Working Papers Series

Centre d'Analyse Théorique et de Traitement des données économiques

CATT WP No. 6.
January 2011

ECONOMIC INTEGRATION AND PRODUCTIVE SPECIALIZATION IN THE EU27: DOES FDI INFLUENCE COUNTRIES' SPECIALIZATION?

Natalia VECHIU

Farid MAKHLOUF

UNIVERSITÉ
DE PAU ET DES
PAYS DE L'ADOUR

Economic integration and productive specialization in the EU27: does FDI influence countries' specialization?

By Natalia Vechiu† & Farid Makhlouf‡

December 2010

† Corresponding author: Post-doctoral researcher, CATT (Centre d'Analyse Théorique et Traitement des données économiques), Université de Pau et des Pays de l'Adour, Domaine universitaire, Avenue du Doyen Poplawski, BP 1633, 64016 PAU Cedex, France; Tel: 0033 559 40 80 01; Fax: 0033 559 40 80 10; Email: natalia.vechiu@univ-pau.fr
‡ PhD student, CATT (Centre d'Analyse Théorique et Traitement des données économiques), Université de Pau et des Pays de l'Adour, Domaine universitaire, Avenue du Doyen Poplawski, BP 1633, 64016 PAU Cedex, France

Abstract The objective of this article is two folded. Firstly, we proceed to an analysis of the evolution of productive specialization in the enlarged EU, taking into account all its actual 27 member countries. Given their decomposability properties, we use the entropy-based indices to measure countries' relative specialization and then, given our rather short period of analysis, we use the bootstrap method to analyze the evolution of the specialization index. We first analyze all economic sectors and then, our analysis is more detailed focusing on manufacturing industries. Globally, we find that specialization is decreasing across all economic sectors, while it is increasing across manufacturing industries. Secondly, we study specialization determinants, with a special interest for the impact of foreign direct investment (FDI). For homogeneity reasons, we analyze two separate samples, one including only developed countries of the European Union and the other, only developing member countries. In order to take into account endogeneity highly probable of most of our independent variables, we use the vector autoregression (VAR) technique and analyse the impulse response functions. Globally, FDIs seem to positively influence countries' relative specialization, for our both samples and for both economic sectors and manufacturing industries. However, their impact appears weaker than most of the other independent variables, such as market potential or relative endowments.

1 Introduction

In the context of economic integration, the literature (both empiric and theoretic) largely studied the phenomenon of economic agglomeration and its determinants, but, since the Classics' era and the basic Hecksher-Ohlin-Samuelson (HOS) model, there has been surprisingly very little development in assessing and testing the determinants of specialization. A notable exception would be the new economic geography (NEG) models, but they deal explicitly with agglomeration rather than specialization. Their conclusions about specialization are based more on an interpretation of their results rather than on explicit modelling. Of course, in the light of the NEG models, the two notions are strongly dependent, often being referred to as the two facets of the same medal (Aiginger and Davies 2004; Cutrini 2009) because in fact they analyze the same economic variables (most often, employment or value added). Nevertheless, concentration and specialization are structurally different, given that their definition, even though based on the same economic variables, uses those in two different ways. The measurement of specialization implies an analysis of the productive structure of a country. It is thus a question of identifying if the country in question is active in a restricted number of sectors or its production activity is equitably distributed between the various sectors. The measurement of the geographical concentration implies an analysis of the distribution of the economic activities across countries. It is thus a question of identifying if the production of a certain good takes place in a restricted number of countries or if it is equitably distributed between them. Finally, Aiginger and Davies (2004) analytically deduced the mathematical relation between the two concepts and under certain conditions, concentration and specialization follow the same evolution: an increase in concentration is the equivalent of an increase in specialization. In this case, it is necessary that the countries and industries under study have the same size or that the shares of the countries and industries in the total activity remain constant over time.

The impact of new economic geography models was tremendous with regard to the empirical research, by offering to the researchers many prospects. Certain studies were related to the determinants of the location choices of firms or more generally FDIs; other studies related to the measurement and/or the determinants of specialization or spatial concentration. Lastly, according to the predictions of the new economic geography on the agglomeration of economic activity, a special attention was given to the impact of trade liberalization on concentration.

Considering the small number of studies existing on the determinants of specialization, we try thereafter to fill this gap through a study of the specialization indices calculated at the level of the EU27. Whereas most studies use the Gini index or the Krugman index to analyze concentration or specialization tendencies in EU15 or EU25 (Midelfart-Knarvik et al. 2000; Midelfart-Knarvik and Overman 2002; Dupuch et al. 2004 etc.), Brülhart and Traeger (2005) use the Theil index, but only for Western Europe. Globally, these studies show a decrease of activity agglomeration, thus of spatial concentration, and, at the same time, an increase of specialization. This seems a paradox, but still possible: it is enough for the share of each sector/industry or each country in total activity to change over time (Aiginger and Davies 2004). These tendencies seem stronger with increasing economic integration.

An analysis of all the 27 member states of European Union (EU27) having never been realized yet, we propose to use the indices based on entropy measure (e.g.: the Theil index) to study the evolution of the specialization over the period 1996-2005 and then, its determinants. Since the period of analysis is rather short (1996-2005), we use inference tests to determine significant changes in the level of specialization during this period. Two studies will be presented: first, we analyze all economic sectors; second we focus on manufacturing industries only.

The 1996-2005 period is characterized by an acceleration of the economic integration process of the CEECs in the European Union, knowing that economic integration can take various forms: trade liberalization, technology diffusion, FDIs. More particularly, models developed in Fujita and Thisse (2006) and Vechiu (2010) showed that trade liberalization or technology diffusion trigger FDIs towards the developing countries, but also that FDIs reinforce economic integration through the stronger bonds created between the countries. After a brief review of the literature dealing with specialization and concentration indices evolution and/or determinants (section II), we present some stylized facts based on the calculation of the generalized entropy indices and how it relates to inward FDIs in EU27 member countries section III). In section IV, we will focus on specialization determinants, with a special interest in the role of the FDIs, while section V will conclude and give some future research perspectives.

2 Literature review

Globally the empirical studies dealing with *specialization across economic sectors* show that specialization increased in the EU15 (Amiti 1999; Brülhart 1998a and b, 2001a and b; Brülhart and Torstensson 1996; OECD 1999; Midelfart-Knarvik et al. 2002, 2003; Storper et al. 2002 etc). Combes and Overman (2004) present a review of the empirical work studying this subject and they also conclude to an increase of sectoral specialization in the EU15 member countries. However, Dupuch and Mazier (2002) find that specialization decreased for these countries between 1980 and 1994. The least specialized countries were France and Finland, whereas the most specialized were Greece and Portugal, but also the United Kingdom because of the very important share of its finance services. The CEECs follow about the same evolution: since the years 1990 when their process of integration with the rest of Europe started, they became increasingly specialized in their exports (Crabbé et al. 2005).

Regarding *specialization across manufacturing industries*, Midelfart-Knarvik et al. (2002) find that it is inversely related to the size of the countries and their level of development (the analyzed period extends from 1970 to 1997): the smallest and the least developed countries are the most specialized. More precisely, the large countries of the centre are the least specialized (Germany, France, United Kingdom), the small countries of the centre being relatively more specialized (Austria, Belgium, the Netherlands) and the Scandinavian countries being the most specialized among the countries of the European centre. Lastly, the peripheral countries are the most specialized in the EU15 (Greece, Ireland and Portugal). Nevertheless, there are two essential exceptions: Italy and Spain. Italy is a large country of the centre, but whose specialization is similar to that of the small countries of the centre and Spain is a peripheral country that shows an unexpectedly low level of specialization. The three large countries of the European centre (France, Germany and United Kingdom) and Ireland, the notable exception, specialize in high technology, skilled labour intensive sectors. Greece and Portugal specialize in sectors using mostly unskilled labour and technologically weak. Spain, Austria and Belgium specialize in medium skilled labour and medium technology sectors. Dupuch and Mazier (2002) find that the least specialized among the large countries are the United Kingdom and France, whereas the small countries are more specialized. Aiginger and Davies (2004) find that globally, between 1985 and 1998, specialization increased in EU15 member countries, with the share of the largest industries increasing more quickly than that of the smaller ones, while the growth of the small countries was stronger than that of the large ones. This explains the decrease in manufacturing industries concentration while specialization was increasing. More precisely, these changes were significant especially in the years 1990, after the creation of the Single European Market. They also find that the largest countries specialize in large industries, which could be the result of the strengthening of intra-industry linkages in the large industries already localised in these countries. With a slightly different approach, Aiginger (2000) analyzes and compares specialization in production and exports. This author finds that specialization in production increased significantly, whereas that in exports dropped. Germany, Ireland and Italy became significantly more specialized in the two fields. The United Kingdom, Finland, Greece and Sweden knew an increasing specialization in production, but the opposite for exports. Lastly, Portugal knew a global decrease in specialization, whereas in the other countries the evolution of the two types of specialization is not clear. The CEECs also saw their degree of specialization increase (De Simone 2006; Longhi et al. 2003).

So far, we have seen that the distribution of economic activity across sectors has considerably changed depending on its aggregation level and on the time span. This could also be seen as the result of the different waves of economic integration, in accordance with a broader interpretation of the conclusions of the NEG models that are mainly about concentration patterns instead of specialization. Consequently, most empirical research based on these models deals only with the determinants of concentration. Nevertheless, from the formation of the great urban centres to the deindustrialization of the disadvantaged regions and while passing by vertical specialization and the rising power of developing countries, the link between integration and agglomeration/specialization has not been clearly established yet by the empirical research. For example, in Mexico, integration with NAFTA involved the relocation of the textile industry especially at the border with the United States and was reduced to subcontracting, knowing that before integration, it was rather concentrated geographically (Hanson 1996). Haaland et al. (1998) show that European integration had a positive impact on the industrial agglomeration between 1985 and 1992. Moreover, they identified in which type of countries certain industries tend to concentrate: wearing apparel and railroad equipment tend to concentrate in small countries, whereas motor vehicles, electrical apparatus and machinery and equipment tend to concentrate in large countries. Fiess

and Fugazza (2002) present a review of empirical work on this subject and conclude that overall European integration involved the regional concentration of economic activity and a greater specialization in production. Hildebrandt and Wörz (2004) analyze the evolution of industrial specialization and the concentration of the activities in the CEECs, between 1993 and 2000. They analyze manufacturing industries and find that there is an increase in regional relative concentration and an increase in specialization. Moreover, they show that compared with the EU15, the spatial concentration of manufacturing industries in the CEECs increased more quickly. Thereafter, their first econometric study on the determinants of spatial concentration shows a significant impact of FDIs, differences in technology, human capital and expenditure. But then, their second econometric study, at a more detailed level (by industry), largely overturns the previous one as it finds that the traditional determinants of the NEG are not significant for the CEECs and that FDIs have a significant impact only in two industries (electronic and mineral). Amiti (1999) studies only certain countries of Western Europe, through the Gini coefficient over the period 1976-1990. The author finds that specialization decreased in Spain, in Portugal and the United Kingdom immediately after integration in the EU. Her explanation is that before integration, there were barriers raised to protect industries in which these countries did not have a comparative advantage; once the protection was removed, competition increased and the countries had to develop industries in which they had comparative advantages. Globally, the author finds an increase in specialization, which implies that at least some industries became more concentrated, but the industries most concentrated in 1976 are not the same ones in 1989. The author analyzes also the determinants of the concentration, based on the theories of international trade and the NEG. She finds that scale economies and vertical linkages between firms are the strongest determinants of concentration.

3 Stylized facts: a descriptive analysis of specialization and FDI trends in EU27

As we have seen in the previous section, empirical research already studied the specialization of the Member States and also the geographical concentration of the activities in the EU, but no study was made on EU27. Also, references on the CEECs are very scarce compared with the abundant ones on the rest of the EU. All the studies on this subject relate mostly to the countries of Western Europe (Brülhart and Traeger 2005; Combes and Overman 2004; Midelfart-Knarvik et al. 2000; Midelfart-Knarvik and Overman 2002; Amiti 1999) or only some of these countries (Maurel and Sédillot 1999; Duranton and Overman 2005). Other articles relate to the ten CEECs new members of the EU or present national studies of some of these countries (Hildebrandt and Wörz 2004; De Simone 2006; Dupuch et al. 2001), with the major drawback of not taking into account the strong ties of the CEECs with the rest of the EU and their relative positioning inside the EU. To our knowledge, only one study analyzes EU25 (Dupuch et al. 2004) and also takes into account Romania and Bulgaria. However, the indices of specialization (the Krugman index) are based on exports, which can reflect in fact a change in the consumer's choices without having an impact on the real activity of the sector (Amiti 1999).

Consequently, facing this lack of research on EU27 and especially on the CEECs, in this section we will use improved methods and data to analyze specialization in the wider EU27 and present some stylized facts focusing on the link between specialization and FDIs. Most studies previously cited use the Gini or Krugman index, but here we chose to use entropy-based indices (Brülhart and Traeger 2005), in both absolute and relative terms[1], thanks to its

---

[1] Unlike absolute indices, when calculating them for each country, the relative ones take into account the global distribution of economic activity across sectors/industries at EU27 level.

properties of decomposability[2]. There are generally two types of entropy indices being used: those assuming a sensitivity parameter of 1, also called the Theil index that we shall note GE(1), and those assuming a sensitivity parameter of 2 that we shall note GE(2):

$$GE(1) = \sum_{s=1}^{S} p_{sr} \, log \, \frac{p_{sr}}{x_s}$$

$$GE(2) = \frac{1}{2} \left| \sum_{s=1}^{S} x_s \left(\frac{p_{sr}}{x_s} \right)^2 - 1 \right|$$

(1)

where:

$p_{sr} = \dfrac{y_{sr}}{\sum\limits_{s=1}^{S} y_{sr}}$ represents the share of sector or industry s in the activity of region r

$x_s = \dfrac{\sum\limits_{r=1}^{R} y_{sr}}{X}$ represents the share of sector or industry s in total activity X summed across all regions r

y_{sr} represents sector or industry s activity in region r
R – the number of regions
S – the number of sectors or industries

The sensitivity parameter measures the weight given to the dispersion of the economic activity in sector or industry s and region r y_{sr} at different parts of the distribution over s. Thus, when the sensitivity parameter is 1, the dispersion of y_{sr} is given the same weight at any part of the distribution over s, whereas for a sensitivity parameter superior to 1, the dispersion of y_{sr} is given a more important weight in the upper tail of the distribution. Furthermore, GE(1) allows a decomposition of inequality into within and between-country components, while GE(2) allows identifying countries' contribution to global EU27 specialization[3]. Given that data at the regional level are not available for all the countries of the EU27 and the period of interest (1996-2005), we will use only the second decomposability property, the sectoral decomposition property of the generalized entropy index GE(2). Consequently, measuring entropy at the EU27 level represents a very original analysis, which should give a clearer image of the economic geography of the European Union.

Thus, our sample contains the 27 EU member states, over the period 1996-2005. We have the choice between several variables like proxy for the level of activity in a certain sector: employment, production, value added, exports. We retain employment for two essential reasons. Firstly, regarding production and sectoral value added, the data are not available for our sample of countries and period of interest. Secondly, exports do not represent a better proxy than employment, because for example, a change in exports can simply reflect a change in consumer's choices without having an impact on the real activity of the sector (Amiti

---

[2] We have also measured concentration using the same class of indices. For more interested readers, results are available on request.
[3] We let interested readers refer to Brülhart and Traeger (2005) for a detailed discussion and presentation of the mathematical details regarding both relative and absolute indices.

1999). The data on employment for 25 of our 27 countries come from the *Groningen 60 Industry Database*, which we complete with data coming from the ILO and Eurostat databases for Romania and Bulgaria, all data being at the national level. This could be seen as a homogeneity bias in our sample, but the number of observations for the two countries is rather small compared to the full number of observations. Two types of studies will be presented. Firstly, we study specialization across all the economic sectors, according to the ISIC rev. 3 classification. Secondly, we focus only on manufacturing industries, according to same classification.

Globally, specialization measured through the GE(2) is higher than the one measured through GE(1), for the obvious reason that dispersion in the upper tail is given a more important weight. Here, we present tendencies only for GE(2) in relative terms, knowing that GE(1) that gives quite similar results and absolute indices are available on request. Relative indices are more relevant than the absolute ones, given that they take into account both the importance of a sector or industry in a country and the distribution of the same sector or industry across all the countries we analyze. They are all the more relevant, especially considering that we are interested in the European integration process under its many different forms and thus, in both the EU as a whole and the bonds created between its member countries.

When considering *specialization across all economic sectors*, our conclusions are similar to the ones of the literature aforementioned: small EU countries are more specialized than the large ones and developed EU27 members are generally less specialized than EU27 developing member countries. More precisely, we find Romania, Bulgaria and Luxembourg as being the most specialized, with an increasing specialization over the period under study, whereas Italy, Finland, Austria, Germany are among the least specialized. However, we identify two exceptions from the general trends: Ireland and Spain, a small country and a peripheral country respectively, which should be some of the most specialized EU members, actually find themselves among the least specialized, especially Ireland. As for the CEECs, they are generally more specialized than the old EU members, but the most developed of them, such as Hungary or the Czech Republic, are among the least specialized countries.

To analyze the evolution of specialization, considering the small number of years in our sample, we used bootstrap tests (Brülhart and Traeger 2005), which show that specialization is rather stable for most EU members. However, some slight changes appear: an increasing relative specialization especially in new member countries such as Poland or Slovenia and a decreasing absolute specialization especially in old member countries such as Austria or Portugal. Among the old members of the EU, especially the small or the peripheral countries register significant changes and also Germany and France, which saw their specialization decrease globally.

Finally, the sectoral decomposition of GE(2) shows that the largest countries, like Germany, the United Kingdom, Italy contribute the most to EU27 specialization. Among the CEECs, the countries contributing the most to specialization are Poland, Romania, the Czech Republic and Hungary. We have also noticed the downward trend of the Polish and Romanian contributions and the upward trend of the Spanish contribution. At the beginning of our period under study Spain contributed less than Poland to EU27 specialization, whereas towards its end, it exceeds it. These trends are in line with the evolution of countries' weight in total EU27 activity: Spain's weight in total EU27 economic activity increases over the period, that of Romania and Poland drops.

Considering *specialization across manufacturing industries*, as it was the case for economic sectors, small countries such as Luxembourg, Ireland, Cyprus and Malta or peripheral countries such as Greece and Portugal are more specialized than the large ones, whereas the least specialized remain France, the United Kingdom, Spain and Italy. Among the

CEECs, the most specialized are small countries such as the Baltic States and the least developed ones such as Romania and Bulgaria, while the least specialized are the most developed of them such as the Czech Republic and Poland.

Compared to the results concerning specialization across economic sectors, the bootstrap tests showed significant changes in the productive structures of most countries, in relative as well as in absolute terms. Among the old EU members, all the core large countries (Germany, France, United Kingdom) except Italy saw their relative and absolute specialization increase in the manufacturing industries, as a result of the relocation of certain industries towards the peripheral old members or the CEECs. Among the CEECs, Bulgaria saw its specialization increase both in relative and absolute terms, while Slovenia and the Czech Republic saw theirs increase only in absolute terms. An interesting case is Poland whose specialization increased in absolute terms, but decreased in relative terms.

The decomposition of GE(2) for specialization across manufacturing industries shows about the same tendencies that we identified for specialization across economic sectors. The large countries have a higher contribution to EU27 specialization, with an increasing contribution of Spain, Italy and the Czech Republic and a decreasing contribution of the United Kingdom, Poland, Romania and Bulgaria. This is the result of the increase of Spain's, Italy's and Czech Republic's shares and the decrease of United Kingdom's, Poland's, Romania's and Bulgaria's shares in EU's manufacturing sector.

After analyzing the evolution of specialization, our next concern is about the factors behind this evolution, which could be resumed as fairly stable across economic sectors and rather increasing across manufacturing industries. Besides classic determinants of specialization such as market size or factor endowments, the international trade and economic geography theory also suggest economic integration under its many different aspects such decreasing trade and coordination costs, technology diffusion and especially FDIs. Given the very dynamic evolution of FDIs, we are particularly interested in the link between them and specialization trends in EU27.

At a first glance, sectoral FDI and employment statistics tend to confirm a rather positive link between the two[4]. For instance, in Czech Republic, FDIs level in rubber and plastics industry increased about 700% between 1996 and 2005, while employment level in the same industry increased about 60%. This is one of the most spectacular increases in Czech Republic's FDIs and employment over this period. Furthermore, they increased together also in relative terms: FDIs share in total manufacturing FDI went up from about 4% to about 6%, while employment share in total manufacturing employment went up from about 3% to about 5%. Then, the same trends are followed in transport equipment: about 600% increase in FDIs level and about 34% increase in employment level corresponding to about 54% increase in FDIs share and 42% in employment share. We have noticed similar trends in electrical and optical equipment, about 31% increase in employment, but we do not have enough data to assess FDI increase over this period. Even more interesting evidence supporting a positive link between FDI and specialization is the trends followed by FDIs and employment in food industry, which has one of the highest shares in total manufacturing employment in Czech Republic. While FDIs continue to grow in this industry, as they globally do in almost all industries, their share in total manufacturing FDI is shrinking between 1996 and 2005, from about 18 to 10%. The same is true for employment: its share in total manufacturing employment decreased from 12 to 10%.

Following the same reasoning, we find similar trends in Poland, Slovakia or Bulgaria. In Poland, the shares of FDIs and employment in total manufacturing go up together in wood, publishing and printing and in transport equipment, but down together in textiles and wearing

---

[4] We refer to sectoral employment given that our specialization indices have been calculated based on such statistics.

apparel, which are three of the main manufacturing industries in this country. Only in food products, they follow opposite trends: employment share increases while FDIs share decreases. However, FDIs level does go up over the period of interest. In Slovakia, wearing apparel, wood, publishing and printing and electrical and optical equipment saw their shares increasing in both FDIs and employment, while the food industry saw its same shares decrease in total manufacturing[5].

4 Specialization and FDI in the EU27

4.1 Theoretic background

Vechiu (2010) analyzes a theoretic model based on Fujita and Thisse (2006), where the importance of economic integration (seen as the decrease of trade costs but also as new information and communication technology diffusion) for the distribution of activity across space and sectors is highlighted. More precisely, we showed that wage and communication infrastructure differentials between countries are important determinants of industry agglomeration. The model combines economic geography and multinational firms theory. It is assumed that in the industrial sector, firms may separate their production unit from their headquarters (HQ) depending on production costs advantages offer by different regions or countries. Furthermore, all HQ are exclusively located in a developed region, while the production unit may be established together with the HQ (integrated firms) or in a developing region (multinational firms) depending on communication costs in each region and wage differentials between regions. According to these two criteria combined, the most competitive countries in absolute and/or relative terms are considered the best locations for their production units by multinationals firms (MNFs). Under these conditions, the FDIs undertaken by MNFs triggered by relatively good communications infrastructures and competitive wage differentials can push countries to increased specialization: developing countries offering the most competitive trade off between labour and communication costs will tend to specialize in industrial goods production, whereas developing countries with a less interesting trade off between labour and communication costs will tend to specialize in traditional goods production. Considering that HQs are exclusively located in the developed countries, the latter will specialize in services production.

Consequently, in this section, we propose an empirical analysis of the determinants of specialization in EU27 member countries, with a special interest for the role of FDIs. To our knowledge, the link between FDIs and specialization has never been analyzed empirically at the level of the EU27. The only article dealing with specialization and FDIs is Dupuch and Mazier (2002), but they take into account only EU15 without Luxembourg and Ireland, between 1980 and 1994, completely ignoring the economic integration of the CEECs. Then, it is all the more interesting as the locking-in in a kind of development trap, with specialization in low value added sectors remains a real threat to some developing countries. This issue finds its roots not only in certain models of economic geography (the developing countries would represent the periphery which produces only the traditional good, according to a technology with constant returns), but also in the theories of the international trade (Hecksher-Ohlin) or development economics (Baghwati). Today, as most developing countries receive FDIs which especially seek to benefit from low labour costs, we are tempted to believe that to a certain extent, this type of FDI will push these countries to specialize in low value added sectors, which in the long run will be not beneficial in terms of development.

---

[5] These conclusions are based on authors' calculations using FDI stocks from the OECD database online and employment from the Groningen database.

4.2 Data and methodology

From the model presented in Vechiu (2010) and the literature mentioned above, we could thus identify the main determinants of specialization:

■ economic integration
■ communications infrastructure
■ market potential
■ productivity differential
■ relative factor endowments.

As in the previous section, first we analyze economic sectors and then, manufacturing industries. The determinants, their proxies and the data sources are summarized in Table 1 below. With regard to specialization, we will use as the dependent variable the relative generalized entropy index previously calculated (*GE2rel* for economic sectors and *GE2relm* for manufacturing industries). Knowing that we are interested particularly in the impact of FDIs, we consider them as a proxy for economic integration. More precisely, we will consider stocks, because as compared to flows, they are more likely to influence countries' specialization on the long run. For communications infrastructure, we will consider the number of fixed and mobile lines subscribers per 100 persons in relative terms compared to the EU27 average (*Crel*). For productivity differential, according to same logic prevailing for communications infrastructure, we will use labour productivity relative to the average EU27 (*Prodrel*). For the relative factor endowments, we will consider the capital stock per capita relative to the average EU27 (*Ktrel*), for which we use as a proxy the gross fixed capital formation/total labour force ratio. Finally, for market potential, we will use as a proxy the indicator computed by Mayer (2008) following the Head and Mayer (2004) method, available online on the CEPII website (*RMPhm*).

Table 1 Choice of variable and data sources

Variables	Proxy	Data sources
Specialization (*GE2rel*, *GE2relm*)	Relative entropy index	Authors' calculation
Economic integration (*FDIstp*)	FDI stocks (GDP percentage)	OECD
Relative communications infrastructure (*Crel*)	Number of fixed and mobiles subscribers per 100 persons (relative to the EU27 average)	UN, ITU
Relative productivity (*Prodrel*)	Labour productivity by person employed (relative to the EU27 average)	Groningen
Relative factor endowments (*Ktrel*)	GCF/labour force (relative to the EU27 average)	UN/WB
Market potential (*RMPhm*)	Head and Mayer (2004) indicator	CEPII

Our equations to be estimated is thus written:

$$ln\, GE2rel = ln\, FDIstp + ln\, Crel + ln\, Ktrel + ln\, RMPhm \qquad (2)$$

10

For homogeneity reasons, we use two samples: one containing only the developed countries of the EU and the other comprising only its developing members. More details about our variables are also given by Table 2 below that is showing some salient summary statistics for our both samples.

Table 2 Summary statistics

European Union Developed Member Countries					
Variable	Obs	Mean	Std. Dev.	Min	Max
GE2relm	170	0.1396538	0.1296402	0.020966	0.64858
GE2rel	170	0.0585053	0.0421458	0.012771	0.22245
FDIstp	158	0.376879	0.3384329	0.0379872	1.548794
Crel	170	1.141802	0.1931618	0.7407402	1.883404
Prodrel	170	0.9828733	0.1739294	0.6448414	1.26525
Ktrel	170	1.068803	0.4764045	0.453157	2.862745
RMPhm	129	17.3019	1.095287	15.53241	19.7591
European Union Developing Member Countries					
Variable	Obs	Mean	Std. Dev.	Min	Max
GE2relm	100	0.2090889	0.2262123	0.029005	1.1895
GE2rel	100	0.1627021	0.2070143	0.031025	0.90182
FDIstp	100	0.2883936	0.1701983	0.0308523	0.864131
Crel	100	0.652493	0.1984174	0.2754772	1.037196
Prodrel	100	0.4622703	0.1617731	0.1431197	0.8953142
Ktrel	100	0.2621956	0.1530328	0.0338081	0.6602598
RMPhm	80	15.72331	0.57122	14.84654	16.97376

Concerning methodology, our main concern is the endogeneity that is very likely to characterize most of our dependent variables. Especially, specialization may favour for instance FDIs in a certain sector, which is a quite common phenomenon during our period of study (1996-2005): many developing countries highly specialized in manufacturing receive the bulk of FDIs in this sector. The same may be true about productivity or the market potential: a higher specialization triggers a higher productivity thanks to the learning effect and this, may also lead to a higher market potential. The two stage-least square (2SLS) is quite a common method to deal with endogeneity, but its major inconvenient is that the good instrumental variables are very hard to find. Consequently, we choose the vector autoregression (VAR) technique, which suits well also because our empirical study is not structurally driven from a theoretical model but is based only on interpreting the results of different theoretical models.

In the next section, first we analyze the determinants of specialization across all economic sectors by discussing impulse response functions for the developed members of the EU and then, for its developing member countries. Secondly, we analyze the determinants of specialization across manufacturing industries also by discussing impulse response functions for the developed members of the EU and then, for its developing member countries.

4.3 Results and discussion

In this section, we will present our results for specialization determinants, knowing that we are interested especially in the developing member countries of the EU27. So, after a brief discussion of the results for European Union developed member countries, which are mainly

Western European countries plus Cyprus and Malta (EU17), we will focus more deeply on the Central and Eastern European Countries (CEEC), the new member countries.

4.3.1 Economic sectors

Regarding *EU17*, as expected, we find a positive impact of the FDI (Fig. 1), thus contributing to the reinforcement of these countries' relative specialization, even though much less than the other variables we use in our study (their impact is depicted in Fig. 2). Globally, it seems also that the relative communications infrastructure, the relative endowments and market potential have a rather negative impact on EU17 countries' specialization. This is in accordance with previous studies also mentioned in our literature review section: the higher the level of development, the lower the specialization. Finally, relative productivity has at first a slightly negative impact and then, it becomes positive.
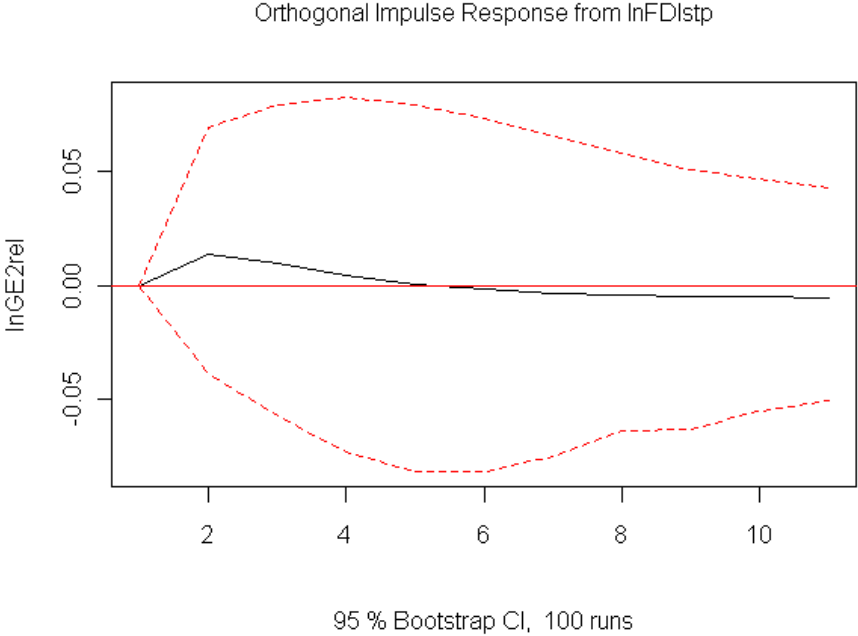
Orthogonal Impulse Response from lnFDIstp

95 % Bootstrap CI, 100 runs

Fig. 1 The impact of *FDIs* on relative specialization across economic sectors in EU17. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.
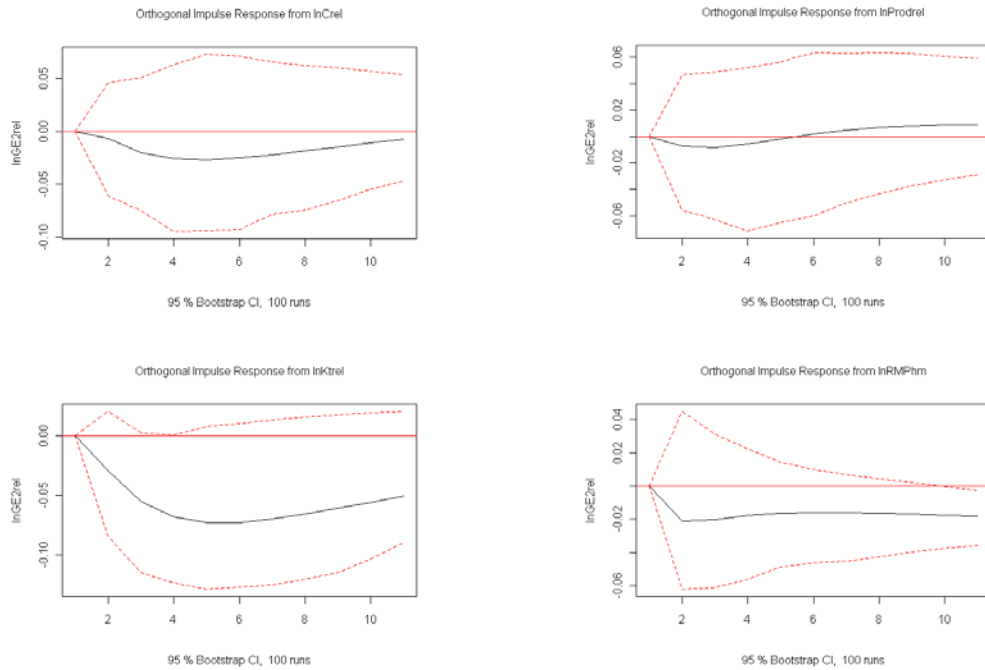
Fig. 2 The impact of *Crel*, *Prodrel*, *Ktrel* and *RMPhm* on relative specialization across economic sectors in EU17. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.

Regarding the *CEECs*, compared to EU17, the impact of most variables is globally stronger on their relative specialization. This shows that these countries are more sensitive to changes in their economic environment, which is easily understandable given that they are at an earlier stage of development when returns to scale are higher.

Even though they have a strong negative impact at first (for a short period), finally in the long run, FDIs enhance the CEECs' relative specialization (Fig. 3). We have very few data on the sectoral FDI, but they nevertheless enable us to note that, for example, in Czech Republic, the share of employment in the manufacturing sector drops over our study period, at the same time as the share of the FDI in this sector. On the contrary, the share of employment in the real estate sector is rising, passing from approximately 7% in 1996 to 10% in 2005, just as the share of the FDI in this sector, which passes from 0% to 18% and reaches even 20% in 2003 and 33% in 2004. In Hungary, the share of employment in the manufacturing sector is decreasing (from 24% to 22%), at the same time as the share of the FDI in this sector lowers approximately from 59% to 37%. We find a similar pattern in trade, whose share of employment increases from 14 to 15%, while the share of the FDI in this sector increases from 15 to 18%.
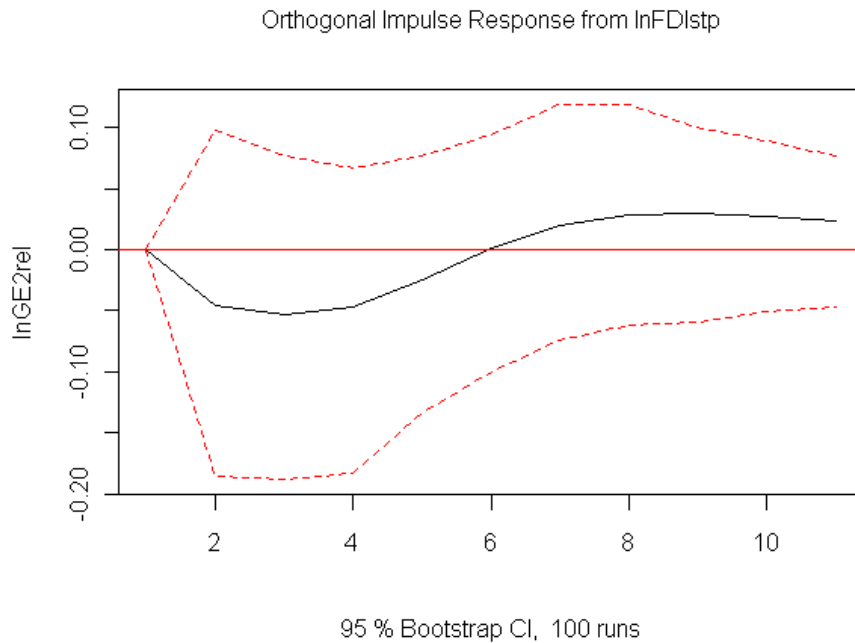
Orthogonal Impulse Response from lnFDIstp

95 % Bootstrap CI, 100 runs

Fig. 3 The impact of *FDIs* on relative specialization across economic sectors in the CEECs. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.

The impact of the relative communications infrastructure is very weak compared to the other variables and it is mainly negative, as it was the case for EU17 (Fig. 4). An improvement of the communications infrastructure helps countries diversify the economic activity. Then, unlike in the EU17 countries, relative productivity has very strong negative impact, while factor endowments have a weaker positive impact (Fig. 4). Therefore, the more the labour productivity improves as compared to the EU27 average, the more the CEECs diversify their economic activity. But, on the contrary, the more capital they accumulate, the more the CEECs specialize. These two phenomena could be the result of a mere catching-up process. While increased productivity of an abundant labour force helps the CEECs diversify their economy, accumulating capital that is rather scarce in these countries forces them to specialize in order to maximize capital returns. Finally, the market potential has a weaker negative impact on the CEECs' specialization (Fig. 4). This may be a sign that increasing national and international demand reflects the classic consumers' love of variety and thus, countries' need to diversify their economy in order to cope with it.
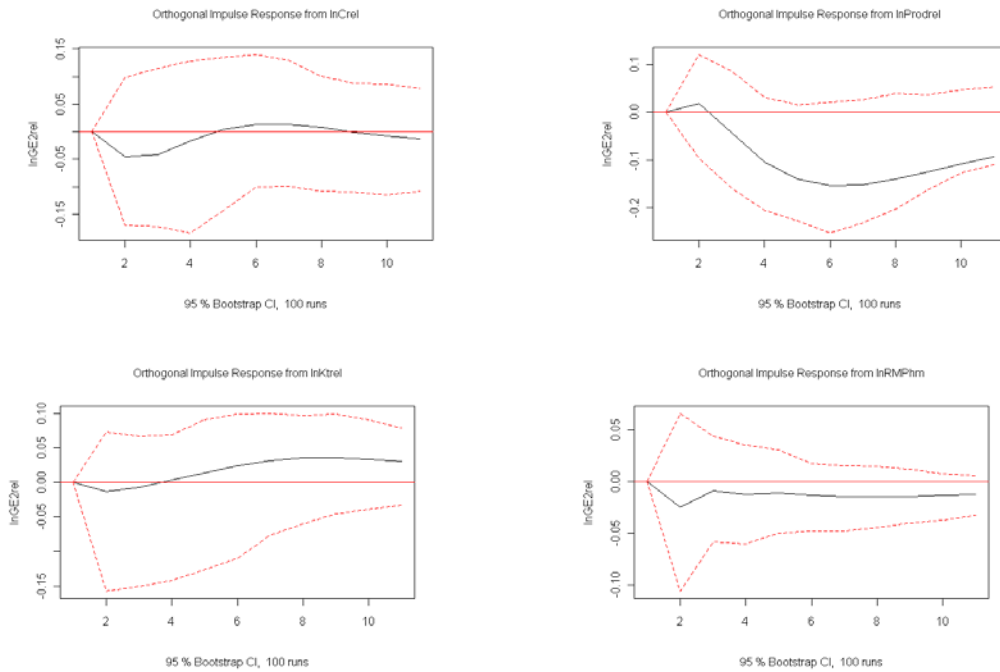
Fig. 4 The impact of *Crel*, *Prodrel*, *Ktrel* and *RMPhm* on relative specialization across economic sectors in the CEECs. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.

4.3.2 Manufacturing industries

Regarding *EU17* countries' relative specialization in the manufacturing industries, results do not change much from the previous. However, FDIs have a slightly stronger impact but still positive (Fig. 5), while quite notable differences can be noticed as regards labour productivity and factor endowments (Fig. 6). The impact of relative labour productivity becomes much stronger and definitely positive, while relative factor endowments have almost no impact at all. The two phenomena are very probably related and their explanation is the opposite to the one given previously about the impact of labour productivity and factor endowments in the CEECs: more productive but scarce labour can only be valued in few branches of the economy, while more capital in already capital rich countries is very unlikely to bring significant changes to their productive structure.
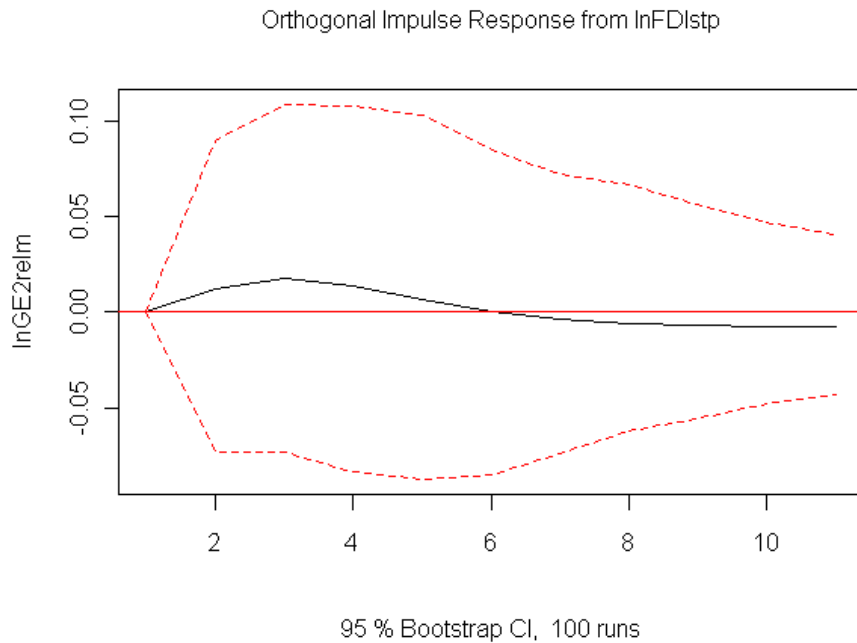
15

Orthogonal Impulse Response from lnFDIstp

95 % Bootstrap CI, 100 runs

Fig. 5 The impact of *FDIs* on relative specialization across manufacturing industries in EU17. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.
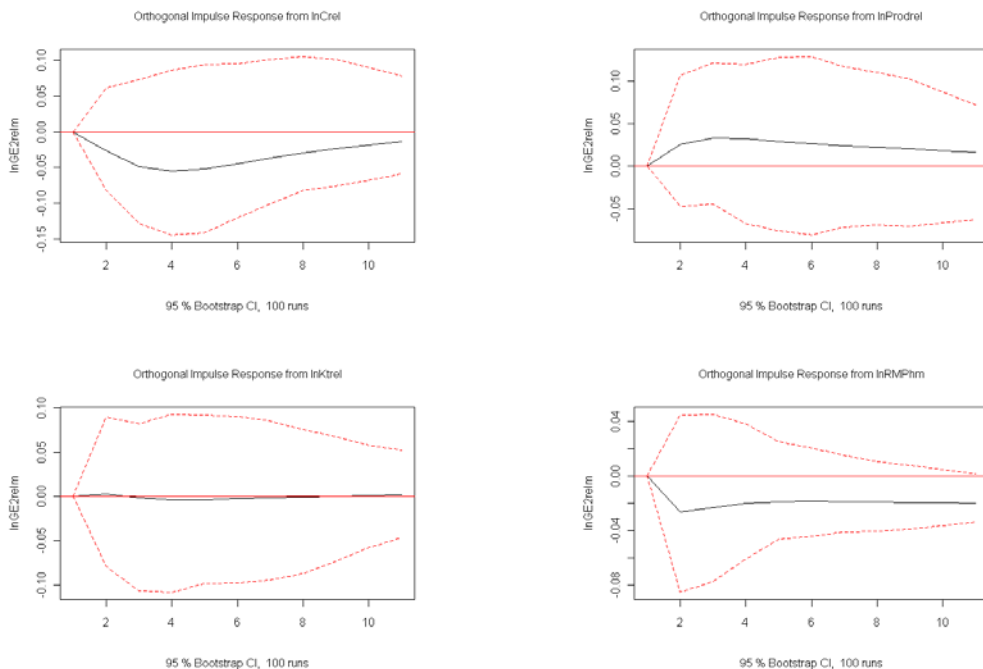

Fig. 6 The impact of *Crel*, *Prodrel*, *Ktrel* and *RMPhm* on relative specialization across manufacturing industries in EU17. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.

In the *CEECs*, the impact of FDIs on relative specialization in the manufacturing industries seems weaker than relative specialization across all economic sectors, but still positive (Fig. 7). This is rather straightforward given that the bulk of FDIs in the CEECs go to the manufacturing sector in general and less to certain manufacturing industries in particular. Then, the other variables have the usual impact (Fig. 8), except for factor endowments which now have a very strong negative impact reminding the one on EU17 countries' specialization across economic sectors. This could be explain by the fact that in the manufacturing industries, which are the CEECs' strongest asset, these countries might have attained a development level similar to the one the EU17 countries have in their global productive structure. On the other hand, if we think that the CEECs are specialized in mainly labour intensive manufacturing industries, capital accumulation may easily help them diversify their manufacturing sector by developing new branches, which are more capital intensive.
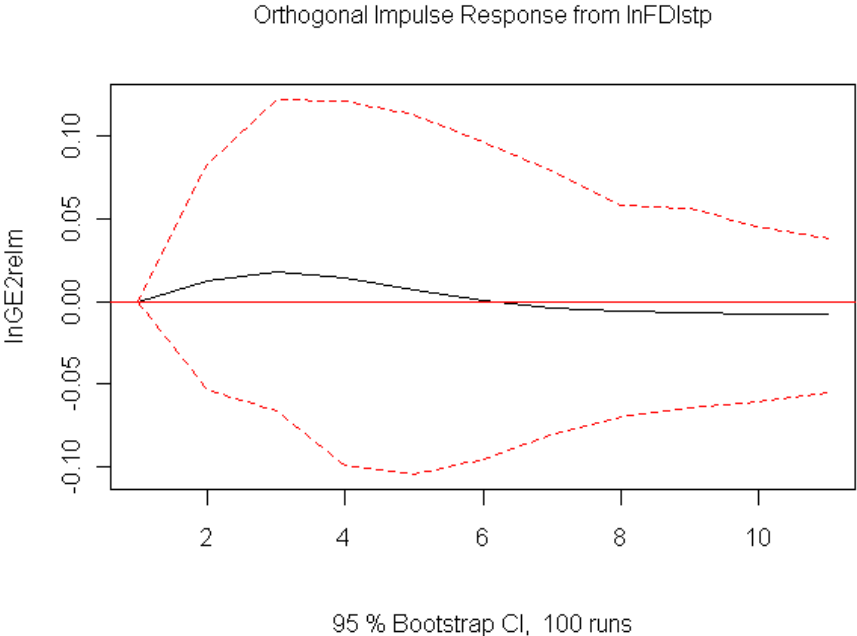

Fig. 7 The impact of *FDIs* on relative specialization across manufacturing industries in the CEECs. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.
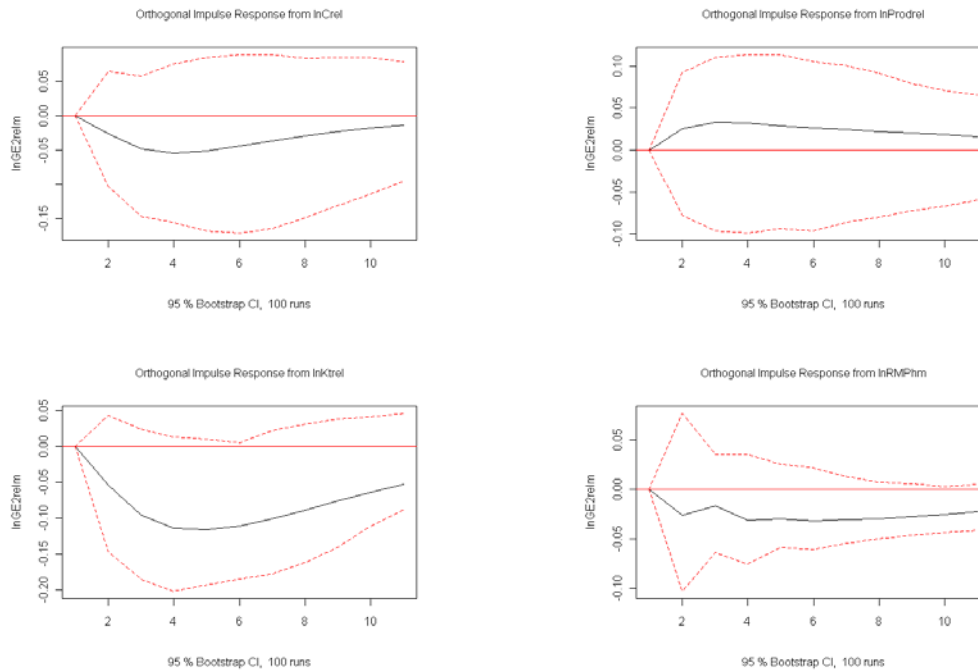
Fig. 8 The impact of *Crel*, *Prodrel*, *Ktrel* and *RMPhm* on relative specialization across manufacturing industries in the CEECs. Note: The dashed lines represent the confidence interval, while the continuous line represents the relation between variables. A continuous line below the zero level axis indicates a negative correlation, while a continuous line above the zero level axis, indicates the opposite.

5 Conclusions

The enlargement of the European Union led us questioning on the evolution of the distribution of the economic activity, through its impact on the member countries' specialization level. We retained indices based on entropy measure to analyze the evolution of the EU's 27 member countries' specialization across all economic sectors and, more in detail, across manufacturing industries. We were interested in measuring countries' productive specialization and also in its determinants. First, after computing entropy indices to measure relative specialization, we use the bootstrap method in order to analyze if significant changes in specialization took place during our rather short period of study, from 1996 to 2005. Then, implementing the panel VAR method, we tried to analyze the impact of different variables on specialization, with a special interest for FDIs' impact.

Generally, the most specialized countries are the smallest or the least developed (peripheral) ones, with some exceptions. Across all economic sectors, Ireland and Spain, respectively a small country and a peripheral country, which should be among the most specialized, are in fact among the least specialized. Across manufacturing industries, we find Spain again with a lower than expected level of specialization and Italy, a large developed country, which should be among the least specialized, but it is among the most specialized countries. Among the CEECs, Romania and Bulgaria are as expected the most specialized, both across all economic sectors and across manufacturing industries. Hungary is the least specialized across all economic sectors, whereas the Czech Republic and Slovenia are the least specialized across manufacturing industries.

As for the evolution of the distribution of the economic activity in the EU27, we found that the tendencies are not same according to whether we analyze specialization across all economic sectors or. More precisely, bootstrap tests show a decreasing tendency in

18

specialization across all economic sectors, but an increasing one in specialization across manufacturing industries.

Lastly, regarding specialization determinants, our panel VAR analysis shows that countries' development level has an important role to play when assessing the impact of the main variables pointed by the theoretical literature on the subject. FDIs seem to have a positive impact on specialization both across economic sectors and manufacturing industries and at the same time, their impact appears to be globally more important in less developed countries (in our case, the CEECs) as compared to the developed ones (in our case, EU17). It is worth mentioned that this positive impact seems to appear rather in the long run in the CEECs, but rather in the short run in the EU17. Globally, the relative communications infrastructure and the market potential seem to have a negative impact, which is in accordance with earlier literature and our own descriptive analysis: more developed countries are less specialized. Then, depending on countries' level of development, relative labour productivity and factor endowments may have different impact on specialization. In developed countries, relative labour productivity has a positive impact, whereas in developing countries, the opposite is true. The reverse is found for factor endowments, with the notable exception that in developing countries, where, given the general trends, we could expect a positive impact of capital accumulation on specialization across manufacturing industries, we find the opposite. This could be explained by the fact that the CEECs are specialized in mainly labour intensive manufacturing industries and thus, capital accumulation may easily help them diversify their manufacturing sector by developing new branches, which are more capital intensive.

Our analysis points out that countries' economic policy aiming to a balanced productive structure should be designed according to their level of development. For instance, in developing countries, such as the CEECS, the high benefits of FDIs in the short run could translate into a higher specialization in the long run that might endanger countries' economic stability.

References

Aiginger K (2000) Specialization of European Manufacturing. Austrian Econ Q 5(2): 81-92

Aiginger K, Davies SW (2004) Industrial Specialisation And Geographic Concentration: Two Sides Of The Same Coin? Not For The European Union. *J Appl Econ* VII(2): 231-248

Amiti M (1999) Specialization Patterns in Europe. *Weltwirtschaftliches Archiv* 135(4): 573-593

Brülhart M, Traeger R (2005) An account of geographic concentration patterns in Europe. *Regional Science and Urban Econ* 35(6): 597-624

Brülhart M (1998a) Economic geography, industry location, and trade: The evidence. *World Econ* 21(6): 775-801

Brülhart M (1998b) Trading places: Industrial specialization in the European Union. *J Common Market Stud* 36(3): 319-346

Brülhart M (2001a) Evolving geographic concentration of European manufacturing industries. *Rev World Econ* 137(2): 215-243

Brülhart M (2001b) Growing alike or growing apart? Industrial specialization of EU countries. In: Wyplosz C (ed) *The Impact of EMU on Europe and the Developing Countries*. Oxford University Press, Oxford, pp. 169-194

Brülhart M, Torstensson J (1996) Regional integration, scale economies and industry location. Centre for Economic Policy Research Working Paper 1435

Combes PP, Overman HG (2004) The spatial distribution of economic activities in the European Union. In: Henderson JV, Thisse JF (ed) *Handbook of Regional and Urban Economics.* Elsevier North-Holland, Amsterdam, pp 2845-2909

Crabbé K, Beine M, Vandenbussche H (2005) Trade Integration and Industrial Specialization in Central Europe. Catholic University Leuven Working Paper

Cutrini E (2009) Using entropy measures to disentangle regional from national localization patterns. *Regional Science and Urban Econ* 39(2): 243-250

De Simone G (2006) Patterns of Trade and Production Specialisation and Trade Value Formation in the Wake of Cross-Border Production Sharing. The Central Eastern European Countries' Case. Social Science Research Network Working Paper 895522

Dupuch S, Mazier J (2002) Mobilité du capital et spécialisation en Union européenne. *Revue économique* 53(3): 483-492

Dupuch S, Jennequin H, Mouhoud EM (2001) Intégration Européenne, Elargissement aux PECO et Economie Géographique. *Région et Développement* 13 : 125-162

Dupuch S, Jennequin H, Mouhoud EM (2004) EU Enlargement, what does it change for the European Economic Geography?. *Revue de l'OFCE* Special edition 29 : 241-274

Duranton G, Overman, HG (2005) Testing for localization using micro-geographic data. *Rev Econ Stud* 72(4): 1077–1106

Fiess N, Marco F (2002) European Integration: A Review of the Literature and Lessons for NAFTA. Article prepared for the *Lessons from NAFTA for Latin America and the Caribbean* repport, World Bank

Fujita M, Thisse, JF (2006) Globalization and the evolution of the supply chain: who gains and who loses?. *Int Econ Rev* 47(3): 811-836

Haaland JI, Kind HJ, Ulltveit-Moe KH (1998) What Determines the Economic Geography of Europe?. Centre for Economic Policy Research Working Paper 2072(

Head CK, Mayer T (2004) Market Potential and the Location of Japanese Investment in the European Union. *Rev Econ Stat* 86(4): 959-972

Hildebrandt A, Wörz J (2004) Determinants of Industrial Location Patterns in the CEECs. The Vienna Institute for International Economic Studies Working Paper 32

Longhi S, Nijkamp P, Traistaru I (2003) Economic Integration and Manufacturing Location in EU Accession Countries. Tinbergen Institute Working Paper 03-093/3

Maurel F, Sédillot B (1999) A measure of the geographic concentration in French manufacturing industries. *Regional Science and Urban Econ* 29(5): 575-604

Mayer T (2008) Market potential and development. CEPII Working Paper 2009-24

Midelfart-Knarvik KH, Overman HG, Redding SJ, Venables AJ (2000) The Location of European Industry. Directorate-General for Economic and Financial Affairs European Economy Working Paper 142

Midelfart-Knarvik KH, Overman HG (2002) Delocation and European integration: is structural spending justified?. *Econ Policy* 17(35): 321-359

Midelfart-Knarvik KH, Overman HG, Venables AJ (2003) Monetary union and the economic geography of Europe. *J common market stud* 41(5): 847-868

Midelfart-Knarvik KH, Overman HG, Redding SJ, Venables AJ (2002) Integration and Industrial Specialization in the European Union. *Revue économique* 53(3): 469-481

OECD (1999) UEM: Faits, défis et politiques. Paris

Storper M, Chen YC, De Paolis F (2002) Trade and the location of industries in the OECD and European Union. *J Econ Geography* 2(1): 73-107

Vechiu N (2010) Economic integration and efficiency seeking FDI: a three-region model. J Regional and Urban Econ 4: 773-796