17	1.102551	.2613799	4.22	0.000	.5902557	1.614846
dcountry18	1.175289	.2429448	4.84	0.000	.699126	1.651452
dcountry19	.8745405	.3092531	2.83	0.005	.2684156	1.480665
dcountry20	(omitted)					
dcountry21	(omitted)					
dcountry22	(omitted)					
dcountry23	(omitted)					
dcountry24	(omitted)					
dcountry25	(omitted)					
dcountry26	(omitted)					
dcountry27	(omitted)					
dcountry28	(omitted)					
dcountry29	(omitted)					
dcountry30	(omitted)					
_cons	-6.534381	.4373765	-14.94	0.000	-7.391623	-5.677138

Table A6.5.6 Poisson Model - Full sample (imputed) estimated results

```
. mi estimate, cmdok: poisson exp_int emp_edu  emp_trng manager_exp new_org_str
new_prod_serv new_methods  location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit   low_mlow_tech  mhigh_tech high_tech   dcountry1-dcountry7
dcountry9-dcountry30, nolog vce(robust)
```

```
Multiple-imputation estimates                   Imputations     =         22
Poisson regression                              Number of obs   =      15883
                                                Average RVI     =     0.0262
                                                Largest FMI     =     0.1162
DF adjustment:   Large sample                   DF:      min    =    1586.49
                                                         avg    = 1423112.95
                                                         max    =   2.93e+07
Model F test:       Equal FMI                   F(  46, 1.4e+06)=      52.42
Within VCE type:       Robust                   Prob > F        =     0.0000
```

exp_int	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0017187	.0012191	1.41	0.159	-.0006725	.0041099
emp_trng	.035797	.0526923	0.68	0.497	-.0674883	.1390824
manager_exp	-.0009699	.0023278	-0.42	0.677	-.0055327	.003593
new_org_str	.0723633	.0603587	1.20	0.231	-.0459473	.1906738
new_prod_serv	-.0644544	.0582472	-1.11	0.268	-.1786191	.0497102
new_methods	.1240578	.0639861	1.94	0.053	-.0013538	.2494693
location	-.1774292	.064346	-2.76	0.006	-.3035503	-.0513081
lnsize	.5099841	.0811112	6.29	0.000	.3510063	.6689618
lnsize_sqr	-.0286046	.0091101	-3.14	0.002	-.0464603	-.0107489
lnage	.1128158	.1430506	0.79	0.430	-.1676642	.3932959
lnage_sqr	-.0436149	.0268989	-1.62	0.105	-.0963602	.0091304
foreign_dummy	.7596171	.070731	10.74	0.000	.6209691	.8982651
state_dummy	-.4668128	.2568423	-1.82	0.069	-.9705838	.0369581
credit	.170163	.0489299	3.48	0.001	.0742496	.2660764
low_mlow_tech	.9948193	.059964	16.59	0.000	.8772905	1.112348
mhigh_tech	1.239652	.0738812	16.78	0.000	1.094838	1.384466
high_tech	1.336185	.1222436	10.93	0.000	1.096585	1.575784
dcountry1	1.699997	.2024048	8.40	0.000	1.303251	2.096743
dcountry2	1.501744	.1774134	8.46	0.000	1.15402	1.849469
dcountry3	.7810713	.2896676	2.70	0.007	.2133331	1.348809
dcountry4	.888987	.2583615	3.44	0.001	.3826036	1.39537
dcountry5	1.981301	.1144111	17.32	0.000	1.757057	2.205545
dcountry6	.7290559	.1420952	5.13	0.000	.4505493	1.007562
dcountry7	.6199537	.2621269	2.37	0.018	.1061937	1.133714
dcountry9	1.453421	.1497578	9.71	0.000	1.1599	1.746941
dcountry10	1.902104	.1401916	13.57	0.000	1.627328	2.17688
dcountry11	1.785512	.1630505	10.95	0.000	1.465937	2.105086
dcountry12	-.4435209	.3373211	-1.31	0.189	-1.104659	.217617
dcountry13	1.046383	.2280622	4.59	0.000	.5993873	1.493378
dcountry14	1.863451	.1633568	11.41	0.000	1.543275	2.183627
dcountry15	-.8299464	.4473852	-1.86	0.064	-1.706805	.0469126
dcountry16	1.882872	.1694689	11.11	0.000	1.550717	2.215026
dcountry17	1.033143	.2357746	4.38	0.000	.5710322	1.495254
dcountry18	1.100151	.2264616	4.86	0.000	.6562946	1.544008
dcountry19	.7111046	.3038758	2.34	0.019	.1155185	1.306691
dcountry20	2.254018	.1489871	15.13	0.000	1.962006	2.546031
dcountry21	1.234355	.2639579	4.68	0.000	.7170073	1.751704
dcountry22	2.155231	.145249	14.84	0.000	1.870533	2.439928
dcountry23	1.525414	.1883448	8.10	0.000	1.156242	1.894586
dcountry24	2.326546	.1494995	15.56	0.000	2.033526	2.619565
dcountry25	2.256049	.1509018	14.95	0.000	1.960233	2.551865
dcountry26	1.878101	.1632465	11.50	0.000	1.558142	2.198061
dcountry27	2.468056	.1460089	16.90	0.000	2.181876	2.754236

```
  dcountry28 |   1.923775   .1704594    11.29   0.000     1.58968    2.257871
  dcountry29 |   1.925713   .1608249    11.97   0.000    1.610497    2.240929
  dcountry30 |   1.284545   .2915923     4.41   0.000    .7129915    1.856098
       _cons |  -6.226869   .2503661   -24.87   0.000   -6.717624   -5.736114
```

Table A6.5.7 Poisson (Augumented) Model - Full sample (imputed) estimated results (45)

```
mi estimate, cmdok: poisson  exp_int emp_edu  emp_trng manager_exp skilled_emp
manager_edu_dummy new_org_str new_prod_serv new_methods  location lnsize lnsize_sqr
lnage lnage_sqr foreign_dummy state_dummy credit  f_inputs tech_dummy bus_assoc
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30, nolog
vce(robust)

Multiple-imputation estimates                   Imputations     =         45
Poisson regression                              Number of obs   =      15883
                                                Average RVI     =     0.5564
                                                Largest FMI     =     0.9269
DF adjustment:   Large sample                   DF:     min     =      51.52
                                                        avg     =   87411.20
                                                        max     = 2301286.32
Model F test:       Equal FMI                   F(  51,17291.3) =      34.67
Within VCE type:       Robust                   Prob > F        =     0.0000

------------------------------------------------------------------------------
          exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+-----------------------------------------------------------
          emp_edu |   .0003327   .0013654     0.24   0.808    -.0023482    .0030136
         emp_trng |   .0091567   .0550444     0.17   0.868    -.0987744    .1170879
      manager_exp |  -.0008135   .0024383    -0.33   0.739    -.0055942    .0039673
      skilled_emp |   .0010561   .0013286     0.79   0.428    -.0015634    .0036755
manager_edu_dummy |   .1971117   .1152273     1.71   0.091    -.0325919    .4268152
      new_org_str |   .0467524   .0636466     0.73   0.463    -.0780771    .1715819
    new_prod_serv |   -.104475    .061091    -1.71   0.087    -.2242563    .0153064
      new_methods |    .105921   .0662846     1.60   0.110    -.0240241    .2358661
         location |  -.2608486   .0672377    -3.88   0.000    -.3926724   -.1290248
           lnsize |   .4712838   .0853843     5.52   0.000     .3038872    .6386803
       lnsize_sqr |  -.0265732   .0096103    -2.77   0.006    -.0454139   -.0077326
            lnage |   .0805252   .1458252     0.55   0.581     -.205383    .3664334
        lnage_sqr |  -.0355568   .0274696    -1.29   0.196    -.0894191    .0183055
    foreign_dummy |   .6281294   .0785724     7.99   0.000     .4739307    .7823281
      state_dummy |  -.4134897   .2601356    -1.59   0.112    -.9236647    .0966853
           credit |   .1768635   .0501788     3.52   0.000      .078484     .275243
         f_inputs |   .0072679   .0009485     7.66   0.000     .0053989     .009137
       tech_dummy |   .2180284   .2109932     1.03   0.306    -.2046262    .6406829
        bus_assoc |  -.0295667   .1694599    -0.17   0.862     -.369688    .3105547
    low_mlow_tech |   .9867354   .0664718    14.84   0.000     .8563095    1.117161
       mhigh_tech |   1.176714   .0818997    14.37   0.000     1.016032    1.337396
        high_tech |   1.165316   .1309253     8.90   0.000     .9085787    1.422054
        dcountry1 |    1.46528   .2103528     6.97   0.000     1.052824    1.877736
        dcountry2 |   1.332581   .1785774     7.46   0.000     .9825688    1.682592
        dcountry3 |   .7240589   .2910414     2.49   0.013     .1536235    1.294494
        dcountry4 |   .8234397   .2644583     3.11   0.002     .3050951    1.341784
        dcountry5 |   2.057475   .1174744    17.51   0.000     1.827208    2.287742
        dcountry6 |   .7470446   .1437524     5.20   0.000     .4652873    1.028802
        dcountry7 |   .6584635   .2644258     2.49   0.013     .1401975    1.176729
        dcountry9 |   1.490373   .1578676     9.44   0.000     1.180869    1.799877
       dcountry10 |   1.702227    .142735    11.93   0.000      1.42245    1.982004
       dcountry11 |   1.708107   .1712216     9.98   0.000     1.372439    2.043776
       dcountry12 |  -.5475335   .3383725    -1.62   0.106    -1.210733    .1156664
       dcountry13 |   1.028412   .2377376     4.33   0.000     .5623394    1.494484
       dcountry14 |    1.77128   .1665673    10.63   0.000     1.444786    2.097774
```

```
       dcountry15 |  -.6930696   .4498764    -1.54   0.123    -1.574812    .1886725
       dcountry16 |   1.669211   .1744446     9.57   0.000     1.327269    2.011153
       dcountry17 |   .8369386   .2400562     3.49   0.000     .3664213    1.307456
       dcountry18 |    .999069   .2285224     4.37   0.000     .5511665    1.446971
       dcountry19 |   .7553061   .3046446     2.48   0.013     .1582119      1.3524
       dcountry20 |   1.942658   .1552903    12.51   0.000     1.638246    2.247069
       dcountry21 |   .9523006   .2696072     3.53   0.000     .4238699    1.480731
       dcountry22 |    2.10677   .1480781    14.23   0.000     1.816506    2.397034
       dcountry23 |   1.492417    .190628     7.83   0.000     1.118726    1.866108
       dcountry24 |   2.168516   .1556687    13.93   0.000      1.86336    2.473672
       dcountry25 |   2.078605   .1546502    13.44   0.000     1.775445    2.381765
       dcountry26 |   1.807857   .1652014    10.94   0.000      1.48406    2.131655
       dcountry27 |   2.337375   .1512016    15.46   0.000     2.040993    2.633757
       dcountry28 |   1.792403    .171914    10.43   0.000      1.45545    2.129357
       dcountry29 |   1.749476    .164106    10.66   0.000     1.427801     2.07115
       dcountry30 |   1.009952   .2948445     3.43   0.001     .4319694    1.587934
            _cons |  -6.562049   .3434025   -19.11   0.000    -7.238619    -5.88548
```

Table A6.5.8 Poisson (Augumented) Model - Full sample (imputed) estimated results (95)

```
. mi estimate, cmdok: poisson  exp_int emp_edu  emp_trng manager_exp skilled_emp
manager_edu_dummy new_org_str new_prod_serv new_methods  location lnsize lnsize_sqr
lnage  lnage_sqr  foreign_dummy  state_dummy  credit   f_inputs  tech_dummy  bus_assoc
low_mlow_tech   mhigh_tech   high_tech    dcountry1-dcountry7  dcountry9-dcountry30,
nolog vce(robust)

Multiple-imputation estimates                   Imputations     =         95
Poisson regression                              Number of obs   =      15883
                                                Average RVI     =     0.5308
                                                Largest FMI     =     0.9129
DF adjustment:   Large sample                   DF:     min     =     113.17
                                                        avg     =  188254.38
                                                        max     = 5714940.38
Model F test:       Equal FMI                   F(  51,39455.7) =      35.06
Within VCE type:       Robust                   Prob > F        =     0.0000

------------------------------------------------------------------------------
          exp_int |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+-----------------------------------------------------------
          emp_edu |   .0004966   .0013415     0.37   0.711    -.0021345    .0031276
         emp_trng |   .0126721   .0550033     0.23   0.818    -.0951534    .1204976
      manager_exp |  -.0009069   .0024306    -0.37   0.709    -.0056714    .0038577
      skilled_emp |   .0010734   .0012753     0.84   0.400    -.0014317    .0035785
manager_edu_dummy |   .1769502   .1127768     1.57   0.119    -.0458024    .3997028
      new_org_str |   .0466102   .0623997     0.75   0.455    -.0757143    .1689347
    new_prod_serv |  -.1018773   .0605082    -1.68   0.092    -.2204861    .0167315
      new_methods |   .1069029   .0654323     1.63   0.102    -.0213494    .2351552
         location |  -.2594634   .0668686    -3.88   0.000    -.3905381   -.1283887
           lnsize |   .4782467   .0853251     5.60   0.000     .3109913    .6455022
       lnsize_sqr |  -.0272544    .009623    -2.83   0.005    -.0461176   -.0083912
            lnage |   .0796817   .1454084     0.55   0.584    -.2053524    .3647158
        lnage_sqr |  -.0356045   .0272906    -1.30   0.192    -.0891014    .0178923
    foreign_dummy |   .6357183   .0773848     8.22   0.000     .4839745    .7874621
      state_dummy |   -.418028   .2565798    -1.63   0.103    -.9210179     .084962
           credit |   .1739868    .050697     3.43   0.001     .0746026     .273371
         f_inputs |   .0072047   .0009254     7.79   0.000     .0053869    .0090225
       tech_dummy |   .1868809   .2185731     0.86   0.394    -.2459935    .6197553
        bus_assoc |  -.0143893   .1566631    -0.09   0.927    -.3247621    .2959835
    low_mlow_tech |   .9908668   .0660148    15.01   0.000     .8614208    1.120313
       mhigh_tech |   1.178649   .0807755    14.59   0.000     1.020274    1.337025
```

```
         high_tech |      1.167    .1293035     9.03   0.000      .9135281    1.420472
         dcountry1 |   .4477958    .3222047     1.39   0.165     -.1837646    1.079356
         dcountry2 |   1.336052    .1796071     7.44   0.000      .9840232    1.688081
         dcountry3 |   .7233699    .2908391     2.49   0.013      .1533343    1.293406
         dcountry4 |   .8217176      .26405     3.11   0.002      .3041822    1.339253
         dcountry5 |    2.05745    .1169983    17.59   0.000       1.82813    2.286769
         dcountry6 |   .7486835    .1438582     5.20   0.000      .4667228    1.030644
         dcountry7 |   .6586189    .2647689     2.49   0.013      .1396809    1.177557
         dcountry9 |   .4698627    .3003745     1.56   0.118      -.118931    1.058656
        dcountry10 |   .6855991    .2895978     2.37   0.018      .1179534    1.253245
        dcountry11 |   .6925458    .3021943     2.29   0.022      .1002014     1.28489
        dcountry12 |  -.5469734    .3385602    -1.62   0.106      -1.21054    .1165935
        dcountry13 |   1.028903    .2375374     4.33   0.000      .5632858    1.494519
        dcountry14 |    .753523    .3010611     2.50   0.012      .1634114    1.343635
        dcountry15 |  -.6893085     .449873    -1.53   0.125     -1.571044    .1924266
        dcountry16 |   .6567295     .302244     2.17   0.030      .0642973    1.249162
        dcountry17 |   .8444971    .2408003     3.51   0.000       .372527    1.316467
        dcountry18 |   .9956669    .2292019     4.34   0.000       .546435    1.444899
        dcountry19 |   .7577015    .3046862     2.49   0.013      .1605268    1.354876
        dcountry20 |   .9285693     .290425     3.20   0.001      .3593077    1.497831
        dcountry21 |  -.0601063    .3670069    -0.16   0.870     -.7794484    .6592358
        dcountry22 |   1.083895     .293591     3.69   0.000      .5084154    1.659374
        dcountry23 |   .4768277    .3134004     1.52   0.128      -.137474    1.091129
        dcountry24 |   1.151396    .2934955     3.92   0.000      .5761071    1.726685
        dcountry25 |   1.061367    .2950064     3.60   0.000      .4831284    1.639606
        dcountry26 |   .7925103    .3028468     2.62   0.009       .198902    1.386119
        dcountry27 |   1.324417    .2883237     4.59   0.000      .7592831     1.88955
        dcountry28 |   .7788371    .3052719     2.55   0.011       .180472    1.377202
        dcountry29 |   .7356585    .2988643     2.46   0.014      .1498487    1.321468
        dcountry30 |          0  (omitted)
             _cons |  -6.549236    .3466009   -18.90   0.000      -7.23028   -5.868192
------------------------------------------------------------------------------------
```

Endogeneity Testing

Table A6.6 Panel estimated results

VARIABLES	Tobit/ Poisson emp_edu	Probit RD	Logit emp_trng
exp_int_lag1	0.00684	0.00349	-0.00181
	(0.0935)	(5.053)	(0.00902)
exp_int_lag2	0.00968	0.00450	0.0127
	(0.0977)	(6.501)	(0.00932)
Constant	26.85***	-0.731	-0.326
	(1.658)	(1,057)	(0.246)
Observations	359	371	107
Number of panelid	359	371	107

Table A6.6.1 IVTobit Model - Full sample estimated results

```
ivtobit  exp_int emp_edu emp_trng manager_exp new_org_str new_prod_serv new_methods
location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit
```

```
low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30 (emp_edu
= avrg_edu),  ll ul vce(robust) nolog

Tobit model with endogenous regressors           Number of obs   =      14026
                                                 Wald chi2(46)   =    2051.88
Log pseudolikelihood = -67964.267                Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |               Robust
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0030349   .0006511     4.66   0.000     .0017588     .004311
    emp_trng |   .0233102    .019635     1.19   0.235    -.0151737    .0617941
 manager_exp |   .0006865   .0009006     0.76   0.446    -.0010786    .0024516
 new_org_str |   .0478622   .0235079     2.04   0.042     .0017875    .0939369
new_prod_s~v |   .0502309   .0217283     2.31   0.021     .0076443    .0928176
 new_methods |   .0279108   .0248207     1.12   0.261    -.0207368    .0765583
    location |  -.0631634   .0248912    -2.54   0.011    -.1119492   -.0143776
      lnsize |   .2097713   .0309238     6.78   0.000     .1491618    .2703807
  lnsize_sqr |  -.0093375   .0037745    -2.47   0.013    -.0167353   -.0019398
       lnage |   .0502857   .0525272     0.96   0.338    -.0526657    .1532371
   lnage_sqr |  -.0160888   .0101906    -1.58   0.114    -.0360621    .0038845
foreign_du~y |   .3710641   .0370439    10.02   0.000     .2984594    .4436689
 state_dummy |  -.1267409   .0867172    -1.46   0.144    -.2967036    .0432218
      credit |   .1092822   .0187219     5.84   0.000     .0725881    .1459764
low_mlow_t~h |   .3861055   .0211696    18.24   0.000     .3446138    .4275972
  mhigh_tech |   .5308491   .0279609    18.99   0.000     .4760468    .5856514
   high_tech |   .5303366   .0518326    10.23   0.000     .4287467    .6319265
   dcountry1 |   .5748757   .0819884     7.01   0.000     .4141815      .73557
   dcountry2 |   .5239227   .0595124     8.80   0.000     .4072805     .640565
   dcountry3 |   .1880388   .0826261     2.28   0.023     .0260945     .349983
   dcountry4 |   .1259382   .0878208     1.43   0.152    -.0461874    .2980637
   dcountry5 |   .7394131   .0413961    17.86   0.000     .6582783    .8205479
   dcountry6 |   .1570664   .0434989     3.61   0.000     .0718101    .2423226
   dcountry7 |   .0821061   .0856085     0.96   0.338    -.0856835    .2498957
   dcountry9 |   .5168578   .0538431     9.60   0.000     .4113272    .6223884
  dcountry10 |   .6056033   .0519121    11.67   0.000     .5038575    .7073491
  dcountry11 |    .771549   .0536279    14.39   0.000     .6664402    .8766578
  dcountry12 |  -.2731645   .0828506    -3.30   0.001    -.4355486   -.1107804
  dcountry13 |   .3530267   .0682913     5.17   0.000     .2191783    .4868752
  dcountry14 |   .6908276   .0573385    12.05   0.000     .5784463     .803209
  dcountry15 |  -.1776069   .1213011    -1.46   0.143    -.4153526    .0601389
  dcountry16 |   .6945648   .0597983    11.62   0.000     .5773623    .8117673
  dcountry17 |   .2487297   .0669108     3.72   0.000      .117587    .3798724
  dcountry18 |   .2215957   .0800976     2.77   0.006     .0646074    .3785841
  dcountry19 |   .0466119   .0953723     0.49   0.625    -.1403144    .2335382
  dcountry20 |   .9149798   .0621433    14.72   0.000     .7931812    1.036778
  dcountry21 |   .5226681   .0738144     7.08   0.000     .3779944    .6673418
  dcountry22 |   .8737956   .0587567    14.87   0.000     .7586345    .9889567
  dcountry23 |   .5123111   .0687615     7.45   0.000      .377541    .6470812
  dcountry24 |     .87781   .0632946    13.87   0.000     .7537549    1.001865
  dcountry25 |    .799218   .0635102    12.58   0.000     .6747404    .9236957
  dcountry26 |    .724402   .0625515    11.58   0.000     .6018033    .8470007
  dcountry27 |   1.078401   .0560024    19.26   0.000     .9686388    1.188164
  dcountry28 |   .6305303   .0677809     9.30   0.000     .4976822    .7633784
  dcountry29 |   .7570319   .0559026    13.54   0.000     .6474648    .8665991
  dcountry30 |   .4407176   .1081846     4.07   0.000     .2286797    .6527556
       _cons |  -2.054761   .0970069   -21.18   0.000    -2.244891   -1.864631
-------------+----------------------------------------------------------------
      /alpha |  -.0013847   .0007949    -1.74   0.082    -.0029427    .0001733
        /lns |  -.4485776   .0218916   -20.49   0.000    -.4914844   -.4056708
        /lnv |   3.076893   .0070579   435.95   0.000      3.06306    3.090726
-------------+----------------------------------------------------------------
```

```
           s |   .6385358   .0139786                      .6117177    .6665296
           v |   21.69091   .1530915                      21.39292    21.99305
------------------------------------------------------------------------------
Instrumented:  emp_edu
Instruments:   emp_trng manager_exp new_org_str new_prod_serv new_methods
               location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
               state_dummy credit low_mlow_tech mhigh_tech high_tech
               dcountry1 dcountry2 dcountry3 dcountry4 dcountry5 dcountry6
               dcountry7 dcountry9 dcountry10 dcountry11 dcountry12
               dcountry13 dcountry14 dcountry15 dcountry16 dcountry17
               dcountry18 dcountry19 dcountry20 dcountry21 dcountry22
               dcountry23 dcountry24 dcountry25 dcountry26 dcountry27
               dcountry28 dcountry29 dcountry30 avrg_edu
------------------------------------------------------------------------------
Wald test of exogeneity (/alpha = 0): chi2(1) =     3.03  Prob > chi2 = 0.0815

  Obs. summary:      11804  left-censored observations at exp_int<=0
                      2047     uncensored observations
                       175 right-censored observations at exp_int>=1
```

Table A6.6.2 IVPoisson Model - Full sample estimated results

```
ivpois  exp_int emp_trng manager_exp new_org_str new_prod_serv new_methods location
lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy credit  low_mlow_tech
mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30, endog (emp_edu) exog
(avrg_edu)
------------------------------------------------------------------------------
     exp_int |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
exp_int      |
    emp_trng |    .062747   .1133685     0.55   0.580    -.1594512    .2849452
 manager_exp |  -.0011441   .0052881    -0.22   0.829    -.0115085    .0092204
 new_org_str |   .2238703   .1222223     1.83   0.067    -.0156809    .4634215
new_prod_s~v |  -.1630698   .1004821    -1.62   0.105    -.3600111    .0338716
 new_methods |  -.0160448   .1204989    -0.13   0.894    -.2522182    .2201286
    location |  -.1219598   .1450168    -0.84   0.400    -.4061874    .1622678
      lnsize |   .1150871   .1791664     0.64   0.521    -.2360726    .4662469
  lnsize_sqr |   .0349075   .0234666     1.49   0.137    -.0110862    .0809012
       lnage |   .6709593   .2785625     2.41   0.016     .1249868    1.216932
   lnage_sqr |  -.1345367   .0552741    -2.43   0.015     -.242872   -.0262014
foreign_du~y |    1.16245   .1611901     7.21   0.000     .8465234    1.478377
 state_dummy |   -1.05899   .3829486    -2.77   0.006    -1.809556   -.3084249
      credit |   .2957289   .0940167     3.15   0.002     .1114596    .4799982
low_mlow_t~h |    1.04483   .1346551     7.76   0.000     .7809111     1.30875
  mhigh_tech |   1.159101    .137246     8.45   0.000     .8901037    1.428098
   high_tech |   .9623794   .1725175     5.58   0.000     .6242513    1.300508
   dcountry1 |   1.370243   .3845505     3.56   0.000     .6165381    2.123948
   dcountry2 |   1.551772   .2755951     5.63   0.000     1.011616    2.091928
   dcountry3 |   .0496556   .3921467     0.13   0.899    -.7189378     .818249
   dcountry4 |   .3743034   .5021244     0.75   0.456    -.6098424    1.358449
   dcountry5 |   1.970393   .2256271     8.73   0.000     1.528172    2.412614
   dcountry6 |   .2897692   .2359993     1.23   0.220    -.1727809    .7523193
   dcountry7 |  -.0877651   .3388342    -0.26   0.796     -.751868    .5763378
   dcountry9 |   1.275979   .2503044     5.10   0.000     .7853915    1.766567
  dcountry10 |   1.482666   .2686756     5.52   0.000     .9560717    2.009261
  dcountry11 |   1.945149   .2475908     7.86   0.000      1.45988    2.430418
  dcountry12 |   -1.51006   .5524494    -2.73   0.006    -2.592841   -.4272788
  dcountry13 |   .7277961   .3402045     2.14   0.032     .0610076    1.394585
  dcountry14 |   1.759181   .2728604     6.45   0.000     1.224384    2.293977
  dcountry15 |  -1.504858   .5510251    -2.73   0.006    -2.584848    -.424869
  dcountry16 |   1.608904   .2782674     5.78   0.000      1.06351    2.154298
```

	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dcountry17	.214065	.319889	0.67	0.503	-.4129059	.841036
dcountry18	.8560062	.3137112	2.73	0.006	.2411435	1.470869
dcountry19	.2544534	.4179528	0.61	0.543	-.564719	1.073626
dcountry20	2.179724	.2815575	7.74	0.000	1.627882	2.731567
dcountry21	1.272565	.3723713	3.42	0.001	.5427309	2.0024
dcountry22	2.224038	.2683873	8.29	0.000	1.698008	2.750067
dcountry23	1.091835	.4062451	2.69	0.007	.2956091	1.888061
dcountry24	2.038851	.2493496	8.18	0.000	1.550135	2.527568
dcountry25	2.114519	.2929466	7.22	0.000	1.540354	2.688684
dcountry26	1.930147	.3124204	6.18	0.000	1.317814	2.542479
dcountry27	2.596931	.269874	9.62	0.000	2.067988	3.125874
dcountry28	1.646363	.2886067	5.70	0.000	1.080704	2.212022
dcountry29	1.970595	.2679974	7.35	0.000	1.44533	2.495861
dcountry30	1.307789	.4939628	2.65	0.008	.3396398	2.275939
emp_edu	.0095658	.0034846	2.75	0.006	.0027362	.0163954
_cons	-6.645289	.4948344	-13.43	0.000	-7.615146	-5.675431

```
test vhat
 ( 1)  [exp_int]vhat = 0
           chi2(  1) =    0.09
         Prob > chi2 =    0.7699
```

Estimated results: Export market share

Table A6.7 Tobit Model - Full sample estimated results (exp_share_industryEU28)

```
tobit exp_share_industryEU28 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
ll ul vce(robust) nolog

Tobit regression                                  Number of obs   =      13711
                                                  F(  46,  13665) =      63.64
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  -34.78356                 Pseudo R2       =     0.9650
```

exp_sh~yEU28	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	.0002785	.0000576	4.84	0.000	.0001656	.0003913
emp_trng	.0046764	.0023054	2.03	0.043	.0001574	.0091954
manager_exp	-.0001211	.0001337	-0.91	0.365	-.0003833	.000141
new_org_str	.0084459	.0030529	2.77	0.006	.0024618	.01443
new_prod_s~v	.0124381	.0031884	3.90	0.000	.0061884	.0186879
new_methods	-.002366	.0032113	-0.74	0.461	-.0086605	.0039285
location	.0077128	.0033136	2.33	0.020	.0012177	.0142078
lnsize	.012319	.0050038	2.46	0.014	.0025108	.0221272
lnsize_sqr	.0006653	.0006783	0.98	0.327	-.0006642	.0019948
lnage	.0053059	.0072127	0.74	0.462	-.0088321	.0194438
lnage_sqr	-.0008334	.001425	-0.58	0.559	-.0036266	.0019598
foreign_du~y	.0240689	.0039764	6.05	0.000	.0162745	.0318632
state_dummy	-.0145448	.0115853	-1.26	0.209	-.0372535	.0081639
credit	.0181319	.0024646	7.36	0.000	.0133009	.0229629
low_mlow_t~h	.0369272	.0024484	15.08	0.000	.0321279	.0417264
mhigh_tech	.055048	.0033143	16.61	0.000	.0485515	.0615445
high_tech	.0547239	.0059026	9.27	0.000	.043154	.0662938
dcountry1	.0501961	.0091248	5.50	0.000	.0323102	.068082
dcountry2	.052439	.0069409	7.56	0.000	.0388339	.0660442
dcountry3	.0127452	.0096406	1.32	0.186	-.0061517	.031642

```
   dcountry4 |  -.0069418   .0111724    -0.62   0.534    -.0288412    .0149576
   dcountry5 |   .0692111    .004351    15.91   0.000     .0606824    .0777397
   dcountry6 |   .0092747   .0057667     1.61   0.108    -.0020288    .0205781
   dcountry7 |   -.000978   .0097482    -0.10   0.920    -.0200858    .0181298
   dcountry9 |   .0499927   .0066478     7.52   0.000     .0369621    .0630233
  dcountry10 |   .0562414   .0055702    10.10   0.000     .0453231    .0671597
  dcountry11 |   .0836858   .0058706    14.26   0.000     .0721786     .095193
  dcountry12 |  -.0384346   .0107297    -3.58   0.000    -.0594663   -.0174029
  dcountry13 |   .0293762   .0085859     3.42   0.001     .0125467    .0462058
  dcountry14 |   .0657518   .0064192    10.24   0.000     .0531693    .0783344
  dcountry15 |    -.04169   .0165476    -2.52   0.012    -.0741257   -.0092544
  dcountry16 |   .0698868   .0065039    10.75   0.000     .0571382    .0826354
  dcountry17 |   .0060696   .0088648     0.68   0.494    -.0113066    .0234457
  dcountry18 |   .0173181   .0102645     1.69   0.092    -.0028018    .0374381
  dcountry19 |  -.0194869    .011515    -1.69   0.091     -.042058    .0030841
  dcountry20 |   .0908044   .0065366    13.89   0.000     .0779917     .103617
  dcountry21 |   .0554939   .0088478     6.27   0.000      .038151    .0728368
  dcountry22 |   .0890129   .0061014    14.59   0.000     .0770534    .1009725
  dcountry23 |   .0475131   .0083615     5.68   0.000     .0311233    .0639029
  dcountry24 |   .0863787   .0065863    13.11   0.000     .0734687    .0992888
  dcountry25 |   .0791589   .0068167    11.61   0.000     .0657972    .0925205
  dcountry26 |   .0593752   .0079956     7.43   0.000     .0437028    .0750477
  dcountry27 |   .1411126     .00809    17.44   0.000     .1252552      .15697
  dcountry28 |    .056652    .006851     8.27   0.000     .0432231    .0700808
  dcountry29 |   .0813099   .0058302    13.95   0.000     .0698818     .092738
  dcountry30 |   .0395044   .0134887     2.93   0.003     .0130646    .0659442
       _cons |  -.2523495    .013594   -18.56   0.000    -.2789955   -.2257035
-------------+----------------------------------------------------------------
      /sigma |   .0872653   .0005487                      .0861898    .0883409
------------------------------------------------------------------------------
  Obs. summary:      11804  left-censored observations at exp_sh~yEU28<=0
                      1906     uncensored observations
                         1 right-censored observation  at exp_sh~yEU28>=3.0019033
```

Table A6.7.1 Tobit Model - CEECs estimated results (exp_share_industryEU28)

```
tobit exp_share_industryEU28 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==1, ll ul vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       4720
                                                  F(  33,    4687) =      41.03
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  4.3134043                 Pseudo R2       =     1.0137

------------------------------------------------------------------------------
             |               Robust
```

```
exp_sh~yEU28 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0002922   .0000795     3.67   0.000     .0001363    .0004481
    emp_trng |   -.003174   .0036952    -0.86   0.390    -.0104183    .0040704
 manager_exp |  -.0001631   .0002034    -0.80   0.423    -.0005618    .0002356
 new_org_str |   .0141863   .0042216     3.36   0.001     .0059099    .0224627
new_prod_s~v |   .0138191   .0045483     3.04   0.002     .0049021     .022736
 new_methods |    .004811   .0048268     1.00   0.319    -.0046519    .0142738
    location |   .0180786   .0046667     3.87   0.000     .0089296    .0272276
      lnsize |   .0067783   .0096957     0.70   0.485    -.0122298    .0257864
  lnsize_sqr |   .0014803   .0014777     1.00   0.316    -.0014166    .0043773
       lnage |    .002001   .0116854     0.17   0.864    -.0209078    .0249097
   lnage_sqr |  -.0005761   .0021232    -0.27   0.786    -.0047386    .0035864
foreign_du~y |   .0270814    .005646     4.80   0.000     .0160127    .0381502
 state_dummy |  -.0238731   .0333706    -0.72   0.474    -.0892951    .0415489
      credit |   .0213471   .0039891     5.35   0.000     .0135267    .0291676
low_mlow_t~h |   .0525781   .0037502    14.02   0.000     .0452258    .0599303
  mhigh_tech |    .064769   .0052956    12.23   0.000     .0543871    .0751509
   high_tech |   .0511486   .0091986     5.56   0.000      .033115    .0691822
   dcountry1 |    .007669   .0183852     0.42   0.677    -.0283746    .0437126
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |   .0151736   .0172438     0.88   0.379    -.0186324    .0489796
  dcountry10 |   .0208448   .0164145     1.27   0.204    -.0113353    .0530249
  dcountry11 |   .0531184   .0165298     3.21   0.001     .0207122    .0855247
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |   .0339859   .0168634     2.02   0.044     .0009258     .067046
  dcountry15 |  (omitted)
  dcountry16 |   .0343723   .0168448     2.04   0.041     .0013486     .067396
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |   .0607032   .0168168     3.61   0.000     .0277344     .093672
  dcountry21 |   .0156619   .0183267     0.85   0.393    -.0202671    .0515908
  dcountry22 |   .0623033    .016783     3.71   0.000     .0294007    .0952059
  dcountry23 |   .0092041    .017826     0.52   0.606    -.0257431    .0441514
  dcountry24 |   .0534687   .0168704     3.17   0.002     .0203949    .0865426
  dcountry25 |   .0470039   .0171096     2.75   0.006      .013461    .0805469
  dcountry26 |   .0271532   .0176557     1.54   0.124    -.0074603    .0617667
  dcountry27 |   .1199547   .0178153     6.73   0.000     .0850284    .1548809
  dcountry28 |   .0228983   .0171489     1.34   0.182    -.0107216    .0565182
  dcountry29 |   .0511304    .016561     3.09   0.002     .0186631    .0835976
  dcountry30 |  (omitted)
       _cons |  -.2324305   .0239362    -9.71   0.000    -.2793567   -.1855042
-------------+----------------------------------------------------------------
      /sigma |   .1042454   .0014172                       .101467    .1070239
------------------------------------------------------------------------------
  Obs. summary:       3613  left-censored observations at exp_sh~yEU28<=0
                      1106     uncensored observations
                         1 right-censored observation  at exp_sh~yEU28>=3.0019033
```

Table A6.7.2 Tobit Model - CIS estimated results (exp_share_industryEU28)

```
tobit exp_share_industryEU28 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==0, ll ul vce(robust) nolog
```

```
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       8991
                                                  F(  29,   8962) =      53.47
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  147.22029                 Pseudo R2       =     1.4493

------------------------------------------------------------------------------
             |               Robust
exp_sh~yEU28 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .000221    .000038     5.82   0.000     .0001466    .0002954
    emp_trng |   .0072423   .0021007     3.45   0.001     .0031245    .0113601
 manager_exp |  -.0001029    .000093    -1.11   0.269    -.0002853    .0000795
 new_org_str |   .0050947   .0024693     2.06   0.039     .0002544    .0099351
new_prod_s~v |   .0063879   .0026494     2.41   0.016     .0011944    .0115813
 new_methods |  -.0055112   .0030758    -1.79   0.073    -.0115405    .0005181
    location |  -.0042943   .0030821    -1.39   0.164    -.0103358    .0017473
      lnsize |   .0171191   .0031425     5.45   0.000     .0109592    .0232791
  lnsize_sqr |  -.0005797    .000362    -1.60   0.109    -.0012893    .0001298
       lnage |    .003887   .0055263     0.70   0.482    -.0069458    .0147198
   lnage_sqr |  -.0004679   .0010646    -0.44   0.660    -.0025547    .0016189
foreign_du~y |   .0215052   .0048489     4.44   0.000     .0120002    .0310102
 state_dummy |  -.0099315    .007506    -1.32   0.186     -.024645     .004782
      credit |   .0123648   .0019832     6.23   0.000     .0084773    .0162522
low_mlow_t~h |   .0172432    .002516     6.85   0.000     .0123113    .0221752
  mhigh_tech |   .0324257   .0030779    10.53   0.000     .0263922    .0384592
   high_tech |   .0359641   .0049604     7.25   0.000     .0262407    .0456875
   dcountry1 |  (omitted)
   dcountry2 |   .0346854   .0044971     7.71   0.000       .02587    .0435007
   dcountry3 |   .0114056    .006052     1.88   0.060    -.0004577     .023269
   dcountry4 |  -.0021565   .0069388    -0.31   0.756    -.0157581     .011445
   dcountry5 |    .045137    .002999    15.05   0.000     .0392583    .0510157
   dcountry6 |   .0077278   .0035224     2.19   0.028     .0008231    .0146325
   dcountry7 |   .0003348   .0064011     0.05   0.958    -.0122128    .0128825
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -.0257626   .0064879    -3.97   0.000    -.0384804   -.0130448
  dcountry13 |   .0223276    .005404     4.13   0.000     .0117346    .0329206
  dcountry14 |  (omitted)
  dcountry15 |  -.0214014   .0104137    -2.06   0.040    -.0418146   -.0009883
  dcountry16 |  (omitted)
  dcountry17 |   .0083219    .005861     1.42   0.156    -.0031671    .0198108
  dcountry18 |   .0145756   .0067513     2.16   0.031     .0013416    .0278097
  dcountry19 |  -.0071331   .0072234    -0.99   0.323    -.0212927    .0070265
  dcountry20 |  (omitted)
```

```
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -.1771081   .0092592   -19.13   0.000    -.1952582   -.1589579
-------------+----------------------------------------------------------------
      /sigma |   .0542187   .0001715                      .0538825    .0545549
------------------------------------------------------------------------------
  Obs. summary:       8191  left-censored observations at exp_sh~yEU28<=0
                       799     uncensored observations
                         1 right-censored observation  at exp_sh~yEU28>=1.4024965
```

Table A6.7.3 Tobit Model - Full sample estimated results (exp_share_industryEA40)

```
. tobit exp_share_industryEA40 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
ll ul vce(robust) nolog

Tobit regression                                  Number of obs   =      13711
                                                  F(  46,  13665) =      65.98
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -210.72754                 Pseudo R2       =     0.8232

------------------------------------------------------------------------------
             |               Robust
exp_sh~yEA40 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .000323   .0000655     4.93   0.000     .0001947    .0004514
    emp_trng |     .00472   .0028911     1.63   0.103     -.000947    .0103869
 manager_exp |  -.0001252   .0001493    -0.84   0.402    -.0004178    .0001675
 new_org_str |   .0064416    .003915     1.65   0.100    -.0012323    .0141154
new_prod_s~v |   .0137579   .0033398     4.12   0.000     .0072114    .0203044
 new_methods |  -.0002046   .0045059    -0.05   0.964    -.0090369    .0086276
    location |   .0087067   .0039093     2.23   0.026     .0010439    .0163696
      lnsize |   .0167209   .0070617     2.37   0.018     .0028789    .0305629
  lnsize_sqr |   .0003631   .0009235     0.39   0.694     -.001447    .0021733
       lnage |   .0063011   .0077683     0.81   0.417    -.0089259    .0215281
   lnage_sqr |  -.0011189   .0015678    -0.71   0.475    -.0041921    .0019543
foreign_du~y |     .02776   .0051452     5.40   0.000     .0176747    .0378453
 state_dummy |  -.0149761   .0124883    -1.20   0.230    -.0394548    .0095026
      credit |   .0198087   .0027135     7.30   0.000     .0144898    .0251276
low_mlow_t~h |   .0377807   .0028846    13.10   0.000     .0321264     .043435
  mhigh_tech |   .0572824   .0037056    15.46   0.000     .0500189    .0645458
   high_tech |   .0560235   .0066013     8.49   0.000      .043084     .068963
   dcountry1 |   .0550678   .0098534     5.59   0.000     .0357539    .0743818
   dcountry2 |   .0576934   .0075439     7.65   0.000     .0429063    .0724806
   dcountry3 |   .0142544   .0104463     1.36   0.172    -.0062218    .0347305
   dcountry4 |  -.0071566    .012118    -0.59   0.555    -.0309096    .0165965
   dcountry5 |   .0789219   .0049983    15.79   0.000     .0691246    .0887192
   dcountry6 |   .0114172   .0062127     1.84   0.066    -.0007605    .0235949
   dcountry7 |  -.0002774    .010622    -0.03   0.979    -.0210979    .0205431
   dcountry9 |   .0556046   .0072578     7.66   0.000     .0413783     .069831
  dcountry10 |   .0620182   .0060168    10.31   0.000     .0502244     .073812
  dcountry11 |   .0919824   .0064792    14.20   0.000     .0792823    .1046826
  dcountry12 |  -.0410226   .0115548    -3.55   0.000    -.0636716   -.0183736
```

```
  dcountry13 |   .0326192   .0093465     3.49   0.000     .0142988    .0509396
  dcountry14 |   .0727057   .0070219    10.35   0.000     .0589417    .0864696
  dcountry15 |  -.0447997   .0180034    -2.49   0.013    -.0800889   -.0095105
  dcountry16 |   .0779943   .0072555    10.75   0.000     .0637724    .0922161
  dcountry17 |   .0064922   .0096569     0.67   0.501    -.0124367    .0254212
  dcountry18 |   .0184553   .0110264     1.67   0.094     -.003158    .0400686
  dcountry19 |   -.020591   .0125199    -1.64   0.100    -.0451316    .0039497
  dcountry20 |   .0999315    .007164    13.95   0.000     .0858891    .1139739
  dcountry21 |   .0617405   .0096412     6.40   0.000     .0428423    .0806386
  dcountry22 |    .122823   .0148885     8.25   0.000     .0936394    .1520065
  dcountry23 |   .0522269   .0090813     5.75   0.000     .0344263    .0700275
  dcountry24 |   .0953119   .0072961    13.06   0.000     .0810106    .1096132
  dcountry25 |   .0871616   .0074867    11.64   0.000     .0724866    .1018366
  dcountry26 |   .0767276   .0123598     6.21   0.000     .0525007    .1009545
  dcountry27 |   .1505079   .0089821    16.76   0.000     .1329017     .168114
  dcountry28 |   .0631225    .007491     8.43   0.000     .0484392    .0778058
  dcountry29 |   .0897366   .0064394    13.94   0.000     .0771145    .1023588
  dcountry30 |   .0441381   .0146761     3.01   0.003      .015371    .0729052
       _cons |  -.2813399   .0177532   -15.85   0.000    -.3161386   -.2465411
-------------+----------------------------------------------------------------
      /sigma |   .0950012   .0010073                      .0930268    .0969756
------------------------------------------------------------------------------
  Obs. summary:      11804  left-censored observations at exp_sh~yEA40<=0
                      1906     uncensored observations
                         1 right-censored observation  at exp_sh~yEA40>=2.7831056
```

Table A6.7.4 Tobit Model - CEECs estimated results (exp_share_industryEA40)

```
tobit exp_share_industryEA40 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==1, ll ul vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       4720
                                                  F(  33,    4687) =      41.10
                                                  Prob > F        =     0.0000
Log pseudolikelihood = -134.40246                 Pseudo R2       =     0.7043

------------------------------------------------------------------------------
             |               Robust
exp_sh~yEA40 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0003865   .0001096     3.53   0.000     .0001716    .0006014
    emp_trng |  -.0044988   .0050389    -0.89   0.372    -.0143774    .0053798
 manager_exp |  -.0002216   .0002363    -0.94   0.348    -.0006849    .0002417
 new_org_str |    .011477   .0057928     1.98   0.048     .0001204    .0228336
new_prod_s~v |    .015488   .0050095     3.09   0.002     .0056671    .0253089
 new_methods |   .0094421   .0071799     1.32   0.189     -.004634    .0235182
```

location	.0203201	.0057138	3.56	0.000	.0091184	.0315218
lnsize	.0174494	.0147568	1.18	0.237	-.0114808	.0463796
lnsize_sqr	.0004086	.0020835	0.20	0.845	-.0036761	.0044934
lnage	.0042691	.013069	0.33	0.744	-.0213522	.0298904
lnage_sqr	-.0012806	.0024841	-0.52	0.606	-.0061507	.0035894
foreign_du~y	.0330351	.0075269	4.39	0.000	.0182788	.0477915
state_dummy	-.0266572	.0363078	-0.73	0.463	-.0978375	.0445232
credit	.0245357	.0045865	5.35	0.000	.015544	.0335273
low_mlow_t~h	.0549707	.0046199	11.90	0.000	.0459136	.0640278
mhigh_tech	.0664297	.006139	10.82	0.000	.0543945	.078465
high_tech	.0493743	.0106922	4.62	0.000	.0284126	.070336
dcountry1	.0069257	.0205598	0.34	0.736	-.0333812	.0472326
dcountry2	(omitted)					
dcountry3	(omitted)					
dcountry4	(omitted)					
dcountry5	(omitted)					
dcountry6	(omitted)					
dcountry7	(omitted)					
dcountry9	.0172215	.0192197	0.90	0.370	-.0204581	.0549011
dcountry10	.0227597	.0183313	1.24	0.214	-.0131783	.0586976
dcountry11	.0591845	.0184425	3.21	0.001	.0230285	.0953404
dcountry12	(omitted)					
dcountry13	(omitted)					
dcountry14	.0378957	.0187988	2.02	0.044	.0010413	.0747502
dcountry15	(omitted)					
dcountry16	.0400203	.0188493	2.12	0.034	.0030668	.0769738
dcountry17	(omitted)					
dcountry18	(omitted)					
dcountry19	(omitted)					
dcountry20	.0677503	.0187805	3.61	0.000	.0309316	.1045689
dcountry21	.0174913	.0204371	0.86	0.392	-.022575	.0575577
dcountry22	.0953556	.0229127	4.16	0.000	.0504359	.1402752
dcountry23	.0099697	.0199053	0.50	0.616	-.0290541	.0489935
dcountry24	.0602668	.0189231	3.18	0.001	.0231688	.0973649
dcountry25	.0520565	.0191285	2.72	0.007	.0145556	.0895574
dcountry26	.0414101	.0219355	1.89	0.059	-.0015938	.0844141
dcountry27	.1301859	.0196953	6.61	0.000	.0915738	.1687979
dcountry28	.0263816	.0191253	1.38	0.168	-.011113	.0638762
dcountry29	.0579011	.0184792	3.13	0.002	.0216731	.0941291
dcountry30	(omitted)					
_cons	-.2761549	.0336041	-8.22	0.000	-.3420348	-.210275
/sigma	.1169155	.0024827			.1120482	.1217829

```
  Obs. summary:       3613  left-censored observations at exp_sh~yEA40<=0
                      1106     uncensored observations
                         1 right-censored observation  at exp_sh~yEA40>=2.7831056
```

Table A6.7.5 Tobit Model - CIS estimated results (exp_share_industryEA40)

```
. tobit exp_share_industryEA40 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==0, ll ul vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
```

```
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Tobit regression                                  Number of obs   =       8991
                                                  F(  29,   8962) =      53.44
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  205.00306                 Pseudo R2       =     1.7119

------------------------------------------------------------------------------
             |               Robust
exp_sh~yEA40 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .000207   .0000355     5.84   0.000     .0001374    .0002765
    emp_trng |   .0070926   .0019616     3.62   0.000     .0032475    .0109377
 manager_exp |  -.0000864   .0000871    -0.99   0.321    -.0002572    .0000843
 new_org_str |   .0051088    .002322     2.20   0.028     .0005573    .0096604
new_prod_s~v |   .0057646   .0024728     2.33   0.020     .0009174    .0106117
 new_methods |  -.0055633   .0028732    -1.94   0.053    -.0111955    .0000688
    location |  -.0042069    .002877    -1.46   0.144    -.0098464    .0014326
      lnsize |   .0146043   .0029593     4.93   0.000     .0088033    .0204053
  lnsize_sqr |  -.0003244    .000344    -0.94   0.346    -.0009986    .0003498
       lnage |   .0037247   .0051718     0.72   0.471    -.0064132    .0138627
   lnage_sqr |  -.0004679   .0009956    -0.47   0.638    -.0024195    .0014837
foreign_du~y |   .0194927   .0045422     4.29   0.000      .010589    .0283964
 state_dummy |  -.0103103   .0070993    -1.45   0.146    -.0242266    .0036059
      credit |    .011547   .0018516     6.24   0.000     .0079175    .0151766
low_mlow_t~h |   .0156464   .0023885     6.55   0.000     .0109643    .0203284
  mhigh_tech |   .0304303   .0028799    10.57   0.000      .024785    .0360756
   high_tech |   .0333908    .004644     7.19   0.000     .0242875     .042494
   dcountry1 |  (omitted)
   dcountry2 |   .0326498   .0042014     7.77   0.000     .0244141    .0408855
   dcountry3 |   .0110373    .005651     1.95   0.051    -.0000401    .0221146
   dcountry4 |  -.0016969   .0064703    -0.26   0.793    -.0143802    .0109863
   dcountry5 |   .0433702   .0028348    15.30   0.000     .0378133    .0489272
   dcountry6 |   .0075572   .0032952     2.29   0.022     .0010979    .0140165
   dcountry7 |   .0003472   .0060022     0.06   0.954    -.0114185    .0121129
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -.0240828   .0060788    -3.96   0.000    -.0359987    -.012167
  dcountry13 |   .0212507   .0050353     4.22   0.000     .0113803     .031121
  dcountry14 |  (omitted)
  dcountry15 |  -.0195634   .0097196    -2.01   0.044    -.0386162   -.0005107
  dcountry16 |  (omitted)
  dcountry17 |   .0081085   .0054688     1.48   0.138    -.0026115    .0188285
  dcountry18 |   .0139034   .0062969     2.21   0.027     .0015601    .0262468
  dcountry19 |  -.0062268   .0067415    -0.92   0.356    -.0194417    .0069882
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
```

```
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons | -.1636361   .0086392   -18.94   0.000    -.1805708   -.1467014
-------------+----------------------------------------------------------------
      /sigma |   .0504779   .0001625                      .0501592    .0507965
------------------------------------------------------------------------------
  Obs. summary:       8191  left-censored observations at exp_sh~yEA40<=0
                       799     uncensored observations
                         1 right-censored observation  at exp_sh~yEA40>=1.2897083
```

Table A6.7.6 Tobit Model - Full sample estimated results (exp_share_totalEU28)

```
. tobit exp_share_totalEU28 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
ll ul vce(robust) nolog

Tobit regression                                  Number of obs   =      13711
                                                  F(  46,  13665) =      71.53
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  9126.4716                 Pseudo R2       =    -0.1528

------------------------------------------------------------------------------
             |               Robust
exp_sh~lEU28 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   2.45e-06   4.27e-07     5.74   0.000     1.61e-06    3.29e-06
    emp_trng |   .0000439   .0000208     2.11   0.035     3.11e-06    .0000848
 manager_exp |   1.30e-06   1.62e-06     0.80   0.423    -1.88e-06    4.47e-06
 new_org_str |   .0000901   .0000273     3.30   0.001     .0000366    .0001436
new_prod_s~v |   .0000724   .0000334     2.17   0.030     6.90e-06    .0001379
 new_methods |  -.0000121    .000034    -0.36   0.722    -.0000787    .0000546
    location |   .0000309   .0000306     1.01   0.313    -.0000291    .0000908
      lnsize |  -.0000169   .0000666    -0.25   0.800    -.0001474    .0001137
  lnsize_sqr |   .0000256   9.03e-06     2.83   0.005     7.86e-06    .0000433
       lnage |   .0000692   .0000668     1.04   0.300    -.0000616    .0002001
   lnage_sqr |  -.0000146   .0000143    -1.02   0.309    -.0000427    .0000135
foreign_du~y |   .0002607   .0000557     4.68   0.000     .0001516    .0003699
 state_dummy |  -.0001531   .0001201    -1.28   0.202    -.0003885    .0000822
      credit |   .0001441   .0000229     6.29   0.000     .0000992    .0001889
low_mlow_t~h |    .000354   .0000284    12.47   0.000     .0002983    .0004096
  mhigh_tech |   .0005351   .0000355    15.08   0.000     .0004656    .0006046
   high_tech |   .0004906   .0000523     9.38   0.000      .000388    .0005931
   dcountry1 |   .0004479    .000075     5.97   0.000     .0003008    .0005949
   dcountry2 |   .0004484   .0000611     7.34   0.000     .0003286    .0005681
   dcountry3 |   .0001403   .0000808     1.74   0.082     -.000018    .0002986
   dcountry4 |  -.0000316   .0000943    -0.33   0.738    -.0002164    .0001533
   dcountry5 |   .0006438   .0000433    14.86   0.000     .0005589    .0007287
   dcountry6 |   .0000707   .0000483     1.46   0.144    -.0000241    .0001655
   dcountry7 |   .0000192   .0000903     0.21   0.832    -.0001579    .0001963
   dcountry9 |    .000436   .0000589     7.40   0.000     .0003205    .0005515
  dcountry10 |    .000582   .0000858     6.78   0.000     .0004139    .0007502
  dcountry11 |   .0007218   .0000538    13.42   0.000     .0006164    .0008272
  dcountry12 |  -.0002976    .000096    -3.10   0.002    -.0004856   -.0001095
  dcountry13 |    .000283    .000073     3.88   0.000       .00014     .000426
  dcountry14 |   .0005757   .0000554    10.39   0.000      .000467    .0006843
  dcountry15 |  -.0003087   .0001367    -2.26   0.024    -.0005767   -.0000407
```

	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dcountry16	.0006046	.0000568	10.64	0.000	.0004932	.0007159
dcountry17	.0000786	.0000759	1.04	0.300	-.0000701	.0002273
dcountry18	.0001469	.0000851	1.73	0.084	-.00002	.0003137
dcountry19	-.0001323	.0000962	-1.38	0.169	-.000321	.0000563
dcountry20	.0007937	.0000565	14.04	0.000	.0006829	.0009046
dcountry21	.0004915	.0000737	6.67	0.000	.0003471	.000636
dcountry22	.0007798	.0000554	14.08	0.000	.0006712	.0008884
dcountry23	.0004338	.0000721	6.01	0.000	.0002924	.0005751
dcountry24	.0007331	.0000582	12.60	0.000	.0006191	.0008471
dcountry25	.0007008	.0000587	11.94	0.000	.0005858	.0008159
dcountry26	.0005231	.0000689	7.59	0.000	.000388	.0006582
dcountry27	.0011446	.000071	16.12	0.000	.0010054	.0012837
dcountry28	.000482	.0000594	8.12	0.000	.0003656	.0005984
dcountry29	.0007179	.0000528	13.60	0.000	.0006145	.0008214
dcountry30	.0003621	.000114	3.18	0.001	.0001386	.0005856
_cons	-.00202	.0001644	-12.29	0.000	-.0023422	-.0016978
/sigma	.0007084	.0000135			.000682	.0007348

```
  Obs. summary:      11804  left-censored observations at exp_sh~lEU28<=0
                      1906     uncensored observations
                         1 right-censored observation  at exp_sh~lEU28>=.01620722
```

Table A6.7.7 Tobit Model - Full sample estimated results (exp_share_totalEA40)

```
tobit exp_share_totalEA40 emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
ll ul vce(robust) nolog

Tobit regression                                  Number of obs   =      13711
                                                  F(  46,  13665) =      68.70
                                                  Prob > F        =     0.0000
Log pseudolikelihood =  7169.7945                 Pseudo R2       =    -0.2072
```

exp_sh~lEA40	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
emp_edu	7.16e-06	1.09e-06	6.55	0.000	5.02e-06	9.31e-06
emp_trng	.0001927	.0000569	3.39	0.001	.0000813	.0003042
manager_exp	8.40e-06	4.26e-06	1.97	0.049	3.75e-08	.0000168
new_org_str	.0002786	.0000906	3.08	0.002	.000101	.0004561
new_prod_s~v	.0001945	.0000833	2.34	0.020	.0000312	.0003578
new_methods	-.0000677	.0000734	-0.92	0.357	-.0002116	.0000763
location	-.0000123	.0000698	-0.18	0.860	-.0001492	.0001245
lnsize	-.0000993	.0001242	-0.80	0.424	-.0003428	.0001441
lnsize_sqr	.0000785	.0000164	4.78	0.000	.0000463	.0001107
lnage	.0002099	.0001759	1.19	0.233	-.0001349	.0005547
lnage_sqr	-.0000436	.0000365	-1.19	0.232	-.0001151	.000028
foreign_du~y	.0006105	.0001052	5.80	0.000	.0004042	.0008168
state_dummy	-.0006144	.0003046	-2.02	0.044	-.0012116	-.0000173
credit	.0003727	.0000659	5.65	0.000	.0002435	.0005019
low_mlow_t~h	.0009572	.0000658	14.55	0.000	.0008283	.0010862
mhigh_tech	.0016089	.0001343	11.98	0.000	.0013457	.001872
high_tech	.0013558	.0001384	9.79	0.000	.0010844	.0016271
dcountry1	.0014232	.0002009	7.08	0.000	.0010293	.0018171
dcountry2	.001413	.0001679	8.42	0.000	.001084	.0017421
dcountry3	.0005487	.0002278	2.41	0.016	.000102	.0009953
dcountry4	.0000439	.0002658	0.17	0.869	-.000477	.0005649
dcountry5	.0021829	.0001352	16.15	0.000	.001918	.0024478

```
   dcountry6 |   .0003125   .0001324     2.36   0.018      .000053    .0005721
   dcountry7 |   .0001102   .0002467     0.45   0.655    -.0003733    .0005938
   dcountry9 |   .0012788    .000161     7.94   0.000     .0009632    .0015944
  dcountry10 |   .0015237   .0001509    10.09   0.000     .0012278    .0018196
  dcountry11 |   .0021604   .0001434    15.06   0.000     .0018793    .0024416
  dcountry12 |  -.0008531   .0002615    -3.26   0.001    -.0013656   -.0003406
  dcountry13 |   .0009613   .0002008     4.79   0.000     .0005676    .0013549
  dcountry14 |   .0017207   .0001544    11.14   0.000      .001418    .0020234
  dcountry15 |  -.0007299   .0003837    -1.90   0.057     -.001482    .0000222
  dcountry16 |   .0018049   .0001611    11.21   0.000     .0014892    .0021206
  dcountry17 |   .0004057   .0002091     1.94   0.052    -4.19e-06    .0008156
  dcountry18 |   .0005146   .0002343     2.20   0.028     .0000553    .0009738
  dcountry19 |  -.0002001   .0002707    -0.74   0.460    -.0007307    .0003305
  dcountry20 |   .0023383   .0001558    15.01   0.000     .0020329    .0026437
  dcountry21 |   .0014902   .0002089     7.13   0.000     .0010807    .0018996
  dcountry22 |   .0025249   .0001767    14.29   0.000     .0021784    .0028713
  dcountry23 |   .0012415   .0002021     6.14   0.000     .0008454    .0016376
  dcountry24 |   .0021852   .0001611    13.56   0.000     .0018694    .0025009
  dcountry25 |   .0020638   .0001621    12.73   0.000      .001746    .0023816
  dcountry26 |   .0017114   .0002041     8.38   0.000     .0013112    .0021116
  dcountry27 |   .0029164   .0001619    18.01   0.000      .002599    .0032338
  dcountry28 |   .0014042   .0001662     8.45   0.000     .0010785      .00173
  dcountry29 |   .0020566   .0001433    14.35   0.000     .0017757    .0023375
  dcountry30 |   .0011452   .0003207     3.57   0.000     .0005167    .0017738
       _cons |  -.0058208   .0003132   -18.59   0.000    -.0064346    -.005207
-------------+----------------------------------------------------------------
      /sigma |   .0020043    .000019                      .0019671    .0020415
------------------------------------------------------------------------------
  Obs. summary:      11804  left-censored observations at exp_sh~lEA40<=0
                      1906     uncensored observations
                         1 right-censored observation  at exp_sh~lEA40>=.04731133
```

Fractional Logit Model

Table A6.8 Fractional Logit Model - Full sample estimated results (exp_share_industryEU28)

```
glm exp_share_industryEU28prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
family(binomial) link (logit) vce(robust) nolog
note: exp_share_industryEU28prp has noninteger values

Generalized linear models                         No. of obs      =     13711
Optimization     : ML                             Residual df     =     13664
                                                  Scale parameter =         1
Deviance         =  .5364689611                   (1/df) Deviance =  .0000393
Pearson          =   6.46693427                   (1/df) Pearson  =  .0004733

Variance function: V(u) = u*(1-u/1)               [Binomial]
Link function    : g(u) = ln(u/(1-u))             [Logit]

                                                  AIC             =  .0069758
Log pseudolikelihood = -.8225242229               BIC             = -130162.1

------------------------------------------------------------------------------
             |               Robust
exp~yEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .017534   .0175228     1.00   0.317     -.01681     .051878
    emp_trng |  -.3187703   .3563888    -0.89   0.371    -1.01728     .3797389
```

manager_exp	-.0482272	.0448921	-1.07	0.283	-.1362141	.0397596
new_org_str	1.446875	.5674272	2.55	0.011	.3347382	2.559012
new_prod_s~v	-.3886401	.5733063	-0.68	0.498	-1.5123	.7350197
new_methods	-.510409	.6171066	-0.83	0.408	-1.719916	.6990977
location	1.073224	1.311746	0.82	0.413	-1.49775	3.644199
lnsize	-.2507469	.8899208	-0.28	0.778	-1.99496	1.493466
lnsize_sqr	.0796062	.0758359	1.05	0.294	-.0690294	.2282418
lnage	.5516593	1.408667	0.39	0.695	-2.209278	3.312597
lnage_sqr	-.0907862	.2384432	-0.38	0.703	-.5581261	.3765538
foreign_du~y	-.6375387	.8631402	-0.74	0.460	-2.329262	1.054185
state_dummy	-1.429663	1.319222	-1.08	0.278	-4.01529	1.155964
credit	1.663272	.5425054	3.07	0.002	.599981	2.726563
low_mlow_t~h	-3.09368	.4109512	-7.53	0.000	-3.899129	-2.28823
mhigh_tech	-2.637556	.5586788	-4.72	0.000	-3.732546	-1.542566
high_tech	-3.50437	.5930157	-5.91	0.000	-4.66666	-2.342081
dcountry1	.1376496	1.726574	0.08	0.936	-3.246373	3.521672
dcountry2	-2.119254	.8862206	-2.39	0.017	-3.856214	-.3822931
dcountry3	-3.95886	1.242407	-3.19	0.001	-6.393934	-1.523786
dcountry4	-3.564329	1.179221	-3.02	0.003	-5.87556	-1.253099
dcountry5	.4310945	.9543721	0.45	0.651	-1.439441	2.301629
dcountry6	-4.558481	.5658257	-8.06	0.000	-5.667479	-3.449483
dcountry7	-2.269972	1.163166	-1.95	0.051	-4.549736	.0097919
dcountry9	-1.198536	.7359417	-1.63	0.103	-2.640955	.2438834
dcountry10	-1.091361	.6897482	-1.58	0.114	-2.443243	.2605205
dcountry11	-.9941827	.8846769	-1.12	0.261	-2.728118	.7397521
dcountry12	-4.069419	1.049649	-3.88	0.000	-6.126694	-2.012144
dcountry13	-2.415779	1.303752	-1.85	0.064	-4.971086	.1395282
dcountry14	-1.609517	.7509327	-2.14	0.032	-3.081318	-.1377163
dcountry15	-9.35746	1.209284	-7.74	0.000	-11.72761	-6.987307
dcountry16	-1.379869	1.259945	-1.10	0.273	-3.849316	1.089578
dcountry17	-5.731202	1.2006	-4.77	0.000	-8.084335	-3.378069
dcountry18	-.3544237	.9195549	-0.39	0.700	-2.156718	1.447871
dcountry19	-5.304807	1.1761	-4.51	0.000	-7.60992	-2.999694
dcountry20	-.4740049	.9174568	-0.52	0.605	-2.272187	1.324177
dcountry21	-.545601	1.369012	-0.40	0.690	-3.228815	2.137613
dcountry22	.8372287	1.122799	0.75	0.456	-1.363417	3.037874
dcountry23	-.2332559	1.49919	-0.16	0.876	-3.171614	2.705102
dcountry24	-.5960164	1.644138	-0.36	0.717	-3.818468	2.626436
dcountry25	-1.097629	.8965445	-1.22	0.221	-2.854824	.6595656
dcountry26	.0199386	1.199998	0.02	0.987	-2.332015	2.371892
dcountry27	2.446124	.4750827	5.15	0.000	1.514979	3.377269
dcountry28	-1.031715	.7723546	-1.34	0.182	-2.545502	.4820725
dcountry29	-.2735006	.6565029	-0.42	0.677	-1.560223	1.013222
dcountry30	-.8331052	1.491635	-0.56	0.576	-3.756656	2.090445
_cons	-13.84364	4.094587	-3.38	0.001	-21.86889	-5.8184

Table A6.8.1 Fractional Logit Model - CEECs estimated results (exp_share_industryEU28)

```
glm exp_share_industryEU28prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==1, family (binomial) link (logit) vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
```

```
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_share_industryEU28prp has noninteger values

Generalized linear models                         No. of obs      =       4720
Optimization     : ML                             Residual df     =       4686
                                                  Scale parameter =          1
Deviance         =  .2831471323                   (1/df) Deviance =   .0000604
Pearson          =  4.452913879                   (1/df) Pearson  =   .0009503

Variance function: V(u) = u*(1-u/1)               [Binomial]
Link function    : g(u) = ln(u/(1-u))             [Logit]

                                                  AIC             =   .0146219
Log pseudolikelihood = -.5075938772               BIC             =  -39641.23

------------------------------------------------------------------------------
             |               Robust
exp~yEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0021494   .0085893     0.25   0.802    -.0146852    .0189841
    emp_trng |  -.5936601    .464368    -1.28   0.201    -1.503805    .3164844
 manager_exp |  -.0218334   .0288327    -0.76   0.449    -.0783446    .0346777
 new_org_str |   .9065984   .3642762     2.49   0.013     .1926301    1.620567
new_prod_s~v |   .5247244   .3576392     1.47   0.142    -.1762355    1.225684
 new_methods |  -.5948629   .6073991    -0.98   0.327    -1.785343    .5956173
    location |   1.799245   1.010638     1.78   0.075     -.181569     3.78006
      lnsize |  -1.339983   .8513932    -1.57   0.116    -3.008683    .3287165
  lnsize_sqr |   .1739963   .0898802     1.94   0.053    -.0021657    .3501582
       lnage |  -.7400989   .9860152    -0.75   0.453    -2.672653    1.192455
   lnage_sqr |   .0938882   .2808892     0.33   0.738    -.4566446    .6444209
foreign_du~y |    -.83657   1.046452    -0.80   0.424    -2.887579    1.214439
 state_dummy |   -2.17678   1.589821    -1.37   0.171    -5.292772    .9392114
      credit |   .9742668   .5098582     1.91   0.056     -.025037    1.973571
low_mlow_t~h |  -2.775479   .3658784    -7.59   0.000    -3.492587    -2.05837
  mhigh_tech |  -2.645133   .5346479    -4.95   0.000    -3.693023   -1.597242
   high_tech |  -3.162293   .8367406    -3.78   0.000    -4.802274   -1.522311
   dcountry1 |   .3638626   1.153309     0.32   0.752    -1.896581    2.624306
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |   .0135349   1.216595     0.01   0.991    -2.370948    2.398018
  dcountry10 |  -.3365125   .8980292    -0.37   0.708    -2.096617    1.423592
  dcountry11 |  -.2237898   .8589291    -0.26   0.794     -1.90726     1.45968
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |  -.7275774   1.038369    -0.70   0.483    -2.762743    1.307588
  dcountry15 |  (omitted)
  dcountry16 |  -.9967144   .8633925    -1.15   0.248    -2.688933    .6955039
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |   .3325825   1.126556     0.30   0.768    -1.875427    2.540592
  dcountry21 |  -.1489474   1.077526    -0.14   0.890     -2.26086    1.962965
```

```
  dcountry22 |   1.359818   1.013161     1.34   0.180    -.6259404    3.345577
  dcountry23 |    .078199   1.063097     0.07   0.941    -2.005433    2.161831
  dcountry24 |  -.7802287   1.293745    -0.60   0.546    -3.315922    1.755465
  dcountry25 |  -.2978322   .9542082    -0.31   0.755    -2.168046    1.572382
  dcountry26 |   .7283198   1.064967     0.68   0.494    -1.358976    2.815616
  dcountry27 |    3.59483   1.343665     2.68   0.007     .9612957    6.228364
  dcountry28 |  -.0609036   .9308233    -0.07   0.948    -1.885284    1.763476
  dcountry29 |   .5316472   .8874161     0.60   0.549    -1.207656    2.270951
  dcountry30 |  (omitted)
       _cons |  -10.24436    1.15669    -8.86   0.000    -12.51143    -7.97729
```

Table A6.8.3 Fractional Logit Model - Full sample estimated results (exp_share_industryEA40)

```
. glm  exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30,  family(binomial) link (logit) vce(robust) nolog
note: exp_share_industryEA40prp has noninteger values

Generalized linear models                          No. of obs      =     13711
Optimization     : ML                              Residual df     =     13664
                                                   Scale parameter =         1
Deviance         =  .8191251163                    (1/df) Deviance =  .0000599
Pearson          =  9.808617362                    (1/df) Pearson  =  .0007178

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =  .0070351
Log pseudolikelihood = -1.229238223                BIC             = -130161.8

------------------------------------------------------------------------------
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |     .02218   .0127918     1.73   0.083    -.0028914    .0472514
    emp_trng |  -.3040897   .5314622    -0.57   0.567    -1.345737    .7375571
 manager_exp |  -.0320983    .029282    -1.10   0.273      -.08949    .0252934
 new_org_str |   .5422974    .624063     0.87   0.385    -.6808436    1.765438
new_prod_s~v |  -.0503573   .5168732    -0.10   0.922     -1.06341    .9626957
 new_methods |   .1548825   .6840044     0.23   0.821    -1.185741    1.495506
    location |   .9515567   .6242008     1.52   0.127    -.2718544    2.174968
      lnsize |   .7408058   .7406584     1.00   0.317    -.7108579     2.19247
  lnsize_sqr |  -.0201794   .0607604    -0.33   0.740    -.1392676    .0989088
       lnage |  -.6990683   .9059487    -0.77   0.440    -2.474695    1.076558
   lnage_sqr |   .1668978   .1586455     1.05   0.293    -.1440416    .4778372
foreign_du~y |   -.543913   .5206579    -1.04   0.296    -1.564384    .4765576
 state_dummy |  -1.947326   .9140737    -2.13   0.033    -3.738877   -.1557741
      credit |   1.257123   .3829603     3.28   0.001     .5065343    2.007711
low_mlow_t~h |  -2.830179   .5018247    -5.64   0.000    -3.813738   -1.846621
  mhigh_tech |  -2.474282   .8912344    -2.78   0.005    -4.221069   -.7274942
   high_tech |  -4.568333   .7325935    -6.24   0.000     -6.00419   -3.132476
   dcountry1 |   .4650324   1.205571     0.39   0.700    -1.897843    2.827908
   dcountry2 |  -1.935166   .7459083    -2.59   0.009     -3.39712   -.4732127
   dcountry3 |  -3.810794   .9397904    -4.05   0.000     -5.65275   -1.968839
   dcountry4 |  -3.425192   .9943813    -3.44   0.001    -5.374143    -1.47624
   dcountry5 |   2.084767   .6535781     3.19   0.001     .8037776    3.365757
   dcountry6 |  -4.953387   .5222625    -9.48   0.000    -5.977003   -3.929771
   dcountry7 |   -2.39841   .9111104    -2.63   0.008    -4.184154   -.6126664
```

```
   dcountry9 |   -1.09333    .799111    -1.37   0.171    -2.659559    .4728989
  dcountry10 |  -.9007014   .5807212    -1.55   0.121    -2.038894    .2374912
  dcountry11 |  -.8602172   .6215399    -1.38   0.166    -2.078413    .3579786
  dcountry12 |  -3.942818   .8848224    -4.46   0.000    -5.677038   -2.208598
  dcountry13 |  -2.219384   1.044372    -2.13   0.034    -4.266315   -.1724522
  dcountry14 |  -1.343078   .6974981    -1.93   0.054    -2.710149    .0239934
  dcountry15 |  -9.569105   .7062365   -13.55   0.000     -10.9533   -8.184907
  dcountry16 |  -.8863265   .7178081    -1.23   0.217    -2.293205    .5205516
  dcountry17 |  -5.680102   .7985987    -7.11   0.000    -7.245326   -4.114877
  dcountry18 |   -.242302   .8887209    -0.27   0.785    -1.984163    1.499559
  dcountry19 |  -5.223791    .979745    -5.33   0.000    -7.144056   -3.303526
  dcountry20 |  -.3174275     .79925    -0.40   0.691    -1.883929    1.249074
  dcountry21 |  -.2183173   .9853834    -0.22   0.825    -2.149633    1.712999
  dcountry22 |   4.018228   .6903704     5.82   0.000     2.665127    5.371329
  dcountry23 |  -.2196033   1.043453    -0.21   0.833    -2.264733    1.825526
  dcountry24 |  -.1963268   .9301564    -0.21   0.833      -2.0194    1.626746
  dcountry25 |  -.8711851   .7165748    -1.22   0.224    -2.275646    .5332756
  dcountry26 |   2.919595   .8322313     3.51   0.000     1.288452    4.550739
  dcountry27 |   3.005801   .7095557     4.24   0.000     1.615098    4.396505
  dcountry28 |  -.8164421   .7319124    -1.12   0.265    -2.250964    .6180797
  dcountry29 |   .0180945   .6133464     0.03   0.976    -1.184042    1.220231
  dcountry30 |  -.4706032   1.034093    -0.46   0.649    -2.497388    1.556181
       _cons |   -14.6819   2.688824    -5.46   0.000     -19.9519   -9.411904
------------------------------------------------------------------------------
------------------------------------------------------------------------------
```

Table A6.8.4 Fractional Logit Model - CEECs estimated results (exp_share_industryEA40)

```
glm exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==1, family (binomial) link (logit) vce(robust) nolog
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_share_industryEA40prp has noninteger values

Generalized linear models                          No. of obs      =      4720
Optimization     : ML                              Residual df     =      4686
                                                   Scale parameter =         1
Deviance         =  .5486464385                    (1/df) Deviance =  .0001171
Pearson          =  4.475587223                    (1/df) Pearson  =  .0009551

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =  .0147736
Log pseudolikelihood = -.8656415968                BIC             = -39640.97

------------------------------------------------------------------------------
```

```
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0146112   .0115953     1.26   0.208    -.0081153    .0373376
    emp_trng |  -.5505861   .7242207    -0.76   0.447    -1.970032    .8688603
 manager_exp |  -.0258946   .0227011    -1.14   0.254    -.0703879    .0185988
 new_org_str |  -.0555505   .5540278    -0.10   0.920    -1.141425    1.030324
new_prod_s~v |   .4980572   .5499598     0.91   0.365    -.5798442    1.575959
 new_methods |   .4868794   .6418652     0.76   0.448    -.7711534    1.744912
    location |   1.228414   .6104021     2.01   0.044     .0320479     2.42478
      lnsize |    .301671   .7796611     0.39   0.699    -1.226437    1.829779
  lnsize_sqr |   .0135456   .0634167     0.21   0.831    -.1107489    .1378401
       lnage |  -1.935664   .7371804    -2.63   0.009    -3.380511   -.4908172
   lnage_sqr |   .3778139   .1779189     2.12   0.034     .0290992    .7265286
foreign_du~y |  -.4203342   .5178233    -0.81   0.417    -1.435249    .5945808
 state_dummy |  -3.918893   1.390037    -2.82   0.005    -6.643316   -1.194469
      credit |   .9583705   .4450475     2.15   0.031     .0860934    1.830648
low_mlow_t~h |     -3.487   .7755941    -4.50   0.000    -5.007137   -1.966864
  mhigh_tech |  -4.012746   1.188074    -3.38   0.001    -6.341328   -1.684164
   high_tech |  -4.719881   .9271386    -5.09   0.000    -6.537039   -2.902722
   dcountry1 |   .3695341   1.419664     0.26   0.795    -2.412956    3.152024
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |  -.5692175   1.105551    -0.51   0.607    -2.736058    1.597623
  dcountry10 |  -.5416597   .8758209    -0.62   0.536    -2.258237    1.174918
  dcountry11 |  -.5702165   .8782973    -0.65   0.516    -2.291648    1.151215
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |  -.9914775   .9004713    -1.10   0.271    -2.756369    .7734139
  dcountry15 |  (omitted)
  dcountry16 |  -.5276866   .8952854    -0.59   0.556    -2.282414    1.227041
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |  -.1795567   1.090953    -0.16   0.869    -2.317785    1.958672
  dcountry21 |  -.2615439   1.141564    -0.23   0.819    -2.498969    1.975881
  dcountry22 |   4.199747   .8925361     4.71   0.000     2.450409    5.949086
  dcountry23 |  -.1006133   1.068607    -0.09   0.925    -2.195045    1.993818
  dcountry24 |  -.0761112   1.119367    -0.07   0.946    -2.270031    2.117808
  dcountry25 |  -.5033778   1.036709    -0.49   0.627    -2.535291    1.528535
  dcountry26 |   3.202038   1.181476     2.71   0.007     .8863865    5.517689
  dcountry27 |    3.45576   1.048642     3.30   0.001      1.40046    5.511061
  dcountry28 |  -.3037091   .8926908    -0.34   0.734    -2.053351    1.445933
  dcountry29 |   .3385258   .8060203     0.42   0.674    -1.241245    1.918297
  dcountry30 |  (omitted)
       _cons |  -11.99623   1.771698    -6.77   0.000     -15.4687   -8.523767
```

Table A6.8.5 Fractional Logit Model - CIS estimated results (exp_share_industryEA40)

```
. glm exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods  location  lnsize  lnsize_sqr  lnage  lnage_sqr  foreign_dummy  state_dummy
credit   low_mlow_tech   mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30
if CEEC_dummy==0, family (binomial) link (logit) vce(robust) nolog
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
```

```
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity
note: exp_share_industryEA40prp has noninteger values

Generalized linear models                          No. of obs      =       8991
Optimization     : ML                              Residual df     =       8961
                                                   Scale parameter =          1
Deviance         =  .1469078164                    (1/df) Deviance =   .0000164
Pearson          =   3.19543434                    (1/df) Pearson  =   .0003566

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =   .0067405
Log pseudolikelihood = -.3018111954                BIC             = -81580.61

------------------------------------------------------------------------------
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0319399   .0075902     4.21   0.000     .0170635    .0468164
    emp_trng |   .4981691   .3630256     1.37   0.170     -.213348    1.209686
 manager_exp |  -.0549823   .0242832    -2.26   0.024    -.1025765    -.007388
 new_org_str |   1.652994   .3270995     5.05   0.000      1.01189    2.294097
new_prod_s~v |  -2.146064   .6128006    -3.50   0.000    -3.347131   -.9449965
 new_methods |   -.142293   .5479538    -0.26   0.795    -1.216263    .9316767
    location |  -.7343858   .4985229    -1.47   0.141    -1.711473    .2427011
      lnsize |   1.701615   .7011476     2.43   0.015     .3273907    3.075839
  lnsize_sqr |  -.0469013   .0722454    -0.65   0.516    -.1884996    .0946971
       lnage |   1.059444   1.796578     0.59   0.555    -2.461784    4.580672
   lnage_sqr |  -.0993743   .2946603    -0.34   0.736    -.6768979    .4781493
foreign_du~y |   .7195405   .6319416     1.14   0.255    -.5190422    1.958123
 state_dummy |   -3.29492   1.222911    -2.69   0.007    -5.691781   -.8980596
      credit |   1.746161   .3249532     5.37   0.000     1.109264    2.383057
low_mlow_t~h |  -3.457221   .5623153    -6.15   0.000    -4.559339   -2.355104
  mhigh_tech |  -1.952341   .5820663    -3.35   0.001     -3.09317   -.8115117
   high_tech |  -5.957144   .8816754    -6.76   0.000    -7.685196   -4.229092
   dcountry1 |  (omitted)
   dcountry2 |  -1.526329   .8436152    -1.81   0.070    -3.179785    .1271261
   dcountry3 |  -1.664297   .7705986    -2.16   0.031    -3.174642    -.153951
   dcountry4 |  -1.594665   .8649672    -1.84   0.065    -3.289969    .1006397
   dcountry5 |   2.631386   .4551825     5.78   0.000     1.739245    3.523528
   dcountry6 |  -4.371962   .5200416    -8.41   0.000    -5.391225     -3.3527
   dcountry7 |  -1.533996   .9967898    -1.54   0.124    -3.487668    .4196764
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -5.042725   1.153433    -4.37   0.000    -7.303412   -2.782038
  dcountry13 |   -1.29342    .632941    -2.04   0.041    -2.533961   -.0528783
  dcountry14 |  (omitted)
  dcountry15 |  -8.670242    .752831   -11.52   0.000    -10.14576   -7.194721
```

```
  dcountry16 |  (omitted)
  dcountry17 | -4.482531   .8390482    -5.34   0.000    -6.127035   -2.838027
  dcountry18 |  1.169928   .7270204     1.61   0.108    -.2550061    2.594861
  dcountry19 | -3.848503   .9963971    -3.86   0.000    -5.801406   -1.895601
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons | -22.47224   2.636972    -8.52   0.000    -27.64061   -17.30387
------------------------------------------------------------------------------
------------------------------------------------------------------------------
```

Table A6.8.6 Fractional Logit Model - Full sample estimated results (exp_share_totalEU28)

```
glm  exp_share_totalEU28prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
family(binomial) link (logit) vce(robust) nolog
note: exp_share_totalEU28prp has noninteger values

Generalized linear models                         No. of obs      =     13711
Optimization     : ML                             Residual df     =     13664
                                                  Scale parameter =         1
Deviance         =  .0091922294                   (1/df) Deviance =  6.73e-07
Pearson          =  .1703993822                   (1/df) Pearson  =  .0000125

Variance function: V(u) = u*(1-u/1)               [Binomial]
Link function    : g(u) = ln(u/(1-u))             [Logit]

                                                  AIC             =  .0068602
Log pseudolikelihood = -.0298456656               BIC             = -130162.6

------------------------------------------------------------------------------
             |               Robust
exp~lEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0102515   .0060585     1.69   0.091    -.0016229     .022126
    emp_trng |   .0700893   .2789193     0.25   0.802    -.4765825    .6167611
 manager_exp |   .0048763   .0139782     0.35   0.727    -.0225204     .032273
 new_org_str |   .7777995   .2879819     2.70   0.007     .2133653    1.342234
new_prod_s~v |  -.4420262   .3771592    -1.17   0.241    -1.181245    .2971922
 new_methods |   -.067679   .3862816    -0.18   0.861    -.8247771    .6894191
    location |   .2570956   .3267371     0.79   0.431    -.3832973    .8974885
      lnsize |   .6211288   .4082763     1.52   0.128     -.179078    1.421336
  lnsize_sqr |   .0270868   .0343838     0.79   0.431    -.0403043    .0944779
       lnage |   .2946242   .7681426     0.38   0.701    -1.210908    1.800156
   lnage_sqr |    -.06568   .1221753    -0.54   0.591    -.3051392    .1737791
foreign_du~y |    .482825   .4411376     1.09   0.274    -.3817889    1.347439
 state_dummy |  -.1425061   .7060533    -0.20   0.840    -1.526345    1.241333
      credit |   .4370012   .3261994     1.34   0.180    -.2023379     1.07634
low_mlow_t~h |   1.238472   .2961691     4.18   0.000     .6579912    1.818953
  mhigh_tech |   1.776708   .3189587     5.57   0.000      1.15156    2.401855
   high_tech |   1.053778   .3854378     2.73   0.006     .2983336    1.809222
```

```
   dcountry1 |   1.021708   .8679125     1.18   0.239    -.6793691    2.722785
   dcountry2 |  -.7518966    .458067    -1.64   0.101    -1.649691    .1458983
   dcountry3 |  -.9397037   .7283145    -1.29   0.197    -2.367174    .4877665
   dcountry4 |  -1.938677   .7127912    -2.72   0.007    -3.335722   -.5416319
   dcountry5 |   1.778889   .3244577     5.48   0.000     1.142964    2.414815
   dcountry6 |  -3.063079   .4255294    -7.20   0.000    -3.897101   -2.229057
   dcountry7 |   .2739103   .5437428     0.50   0.614    -.7918059    1.339627
   dcountry9 |   .3495438   .6589019     0.53   0.596    -.9418802    1.640968
  dcountry10 |   2.348841   .6204801     3.79   0.000     1.132722     3.56496
  dcountry11 |   .5160964    .619495     0.83   0.405    -.6980915    1.730284
  dcountry12 |  -.6444332   .7993744    -0.81   0.420    -2.211178    .9223118
  dcountry13 |  -1.979101   .5911746    -3.35   0.001    -3.137782   -.8204204
  dcountry14 |   .3723623   .4715742     0.79   0.430     -.551906    1.296631
  dcountry15 |  -6.064252   .4950893   -12.25   0.000    -7.034609   -5.093895
  dcountry16 |   .4509819   .4212662     1.07   0.284    -.3746847    1.276649
  dcountry17 |  -2.418578   .5898173    -4.10   0.000    -3.574599   -1.262557
  dcountry18 |   .0786339   .6652044     0.12   0.906    -1.225143     1.38241
  dcountry19 |  -5.454489   .5452115   -10.00   0.000    -6.523083   -4.385894
  dcountry20 |   1.651259   .3989213     4.14   0.000     .8693876     2.43313
  dcountry21 |   .4076505   .5758895     0.71   0.479    -.7210722    1.536373
  dcountry22 |   1.410104   .4639114     3.04   0.002     .5008544    2.319354
  dcountry23 |   1.570908   .4771399     3.29   0.001     .6357309    2.506085
  dcountry24 |   .7273101   .4036736     1.80   0.072    -.0638757    1.518496
  dcountry25 |   1.215988   .4391765     2.77   0.006     .3552174    2.076758
  dcountry26 |     1.2518   .5281965     2.37   0.018     .2165535    2.287046
  dcountry27 |   3.092886   .5108193     6.05   0.000     2.091698    4.094073
  dcountry28 |   .6088115   .5032109     1.21   0.226    -.3774638    1.595087
  dcountry29 |   1.349164   .3590623     3.76   0.000     .6454144    2.052913
  dcountry30 |   .2018115   .6612708     0.31   0.760    -1.094255    1.497878
       _cons |  -21.63777    1.79468   -12.06   0.000    -25.15527   -18.12026
```

Table A6.8.7 Fractional Logit Model - Full sample estimated results (exp_share_totalEA40)

```
. glm  exp_share_totalEA40prp emp_edu emp_trng manager_exp new_org_str new_prod_serv
new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy state_dummy
credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7 dcountry9-dcountry30,
family(binomial) link (logit) vce(robust) nolog
note: exp_share_totalEA40prp has noninteger values

Generalized linear models                          No. of obs      =     13711
Optimization     : ML                              Residual df     =     13664
                                                   Scale parameter =         1
Deviance         =  .0166336684                    (1/df) Deviance =  1.22e-06
Pearson          =  .4415905945                    (1/df) Pearson  =  .0000323

Variance function: V(u) = u*(1-u/1)                [Binomial]
Link function    : g(u) = ln(u/(1-u))              [Logit]

                                                   AIC             =  .0068651
Log pseudolikelihood = -.0635955274                BIC             = -130162.6

------------------------------------------------------------------------------
             |               Robust
exp~lEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0054549   .0058363     0.93   0.350     -.005984    .0168939
    emp_trng |    .901092   .2624347     3.43   0.001     .3867295    1.415454
 manager_exp |   .0166454   .0073567     2.26   0.024     .0022265    .0310642
 new_org_str |   .5731831   .2969992     1.93   0.054    -.0089246    1.155291
new_prod_s~v |  -.6330994   .4258754    -1.49   0.137      -1.4678     .201601
```

```
 new_methods |   -.047523   .2708151    -0.18   0.861    -.5783109    .4832649
    location |  -.2170851   .3472616    -0.63   0.532    -.8977053    .4635351
      lnsize |   .7706998   .3759321     2.05   0.040     .0338864    1.507513
  lnsize_sqr |   .0129779   .0307303     0.42   0.673    -.0472525    .0732082
       lnage |   .9841441   .7947112     1.24   0.216    -.5734613    2.541749
   lnage_sqr |  -.1637291   .1296311    -1.26   0.207    -.4178014    .0903432
foreign_du~y |   .3908583   .3543054     1.10   0.270    -.3035676    1.085284
 state_dummy |  -.9691404    .823058    -1.18   0.239    -2.582305    .6440237
      credit |   .2750194   .2274376     1.21   0.227    -.1707501    .7207889
low_mlow_t~h |   1.264254   .3399928     3.72   0.000       .59788    1.930627
  mhigh_tech |   2.294051   .3412392     6.72   0.000     1.625234    2.962867
   high_tech |   1.111373   .3805405     2.92   0.003     .3655278    1.857219
   dcountry1 |   1.474325   .8914759     1.65   0.098    -.2729355    3.221586
   dcountry2 |  -.5880718    .536527    -1.10   0.273    -1.639645    .4635019
   dcountry3 |  -.9519023    .837041    -1.14   0.255    -2.592473     .688668
   dcountry4 |  -1.898963   .7202937    -2.64   0.008    -3.310713   -.4872135
   dcountry5 |   3.094383   .3451714     8.96   0.000      2.41786    3.770907
   dcountry6 |  -3.150119    .448991    -7.02   0.000    -4.030125   -2.270113
   dcountry7 |   .3239171   .6549143     0.49   0.621    -.9596913    1.607525
   dcountry9 |   .1738141   .6561895     0.26   0.791    -1.112294    1.459922
  dcountry10 |   2.285596   .6910942     3.31   0.001     .9310761    3.640116
  dcountry11 |   .7506649   .6133723     1.22   0.221    -.4515227    1.952852
  dcountry12 |  -1.176597    .792636    -1.48   0.138    -2.730135    .3769406
  dcountry13 |  -1.853847   .6377847    -2.91   0.004    -3.103882   -.6038121
  dcountry14 |   .2646183   .5081369     0.52   0.603    -.7313118    1.260548
  dcountry15 |  -4.994691   .5256045    -9.50   0.000    -6.024857   -3.964525
  dcountry16 |   .5170856   .4819567     1.07   0.283     -.427532    1.461703
  dcountry17 |  -2.730187   .6591965    -4.14   0.000    -4.022189   -1.438186
  dcountry18 |    .328765    .708211     0.46   0.642    -1.059303    1.716833
  dcountry19 |  -4.898316   .5806934    -8.44   0.000    -6.036454   -3.760178
  dcountry20 |   1.652069   .4635676     3.56   0.000     .7434928    2.560645
  dcountry21 |   .5294193   .6094317     0.87   0.385     -.665045    1.723884
  dcountry22 |   3.104803   .5370916     5.78   0.000     2.052123    4.157483
  dcountry23 |   1.683344   .4602161     3.66   0.000     .7813374    2.585351
  dcountry24 |   .8713315   .4557407     1.91   0.056    -.0219039    1.764567
  dcountry25 |   1.261629   .4733356     2.67   0.008      .333908     2.18935
  dcountry26 |   2.949672   .5509885     5.35   0.000     1.869755     4.02959
  dcountry27 |   3.104954   .5472837     5.67   0.000     2.032298    4.177611
  dcountry28 |   .5064138   .5147812     0.98   0.325    -.5025387    1.515366
  dcountry29 |   1.336378   .4392146     3.04   0.002      .475533    2.197222
  dcountry30 |   .4201972   .5908106     0.71   0.477    -.7377704    1.578165
       _cons |  -23.68668   1.573381   -15.05   0.000    -26.77045   -20.60291
------------------------------------------------------------------------------
```

Table A6.9 Poisson Model - Full sample estimated results (exp_share_industryEU28)

```
poisson exp_share_industryEU28prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                                Number of obs   =      13711
                                                  Wald chi2(46)   =    1608.46
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood =  -.8652023                 Pseudo R2       =     0.3030

------------------------------------------------------------------------------
```

exp~yEU28prp	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
emp_edu	.0175217	.017522	1.00	0.317	-.0168207	.0518642
emp_trng	-.3182489	.356142	-0.89	0.372	-1.016274	.3797766
manager_exp	-.0481057	.0448708	-1.07	0.284	-.1360509	.0398395
new_org_str	1.443274	.5659382	2.55	0.011	.3340552	2.552492
new_prod_s~v	-.3926597	.573382	-0.68	0.493	-1.516468	.7311484
new_methods	-.5072611	.6164095	-0.82	0.411	-1.715402	.7008794
location	1.073021	1.312009	0.82	0.413	-1.498469	3.644511
lnsize	-.2487213	.8903692	-0.28	0.780	-1.993813	1.49637
lnsize_sqr	.0793339	.0758616	1.05	0.296	-.0693521	.2280198
lnage	.5565657	1.41119	0.39	0.693	-2.209316	3.322447
lnage_sqr	-.0922579	.2387426	-0.39	0.699	-.5601848	.375669
foreign_du~y	-.6359173	.8630315	-0.74	0.461	-2.327428	1.055593
state_dummy	-1.426318	1.320056	-1.08	0.280	-4.01358	1.160943
credit	1.662478	.5428318	3.06	0.002	.5985476	2.726409
low_mlow_t~h	-3.084923	.41034	-7.52	0.000	-3.889174	-2.280671
mhigh_tech	-2.632357	.5563125	-4.73	0.000	-3.722709	-1.542004
high_tech	-3.495734	.5926329	-5.90	0.000	-4.657273	-2.334195
dcountry1	.1367592	1.72595	0.08	0.937	-3.246041	3.51956
dcountry2	-2.117755	.8867232	-2.39	0.017	-3.8557	-.3798092
dcountry3	-3.953979	1.243604	-3.18	0.001	-6.391399	-1.516559
dcountry4	-3.556465	1.180016	-3.01	0.003	-5.869255	-1.243676
dcountry5	.4291207	.953555	0.45	0.653	-1.439813	2.298054
dcountry6	-4.330924	.5931863	-7.30	0.000	-5.493548	-3.1683
dcountry7	-2.26955	1.16334	-1.95	0.051	-4.549654	.010554
dcountry9	-1.196507	.7359718	-1.63	0.104	-2.638985	.2459711
dcountry10	-1.090408	.689615	-1.58	0.114	-2.442029	.2612126
dcountry11	-.9921035	.8850517	-1.12	0.262	-2.726773	.742566
dcountry12	-4.049519	1.070333	-3.78	0.000	-6.147333	-1.951704
dcountry13	-2.415605	1.303604	-1.85	0.064	-4.970623	.1394125
dcountry14	-1.607433	.7510194	-2.14	0.032	-3.079404	-.135462
dcountry15	-8.010586	1.313704	-6.10	0.000	-10.5854	-5.435773
dcountry16	-1.378312	1.260318	-1.09	0.274	-3.84849	1.091866
dcountry17	-5.700994	1.203667	-4.74	0.000	-8.060138	-3.34185
dcountry18	-.3522332	.9195707	-0.38	0.702	-2.154559	1.450092
dcountry19	-5.27154	1.173256	-4.49	0.000	-7.571079	-2.972001
dcountry20	-.472635	.91814	-0.51	0.607	-2.272156	1.326886
dcountry21	-.5437408	1.368768	-0.40	0.691	-3.226477	2.138995
dcountry22	.8393761	1.122078	0.75	0.454	-1.359856	3.038608
dcountry23	-.2346261	1.498266	-0.16	0.876	-3.171173	2.701921
dcountry24	-.5960227	1.642907	-0.36	0.717	-3.816062	2.624017
dcountry25	-1.097016	.8964227	-1.22	0.221	-2.853972	.6599398
dcountry26	.0189777	1.199523	0.02	0.987	-2.332044	2.369999
dcountry27	2.446203	.4752102	5.15	0.000	1.514808	3.377598
dcountry28	-1.031537	.772092	-1.34	0.182	-2.54481	.4817352
dcountry29	-.2727613	.6567384	-0.42	0.678	-1.559945	1.014422
dcountry30	-.8334488	1.490686	-0.56	0.576	-3.75514	2.088242
_cons	-13.84848	4.096646	-3.38	0.001	-21.87776	-5.819207

Table A6.9.1 Poisson Model - CEECs estimated results (exp_share_industryEU28)

```
poisson exp_share_industryEU28prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30 if CEEC_dummy==1, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
```

```
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       4720
                                                  Wald chi2(33)   =     611.47
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -.53712127                 Pseudo R2       =     0.3376

------------------------------------------------------------------------------
             |               Robust
exp~yEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0021483   .0085839     0.25   0.802    -.0146759    .0189724
    emp_trng |  -.5924456   .4639944    -1.28   0.202    -1.501858    .3169667
 manager_exp |  -.0217597   .0288215    -0.75   0.450    -.0782489    .0347294
 new_org_str |   .9027606   .3626251     2.49   0.013     .1920286    1.613493
new_prod_s~v |   .5205504   .3557462     1.46   0.143    -.1766993      1.2178
 new_methods |  -.5912779   .6066225    -0.97   0.330    -1.780236    .5976803
    location |   1.798224   1.009794     1.78   0.075    -.1809356    3.777384
      lnsize |  -1.336846   .8513076    -1.57   0.116    -3.005378    .3316861
  lnsize_sqr |    .173619   .0898673     1.93   0.053    -.0025176    .3497556
       lnage |  -.7349665   .9857974    -0.75   0.456    -2.667094    1.197161
   lnage_sqr |   .0924379   .2806892     0.33   0.742    -.4577029    .6425787
foreign_du~y |   -.834275   1.046501    -0.80   0.425    -2.885379    1.216829
 state_dummy |  -2.117961   1.578885    -1.34   0.180    -5.212519    .9765981
      credit |   .9729354   .5098884     1.91   0.056    -.0264274    1.972298
low_mlow_t~h |   -2.75424   .3615661    -7.62   0.000    -3.462897   -2.045584
  mhigh_tech |  -2.636845   .5323749    -4.95   0.000     -3.68028   -1.593409
   high_tech |  -3.146735   .8313446    -3.79   0.000    -4.776141    -1.51733
   dcountry1 |   .3637252    1.15408     0.32   0.753     -1.89823    2.625681
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |   .0153078   1.216168     0.01   0.990    -2.368338    2.398953
  dcountry10 |  -.3348006   .8982593    -0.37   0.709    -2.095356    1.425755
  dcountry11 |    -.2216   .8589885    -0.26   0.796    -1.905187    1.461987
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |  -.7255515   1.037914    -0.70   0.485    -2.759826    1.308723
  dcountry15 |  (omitted)
  dcountry16 |   -.993721   .8635924    -1.15   0.250    -2.686331    .6988889
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |   .3329976   1.126079     0.30   0.767    -1.874077    2.540072
  dcountry21 |  -.1461052    1.07741    -0.14   0.892    -2.257791     1.96558
  dcountry22 |   1.362587   1.012806     1.35   0.179    -.6224759    3.347649
  dcountry23 |   .0779196   1.063812     0.07   0.942    -2.007113    2.162952
  dcountry24 |  -.7771511   1.292621    -0.60   0.548    -3.310642    1.756339
  dcountry25 |  -.2976731   .9544044    -0.31   0.755    -2.168271    1.572925
  dcountry26 |   .7272345   1.065521     0.68   0.495    -1.361148    2.815617
```

```
  dcountry27 |    3.59522   1.342897     2.68   0.007     .9631911    6.227249
  dcountry28 |  -.0599341   .9310988    -0.06   0.949    -1.884854    1.764986
  dcountry29 |   .5324982   .8875605     0.60   0.549    -1.207088    2.272085
  dcountry30 |  (omitted)
       _cons |    -10.252   1.156294    -8.87   0.000     -12.5183   -7.985711
------------------------------------------------------------------------------
------------------------------------------------------------------------------
```

Table A6.9.2 Poisson Model - CIS estimated results (exp_share_industryEU28)

```
. poisson exp_share_industryEU28prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30 if CEEC_dummy==0, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry1 omitted because of collinearity
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       8991
                                                  Wald chi2(29)   =     425.10
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -.26379213                 Pseudo R2       =     0.3486

------------------------------------------------------------------------------
             |               Robust
exp~yEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |    .034106   .0070087     4.87   0.000     .0203693    .0478427
    emp_trng |   .2091224   .3590888     0.58   0.560    -.4946788    .9129235
 manager_exp |   -.089064   .0289513    -3.08   0.002    -.1458075   -.0323206
 new_org_str |   1.713789    .364673     4.70   0.000     .9990436    2.428535
new_prod_s~v |  -2.273326   .6771504    -3.36   0.001    -3.600517   -.9461359
 new_methods |   .2632507   .5371872     0.49   0.624    -.7896168    1.316118
    location |   -.467589   .5043197    -0.93   0.354    -1.456037    .5208595
      lnsize |   1.972689   .9456444     2.09   0.037     .1192604    3.826118
  lnsize_sqr |  -.0801803    .096454    -0.83   0.406    -.2692267    .1088662
       lnage |  -.1879532   1.128218    -0.17   0.868    -2.399219    2.023313
   lnage_sqr |   .1990336   .1842611     1.08   0.280    -.1621115    .5601787
foreign_du~y |   .7783336   .6640019     1.17   0.241    -.5230862    2.079753
 state_dummy |  -3.214218   1.309254    -2.45   0.014     -5.78031    -.648127
      credit |   1.908541   .3306639     5.77   0.000     1.260451     2.55663
low_mlow_t~h |  -4.875421   .6389063    -7.63   0.000    -6.127655   -3.623188
  mhigh_tech |   -3.93907   .7580581    -5.20   0.000    -5.424837   -2.453304
   high_tech |  -6.779495   1.102624    -6.15   0.000    -8.940598   -4.618392
   dcountry1 |  (omitted)
   dcountry2 |  -1.657398   .8689316    -1.91   0.056    -3.360473    .0456766
```

```
   dcountry3 |  -1.969288   .8156223    -2.41   0.016    -3.567878   -.3706976
   dcountry4 |   -1.46852   .8747824    -1.68   0.093    -3.183062    .2460222
   dcountry5 |   2.030572   .6256453     3.25   0.001     .8043294    3.256814
   dcountry6 |  -3.710827   .8146247    -4.56   0.000    -5.307463   -2.114192
   dcountry7 |  -1.948801   1.116938    -1.74   0.081    -4.137958     .240357
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -4.816259   1.204046    -4.00   0.000    -7.176146   -2.456372
  dcountry13 |  -1.285902   .5756045    -2.23   0.025    -2.414066    -.157738
  dcountry14 |  (omitted)
  dcountry15 |  -5.680603   .7810926    -7.27   0.000    -7.211516    -4.14969
  dcountry16 |  (omitted)
  dcountry17 |  -4.446033    .913891    -4.86   0.000    -6.237226   -2.654839
  dcountry18 |   1.132469   .7338074     1.54   0.123    -.3057673    2.570705
  dcountry19 |  -4.406149   1.103898    -3.99   0.000    -6.569749   -2.242549
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -21.59618   2.336213    -9.24   0.000    -26.17507   -17.01728
------------------------------------------------------------------------------
------------------------------------------------------------------------------
```

Table A6.9.3 Poisson Model - Full sample estimated results

(exp_share_industryEA40)

```
. poisson exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                                Number of obs   =      13711
                                                  Wald chi2(46)   =    1318.74
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1.2918096                 Pseudo R2       =     0.2686

------------------------------------------------------------------------------
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0221619   .0127867     1.73   0.083    -.0028996    .0472233
    emp_trng |  -.3039322   .5312178    -0.57   0.567      -1.3451    .7372355
 manager_exp |  -.0320317   .0292552    -1.09   0.274    -.0893708    .0253073
 new_org_str |   .5412611   .6227751     0.87   0.385    -.6793556    1.761878
new_prod_s~v |  -.0515158   .5162262    -0.10   0.921    -1.063301     .960269
 new_methods |   .1557045   .6826453     0.23   0.820    -1.182256    1.493665
    location |   .9509035    .623996     1.52   0.128    -.2721061    2.173913
      lnsize |   .7418989   .7403693     1.00   0.316    -.7091983    2.192996
  lnsize_sqr |  -.0203508   .0606938    -0.34   0.737    -.1393085    .0986069
       lnage |  -.6977005    .906076    -0.77   0.441    -2.473577    1.078176
   lnage_sqr |   .1664409   .1584822     1.05   0.294    -.1441785    .4770602
foreign_du~y |  -.5424565   .5195858    -1.04   0.296    -1.560826     .475913
```

```
 state_dummy |  -1.943954   .9138698    -2.13   0.033    -3.735106   -.1528025
      credit |   1.256227   .3828722     3.28   0.001     .5058115    2.006643
low_mlow_t~h |   -2.82755   .5014865    -5.64   0.000    -3.810446   -1.844655
  mhigh_tech |  -2.471032   .8894515    -2.78   0.005    -4.214325   -.7277389
   high_tech |  -4.560517   .7344577    -6.21   0.000    -6.000028   -3.121006
   dcountry1 |   .4647464   1.205428     0.39   0.700     -1.89785    2.827343
   dcountry2 |  -1.934634    .745958    -2.59   0.010    -3.396685   -.4725837
   dcountry3 |  -3.805435   .9401197    -4.05   0.000    -5.648036   -1.962835
   dcountry4 |  -3.417542   .9953005    -3.43   0.001    -5.368295   -1.466789
   dcountry5 |   2.083389    .653191     3.19   0.001     .8031578    3.363619
   dcountry6 |   -4.63878   .5773772    -8.03   0.000    -5.770419   -3.507142
   dcountry7 |  -2.396475   .9104789    -2.63   0.008    -4.180981   -.6119696
   dcountry9 |  -1.092777   .7990222    -1.37   0.171    -2.658831    .4732779
  dcountry10 |   -.900682   .5806996    -1.55   0.121    -2.038832    .2374682
  dcountry11 |  -.8594387   .6213168    -1.38   0.167    -2.077197    .3583198
  dcountry12 |  -3.928331   .8923679    -4.40   0.000     -5.67734   -2.179322
  dcountry13 |  -2.219275   1.044452    -2.12   0.034    -4.266364   -.1721857
  dcountry14 |  -1.342873   .6973306    -1.93   0.054    -2.709616    .0238695
  dcountry15 |  -7.997091   .8431727    -9.48   0.000    -9.649679   -6.344503
  dcountry16 |  -.8862838   .7175653    -1.24   0.217    -2.292686    .5201184
  dcountry17 |  -5.649666   .8045027    -7.02   0.000    -7.226463    -4.07287
  dcountry18 |  -.2413759    .888531    -0.27   0.786    -1.982865    1.500113
  dcountry19 |  -5.189666   .9857868    -5.26   0.000    -7.121773    -3.25756
  dcountry20 |  -.3165251   .7988829    -0.40   0.692    -1.882307    1.249257
  dcountry21 |  -.2175514   .9849749    -0.22   0.825    -2.148067    1.712964
  dcountry22 |   4.017109   .6897742     5.82   0.000     2.665177    5.369042
  dcountry23 |   -.220021    1.04306    -0.21   0.833    -2.264381    1.824339
  dcountry24 |  -.1966323   .9298007    -0.21   0.833    -2.019008    1.625744
  dcountry25 |   -.870918    .716325    -1.22   0.224    -2.274889    .5330533
  dcountry26 |    2.91881   .8318231     3.51   0.000     1.288467    4.549154
  dcountry27 |   3.004641   .7097399     4.23   0.000     1.613576    4.395706
  dcountry28 |  -.8166461   .7318304    -1.12   0.264    -2.251007     .617715
  dcountry29 |   .0180602   .6132572     0.03   0.977    -1.183902    1.220022
  dcountry30 |  -.4704636   1.033718    -0.46   0.649    -2.496513    1.555586
       _cons |  -14.68261   2.688558    -5.46   0.000    -19.95209   -9.413132
```

Table A6.9.4 Poisson Model - CEECs estimated results (exp_share_industryEA40)

```
poisson exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30 if CEEC_dummy==1, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry2 omitted because of collinearity
note: dcountry3 omitted because of collinearity
note: dcountry4 omitted because of collinearity
note: dcountry5 omitted because of collinearity
note: dcountry6 omitted because of collinearity
note: dcountry7 omitted because of collinearity
note: dcountry12 omitted because of collinearity
note: dcountry13 omitted because of collinearity
note: dcountry15 omitted because of collinearity
note: dcountry17 omitted because of collinearity
note: dcountry18 omitted because of collinearity
note: dcountry19 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       4720
                                                  Wald chi2(33)   =     348.23
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -.91326999                 Pseudo R2       =     0.2730
```

```
------------------------------------------------------------------------------
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0145974   .0115843     1.26   0.208    -.0081075    .0373023
    emp_trng |  -.5502243   .7237719    -0.76   0.447    -1.968791    .8683425
 manager_exp |  -.0258448   .0226756    -1.14   0.254    -.0702882    .0185986
 new_org_str |  -.0565038   .5519827    -0.10   0.918     -1.13837    1.025362
new_prod_s~v |   .4968261   .5483305     0.91   0.365    -.5778819    1.571534
 new_methods |    .487259   .6403344     0.76   0.447    -.7677734    1.742291
    location |   1.227756   .6100784     2.01   0.044     .0320239    2.423487
      lnsize |   .3028665   .7788546     0.39   0.697     -1.22366    1.829393
  lnsize_sqr |    .013362   .0633087     0.21   0.833    -.1107208    .1374448
       lnage |  -1.933777   .7358687    -2.63   0.009    -3.376053    -.491501
   lnage_sqr |   .3772753   .1774244     2.13   0.033     .0295299    .7250208
foreign_du~y |  -.4185746     .51628    -0.81   0.418    -1.430465    .5933155
 state_dummy |   -3.90557   1.419225    -2.75   0.006    -6.687201    -1.12394
      credit |   .9579925    .444707     2.15   0.031     .0863828    1.829602
low_mlow_t~h |  -3.485509   .7738985    -4.50   0.000    -5.002322   -1.968696
  mhigh_tech |  -4.009195   1.184979    -3.38   0.001    -6.331712   -1.686679
   high_tech |  -4.718269    .926986    -5.09   0.000    -6.535128    -2.90141
   dcountry1 |   .3697997   1.419282     0.26   0.794    -2.411941    3.151541
   dcountry2 |  (omitted)
   dcountry3 |  (omitted)
   dcountry4 |  (omitted)
   dcountry5 |  (omitted)
   dcountry6 |  (omitted)
   dcountry7 |  (omitted)
   dcountry9 |  -.5684763   1.104911    -0.51   0.607    -2.734061    1.597109
  dcountry10 |  -.5413261   .8753336    -0.62   0.536    -2.256948    1.174296
  dcountry11 |  -.5695273   .8778355    -0.65   0.516    -2.290053    1.150999
  dcountry12 |  (omitted)
  dcountry13 |  (omitted)
  dcountry14 |   -.990641   .8997323    -1.10   0.271    -2.754084     .772802
  dcountry15 |  (omitted)
  dcountry16 |  -.5273536   .8947928    -0.59   0.556    -2.281115    1.226408
  dcountry17 |  (omitted)
  dcountry18 |  (omitted)
  dcountry19 |  (omitted)
  dcountry20 |  -.1783885   1.089683    -0.16   0.870    -2.314128    1.957351
  dcountry21 |   -.260213   1.140249    -0.23   0.819    -2.495059    1.974634
  dcountry22 |   4.199158   .8919348     4.71   0.000     2.450998    5.947318
  dcountry23 |  -.1007962   1.068547    -0.09   0.925     -2.19511    1.993517
  dcountry24 |  -.0760822   1.119122    -0.07   0.946    -2.269521    2.117357
  dcountry25 |  -.5030489   1.036236    -0.49   0.627    -2.534035    1.527937
  dcountry26 |   3.201248   1.181037     2.71   0.007     .8864584    5.516038
  dcountry27 |   3.455027   1.048171     3.30   0.001     1.400651    5.509404
  dcountry28 |  -.3035958   .8925141    -0.34   0.734    -2.052891      1.4457
  dcountry29 |   .3384355   .8058824     0.42   0.675    -1.241065    1.917936
  dcountry30 |  (omitted)
       _cons |  -11.99834   1.769576    -6.78   0.000    -15.46665   -8.530036
------------------------------------------------------------------------------
```

Table A6.9.5 Poisson Model - CIS estimated results (exp_share_industryEA40)

```
poisson exp_share_industryEA40prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30 if CEEC_dummy==0, vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable
note: dcountry1 omitted because of collinearity
```

```
note: dcountry9 omitted because of collinearity
note: dcountry10 omitted because of collinearity
note: dcountry11 omitted because of collinearity
note: dcountry14 omitted because of collinearity
note: dcountry16 omitted because of collinearity
note: dcountry20 omitted because of collinearity
note: dcountry21 omitted because of collinearity
note: dcountry22 omitted because of collinearity
note: dcountry23 omitted because of collinearity
note: dcountry24 omitted because of collinearity
note: dcountry25 omitted because of collinearity
note: dcountry26 omitted because of collinearity
note: dcountry27 omitted because of collinearity
note: dcountry28 omitted because of collinearity
note: dcountry29 omitted because of collinearity
note: dcountry30 omitted because of collinearity

Poisson regression                                Number of obs   =       8991
                                                  Wald chi2(29)   =     487.65
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -.31681994                 Pseudo R2       =     0.3048

------------------------------------------------------------------------------
             |               Robust
exp~yEA40prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0318802   .0075825     4.20   0.000     .0170187    .0467416
    emp_trng |   .4961126   .3627561     1.37   0.171    -.2148763    1.207102
 manager_exp |  -.0549361   .0242314    -2.27   0.023    -.1024287   -.0074434
 new_org_str |   1.650973   .3267274     5.05   0.000     1.010599    2.291347
new_prod_s~v |  -2.140977   .6138924    -3.49   0.000    -3.344184   -.9377703
 new_methods |  -.1428894   .5476765    -0.26   0.794    -1.216316    .9305368
    location |  -.7325041   .4986771    -1.47   0.142    -1.709893     .244885
      lnsize |   1.693417   .7025441     2.41   0.016     .3164558    3.070378
  lnsize_sqr |  -.0463455   .0722587    -0.64   0.521      -.18797    .0952789
       lnage |   1.069617   1.802861     0.59   0.553    -2.463926    4.603159
   lnage_sqr |  -.1017781    .295853    -0.34   0.731    -.6816393    .4780832
foreign_du~y |   .7183406   .6315192     1.14   0.255    -.5194143    1.956095
 state_dummy |  -3.275065   1.233467    -2.66   0.008    -5.692616   -.8575145
      credit |   1.742353   .3255057     5.35   0.000     1.104373    2.380332
low_mlow_t~h |  -3.443858   .5673961    -6.07   0.000    -4.555934   -2.331782
  mhigh_tech |  -1.942997   .5833356    -3.33   0.001    -3.086313   -.7996798
   high_tech |  -5.747872    1.06863    -5.38   0.000    -7.842348   -3.653397
   dcountry1 |  (omitted)
   dcountry2 |  -1.522664   .8440355    -1.80   0.071    -3.176943    .1316154
   dcountry3 |  -1.656701   .7708022    -2.15   0.032    -3.167446   -.1459564
   dcountry4 |  -1.582934    .864106    -1.83   0.067     -3.27655    .1106828
   dcountry5 |   2.625628   .4558962     5.76   0.000     1.732088    3.519168
   dcountry6 |   -3.86353   .5577855    -6.93   0.000     -4.95677   -2.770291
   dcountry7 |  -1.523398   .9991095    -1.52   0.127    -3.481617    .4348207
   dcountry9 |  (omitted)
  dcountry10 |  (omitted)
  dcountry11 |  (omitted)
  dcountry12 |  -4.961042   1.233776    -4.02   0.000    -7.379198   -2.542886
  dcountry13 |  -1.289844   .6341868    -2.03   0.042    -2.532827   -.0468605
  dcountry14 |  (omitted)
  dcountry15 |  -5.847681    .746863    -7.83   0.000    -7.311506   -4.383856
  dcountry16 |  (omitted)
  dcountry17 |  -4.395329   .8805871    -4.99   0.000    -6.121248    -2.66941
  dcountry18 |   1.166364   .7266482     1.61   0.108    -.2578406    2.590568
  dcountry19 |  -3.772683   1.024891    -3.68   0.000    -5.781432   -1.763933
  dcountry20 |  (omitted)
  dcountry21 |  (omitted)
```

```
  dcountry22 |  (omitted)
  dcountry23 |  (omitted)
  dcountry24 |  (omitted)
  dcountry25 |  (omitted)
  dcountry26 |  (omitted)
  dcountry27 |  (omitted)
  dcountry28 |  (omitted)
  dcountry29 |  (omitted)
  dcountry30 |  (omitted)
       _cons |  -22.44692   2.648634    -8.47   0.000    -27.63815   -17.25569
------------------------------------------------------------------------------
```

Table A6.9.6 Poisson Model - Full sample estimated results (exp_share_totalEU28)

```
. poisson exp_share_totalEU28prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30,  vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                                Number of obs   =      13711
                                                  Wald chi2(46)   =    1759.82
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -.03078261                 Pseudo R2       =     0.1531

------------------------------------------------------------------------------
             |               Robust
exp~lEU28prp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     emp_edu |   .0100404    .006051     1.66   0.097    -.0018194    .0219002
    emp_trng |   .0702823   .2789468     0.25   0.801    -.4764433    .6170079
 manager_exp |   .0048596   .0139876     0.35   0.728    -.0225555    .0322748
 new_org_str |   .7707679   .2858967     2.70   0.007     .2104208    1.331115
new_prod_s~v |  -.4330558   .3776612    -1.15   0.252    -1.173258    .3071466
 new_methods |  -.0679126     .38477    -0.18   0.860    -.8220479    .6862227
    location |    .227633   .3223101     0.71   0.480    -.4040831    .8593491
      lnsize |   .5287786   .4125092     1.28   0.200    -.2797246    1.337282
  lnsize_sqr |   .0343524   .0346963     0.99   0.322    -.0336512     .102356
       lnage |   .2616217   .7761464     0.34   0.736    -1.259597    1.782841
   lnage_sqr |  -.0594659   .1233747    -0.48   0.630    -.3012759    .1823442
foreign_du~y |   .4845468   .4382284     1.11   0.269    -.3743651    1.343459
 state_dummy |  -.1600998    .702718    -0.23   0.820    -1.537402    1.217202
      credit |   .4212511   .3218278     1.31   0.191    -.2095198    1.052022
low_mlow_t~h |   1.186597   .2965647     4.00   0.000     .6053413    1.767854
  mhigh_tech |   1.725534   .3123225     5.52   0.000     1.113393    2.337674
   high_tech |   1.014679    .383037     2.65   0.008     .2639405    1.765418
   dcountry1 |    .989301   .8689865     1.14   0.255    -.7138812    2.692483
   dcountry2 |   -.682078   .4654282    -1.47   0.143      -1.5943    .2301445
   dcountry3 |  -.7040331   .7039054    -1.00   0.317    -2.083662    .6755961
   dcountry4 |  -.9733255   .5751973    -1.69   0.091    -2.100692    .1540406
   dcountry5 |   1.766162   .3220005     5.48   0.000     1.135053    2.397271
   dcountry6 |  -1.711952   .4071846    -4.20   0.000    -2.510019   -.9138848
   dcountry7 |   .2820555   .5444483     0.52   0.604    -.7850435    1.349155
   dcountry9 |   .3426717   .6602582     0.52   0.604    -.9514106    1.636754
  dcountry10 |   2.323361    .621257     3.74   0.000      1.10572    3.541002
  dcountry11 |   .5074145   .6212864     0.82   0.414    -.7102846    1.725114
  dcountry12 |   -.588677   .8036515    -0.73   0.464    -2.163805    .9864509
  dcountry13 |   -1.05679   .5104595    -2.07   0.038    -2.057272   -.0563078
  dcountry14 |   .3717775   .4725986     0.79   0.431    -.5544986    1.298054
  dcountry15 |  -2.582157    .654558    -3.94   0.000    -3.865067   -1.299247
```

dcountry16	.4472461	.4210591	1.06	0.288	-.3780145	1.272507
dcountry17	-1.792246	.5660236	-3.17	0.002	-2.901631	-.6828597
dcountry18	.0746035	.6655872	0.11	0.911	-1.229923	1.379131
dcountry19	-2.541342	.6672606	-3.81	0.000	-3.849148	-1.233535
dcountry20	1.605439	.4002101	4.01	0.000	.8210413	2.389836
dcountry21	.3804562	.580648	0.66	0.512	-.757593	1.518505
dcountry22	1.375905	.467441	2.94	0.003	.4597375	2.292073
dcountry23	1.536192	.4795086	3.20	0.001	.5963729	2.476012
dcountry24	.7112189	.4068171	1.75	0.080	-.086128	1.508566
dcountry25	1.199219	.4380915	2.74	0.006	.3405759	2.057863
dcountry26	1.224436	.5194551	2.36	0.018	.2063227	2.242549
dcountry27	3.058407	.4991836	6.13	0.000	2.080025	4.036789
dcountry28	.5978256	.5025516	1.19	0.234	-.3871575	1.582809
dcountry29	1.334293	.3580481	3.73	0.000	.6325315	2.036054
dcountry30	.2436769	.6636875	0.37	0.714	-1.057127	1.54448
_cons	-21.24642	1.84394	-11.52	0.000	-24.86048	-17.63236

Table A6.9.7 Poisson Model - Full sample estimated results (exp_share_totalEA40)

```
. poisson exp_share_totalEA40prp emp_edu emp_trng manager_exp new_org_str
new_prod_serv new_methods location lnsize lnsize_sqr lnage lnage_sqr foreign_dummy
state_dummy credit  low_mlow_tech  mhigh_tech high_tech  dcountry1-dcountry7
dcountry9-dcountry30,  vce(robust) nolog
note: you are responsible for interpretation of noncount dep. variable

Poisson regression                               Number of obs    =      13711
                                                 Wald chi2(46)    =    3763.94
                                                 Prob > chi2      =     0.0000
Log pseudolikelihood = -.06596677                Pseudo R2        =     0.2287
```

exp~lEA40prp	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
emp_edu	.0059321	.0058581	1.01	0.311	-.0055496	.0174138
emp_trng	.8750509	.2613405	3.35	0.001	.3628328	1.387269
manager_exp	.0163114	.0074067	2.20	0.028	.0017944	.0308283
new_org_str	.5790581	.2998275	1.93	0.053	-.008593	1.166709
new_prod_s~v	-.6228184	.4298712	-1.45	0.147	-1.46535	.2197136
new_methods	-.054552	.2733968	-0.20	0.842	-.5903999	.4812959
location	-.254674	.3499118	-0.73	0.467	-.9404884	.4311405
lnsize	.6756345	.3837244	1.76	0.078	-.0764516	1.427721
lnsize_sqr	.0207536	.0314108	0.66	0.509	-.0408103	.0823176
lnage	.8660204	.8121589	1.07	0.286	-.7257817	2.457823
lnage_sqr	-.1436285	.1325474	-1.08	0.279	-.4034167	.1161597
foreign_du~y	.3868643	.3568749	1.08	0.278	-.3125975	1.086326
state_dummy	-.9889176	.8230773	-1.20	0.230	-2.60212	.6242843
credit	.2593445	.2276345	1.14	0.255	-.1868109	.7054999
low_mlow_t~h	1.199576	.3400873	3.53	0.000	.533017	1.866135
mhigh_tech	2.232993	.3432713	6.51	0.000	1.560194	2.905793
high_tech	1.042705	.385026	2.71	0.007	.2880676	1.797342
dcountry1	1.493041	.8752269	1.71	0.088	-.2223721	3.208454
dcountry2	-.4677378	.5459816	-0.86	0.392	-1.537842	.6023664
dcountry3	-.454178	.8348611	-0.54	0.586	-2.090476	1.18212
dcountry4	-.7038546	.5968227	-1.18	0.238	-1.873606	.4658964
dcountry5	3.079482	.3430454	8.98	0.000	2.407125	3.751838
dcountry6	-1.644677	.3867327	-4.25	0.000	-2.402659	-.8866948
dcountry7	.3408239	.6596907	0.52	0.605	-.9521461	1.633794
dcountry9	.1695376	.6651785	0.25	0.799	-1.134188	1.473264
dcountry10	2.260662	.6898386	3.28	0.001	.9086029	3.61272

dcountry11	.7455973	.6175648	1.21	0.227	-.4648075	1.956002
dcountry12	-1.04631	.8016546	-1.31	0.192	-2.617524	.524904
dcountry13	-.6061474	.570315	-1.06	0.288	-1.723944	.5116495
dcountry14	.2873672	.5134423	0.56	0.576	-.7189612	1.293696
dcountry15	-2.170382	.6818526	-3.18	0.001	-3.506789	-.833976
dcountry16	.5531146	.4834834	1.14	0.253	-.3944955	1.500725
dcountry17	-1.11941	.5735505	-1.95	0.051	-2.243548	.0047283
dcountry18	.3401161	.7057499	0.48	0.630	-1.043128	1.72336
dcountry19	-2.234719	.7420034	-3.01	0.003	-3.689019	-.7804194
dcountry20	1.629529	.4655006	3.50	0.000	.7171649	2.541894
dcountry21	.5437955	.6184428	0.88	0.379	-.6683301	1.755921
dcountry22	3.059873	.5436131	5.63	0.000	1.99441	4.125335
dcountry23	1.641501	.4668644	3.52	0.000	.7264631	2.556538
dcountry24	.8873558	.4573573	1.94	0.052	-.009048	1.78376
dcountry25	1.238822	.4804654	2.58	0.010	.2971276	2.180517
dcountry26	2.918679	.5456414	5.35	0.000	1.849241	3.988116
dcountry27	3.051306	.5388569	5.66	0.000	1.995166	4.107446
dcountry28	.4964355	.5173633	0.96	0.337	-.5175779	1.510449
dcountry29	1.306438	.4432935	2.95	0.003	.4375986	2.175277
dcountry30	.4874052	.5965659	0.82	0.414	-.6818425	1.656653
_cons	-23.144	1.689192	-13.70	0.000	-26.45476	-19.83325