WORKING PAPERS

UNIVERSITAT JAUME·I

CEECS INTEGRATION INTO REGIONAL PRODUCTION NETWORKS. TRADE EFFECTS OF EU-ACCESSION

Economics Department

Inmaculada Martínez-Zarzoso
Anca M. Voicu
Martina Vidovic

Castellón (Spain)

2012 / 04

CEECS INTEGRATION INTO REGIONAL PRODUCTION NETWORKS. TRADE EFFECTS OF EU-ACCESSION

Inmaculada Martínez-Zarzoso
Georg-August Universitaet Goettingen
University Jaume I
martinei@eco.uji.es

Anca M. Voicu
Department of Economics Rollins College
avoicu@rollins.edu

Martina Vidovic
Department of Economics Rollins College
mvidovic@rollins.edu

2012 / 04

Abstract

We estimate a gravity model that incorporates the extensive margin of trade and accounts for firm heterogeneity to evaluate the effect of the EU-accession on CEECs trade in intermediates and final goods for the period 1999-2009. The importance of production networks is captured by including imports of intermediates as a determinant of a country's exports of final goods. We find a positive and significant effect of the EU-accession on CEECs trade in intermediate and final goods. Hence, the elimination of "behind the border" trade barriers has a positive impact on increasing not only trade volumes but also trade varieties.

Keywords: gravity equation; panel data; production networks; economic integration; trade flows.
JEL Classification: F10, F14

CEECS INTEGRATION INTO REGIONAL PRODUCTION NETWORKS. TRADE EFFECTS OF EU-ACCESSION

Inmaculada Martínez-Zarzoso
Email: martinei@eco.uji.es

Department of Economics and Center for Statistics
Georg-August Universitaet Goettingen
Platz der Goettinger Sieben 3
Goettingen 37073
Germany
and
Department of Economics and Institute of International Economics
University Jaume I, Castellón, Spain

Anca M. Voicu
Email: avoicu@rollins.edu
Department of Economics
Rollins College
1000 Holt Avenue
Winter Park, FL 32724
USA

Martina Vidovic
Email: mvidovic@rollins.edu
Department of Economics
Rollins College
1000 Holt Avenue
Winter Park, FL 32724
USA

CEECs Integration into Regional Production Networks. Trade Effects of EU-Accession

ABSTRACT

We estimate a gravity model that incorporates the extensive margin of trade and accounts for firm heterogeneity to evaluate the effect of the EU-accession on CEECs trade in intermediates and final goods for the period 1999-2009. The importance of production networks is captured by including imports of intermediates as a determinant of a country's exports of final goods. We find a positive and significant effect of the EU-accession on CEECs trade in intermediate and final goods. Hence, the elimination of "behind the border" trade barriers has a positive impact on increasing not only trade volumes but also trade varieties.

Keywords: gravity equation; panel data; production networks; economic integration; trade flows.

JEL: F10, F14

1. Introduction

Geographical proximity as well as historical evidence suggests that Western Europe and Central-East Europe are natural trading partners. Despite this, trade between the eastern and western parts of the European continent was suppressed by two restraints before 1989. The first was explicit government policies of import licensing, state monopolies on foreign trade, foreign exchange restrictions and central planning. The second, less direct, were the growth inhibiting aspects of central planning which impacted negatively income levels in Central-East Europe. The Europe Agreements established bilateral free trade between the European Union (EU) and each individual Central Eastern European country (CEEC) in most industrial products by the end of 1994, and in 2004 and 2007 eight and two CEECs respectively have gained full accession into the EU. Before the CEECs became part of the EU, trade between East and West Europe mainly consisted of final products (Kaminski and Ng, 2001). Following accession, the CEECs

are expected to be more integrated into regional (mainly EU based) and global production networks.

According to the so-called new-new trade theories based on firm heterogeneity in productivity and fixed cost of exporting (Melitz, 2003), a reduction in trade costs will lead to an increase in trade in two margins: the number of traded varieties (extensive margin) and the average volume of trade (intensive margin). But not all new varieties traded are expected to be consumer goods; new intermediate inputs would be exported to countries producing the final good. Due to 'just in time' production processes, intermediates are more likely to be traded over short distances. The recently developed model by Baldwin and Venables (2010) shows how reductions in trade costs beyond a threshold can result in discontinuous changes in location, with a relocation of a wide range of production stages. The authors highlight that there have been important empirical studies charting the rise of trade in parts and components and that formal measurement has been problematic since trade data do not make clear which goods are inputs into the production of other goods.

This study takes a step forward in this direction by examining the involvement of the CEECs into regional and global production networks on two different levels. First, we focus on the effects of the EU-accession and the induced trade-costs reductions on trade in intermediate and final products. Second, we specifically analyze the effects of deeper economic integration on the extensive and the intensive margins of trade. To this end, we employ a theoretically justified gravity model based on Helpman, Melitz and Rubinstein (2008) which incorporates the extensive margin of trade and accounts for firm heterogeneity. We estimate the model over the period 1999 to 2009 using highly

disaggregated data for CEECs imports of parts and components from OECD countries, and for CEECs exports of final goods to OECD countries. We augment the model with a measure of imported intermediate products and estimate it for each trade margin (extensive and intensive) separately by distinguishing also between final and intermediate goods. In this way we are able to estimate the magnitude of the effect of the reduction in trade costs following the agreements for each trade margin and for each category of goods.

The main novelties of this paper are twofold. To our knowledge, this is the first paper that examines the effects of the 2004 and 2007 EU enlargements on trade in intermediates and final goods separately[1]. It is also the first attempt to disentangle the effects of production networks on the two margins of trade, extensive (number of traded varieties) and intensive (average volume of trade). We specifically link parts and components with their corresponding final goods by using trade data disaggregated at the 5 digit Standard International Trade Classification (SITC) level to estimate the effect that an increase in imports of intermediates has on exports of the corresponding final products. To our knowledge this has not been done previously.

Our results indicate that the CEECs have indeed become more integrated into regional (EU) production networks. The EU accession has increased trade volumes and

[1] To our knowledge Antimiani and Constantini (2010) and Hornok (2010) are the only two authors that estimate the effects of the 2004-enlargement. The former paper finds that the effect of the enlargement is much more evident for high tech than for low-tech sectors and the second finds that the impact of the enlargement on exports of final goods is positive and greater for new EU members than for old EU members.

trade varieties in both parts and components and final goods between the two parts of the European continent. Once we account for imported parts and components in the regression model where the dependent variable is exports of final goods, the estimated effect of the CEECs accession into the EU on final goods' trade is considerably reduced. This indicates that part of this effect is in fact due to a more integrated production network that emerged as a consequence of the decline in transport costs.

The remainder of the paper is organized as follows. Section 2 provides a brief discussion of the related literature. Section 3 presents the model specification and discusses several estimation issues. Section 4 describes the data and presents the main results. The conclusions and policy implications are discussed in Section 5.

2. Theoretical Background and Literature Review

In recent years the economic literature has focused its attention on the importance of international supply chains for international trade and location of production. Within this stream of research, scholarly work on fragmentation of production and trade in parts and components has grown in volume and importance. This new trade that has been taking place mainly within multinational enterprises (MNEs) led to the development of production networks[2]. Indeed, due to differences in factor prices in different locations (mainly labor costs) and reductions in service-link costs, vertical fragmentation of production/distribution results in a reduction in production costs. All of these became possible thanks to the recent worldwide efforts to reduce trade impediments, to foster advances in information and

[2] According to Sturgeon's definition, production networks represent "a set of inter-firm relationships that bind a group of firms into a larger economic unit" (Sturgeon, 2001).

telecommunication technologies and to reduce transportation costs. Due to the cost and the unpredictable delays involved in intercontinental shipping, supply chains mainly developed at a regional level, rather than at a global level (Baldwin and Venables, 2010).

The first large scale fragmentation of production developed in the 1980s was the Maquiladora program in Mexico. This created 'twin plants' along the Mexico – US border in order to take advantage of geographic proximity and large wage differences. At the same time and for the same reasons, unbundling of production took place in East Asia. Similarly, in Europe the unbundling process started with the accession of Spain and Portugal into the EU in 1986 and became intensified with the opening up of Central East Europe in the 1990s. Following the fall of the Iron Curtain in Central East Europe at the end of 1989, these countries engaged in a process of fundamental change of their economies from central planning to market type economies and closer integration with Western Europe. Trade became reoriented from the east to the west and has played, and continues to play, an important role as the main engine for the growth of these economies. Since the 1990's and even more so after accession into the EU, the CEECs have intensified their trade in parts and components with the EU as a result of international fragmentation of production and have become integrated into global, mainly EU-based networks of production and distribution (Kaminski and Ng, 2005; Zeddies, 2010). According to Kaminski and Ng (2005), network related trade registered significant growth and underwent a number of changes. First, simple assembly operations have been replaced by processing and specialization in

production of parts. In addition, the CEECs-10[3] network firms have expanded beyond EU markets, and by 1999 these countries have become net exporters of network products and parts. Finally, trade in parts and components for the OECD nations that include the CEECs-10 accounted for approximately 30% of OECD's total trade in the late 1990s (Yeats, 2001).

Jones and Kierzkowski (1990) were the first to propose a theory of international production fragmentation that incorporates differences in comparative advantage in different locations. This new theory is based on the classical (Ricardian) and neoclassical (Hecksher-Ohlin) trade theories. First, in line with the Ricardian theory, differences in labor skills among labor intensive countries imply that labor skills of one country may be more suitable for one stage of production process while labor skills of another country may be more suitable for another stage of production process. Second, based on Hecksher-Ohlin theory of international trade, more labor intensive stages of production will locate in labor abundant, lower wage countries, while more capital intensive stages of production will take place in capital abundant countries. This means that a country does not have to have a comparative advantage in every stage of production, and a firm can take advantage of country-specific differences in resource endowments and productivities through vertical specialization.

From an empirical point of view and given the diversity of forms in which international fragmentation of production can take place, measurement of this phenomenon has been done using several different indicators. First, production

[3] CEECs-10 include Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

fragmentation by MNEs can be measured by the outward processing trade (OPT) statistics. OPT takes place when several stages of production of a firm's main manufacturing activities are shifted abroad and products are exported for processing on a temporary basis, and then are re-imported later. Since OPT data are collected for a specific type of international trade of goods, they tend to underestimate the extent of international fragmentation of production (Baldone et al., 2001). Baldone et al. (2001) and Egger and Egger (2005) empirically analyzed outward processing trade for European countries.

A second measure of international fragmentation of production involves independent firms acting as a network (e.g. vertical specialization) where the principal company does not have to participate in the subcontractor's business activities. In this context, vertical specialization involves those imported goods that are inputs in the production of the country's export goods. In order to estimate such vertical specialization of international trade, Hummels, Ishii and Yi (2001) use input-output tables which provide industry level data on imported inputs, gross output and exports.

A third strand of the literature uses foreign trade statistics to classify goods into parts and components and finished products as well as to measure vertical specialization (Ng and Yeats, 2001, 2003; Yeats, 2001; Kaminski and Ng, 2001; Athukorala, 2006; Zeddies, 2010). Most studies focus on a subset of products within the categories machinery and transport equipment and miscellaneous manufacture articles (SITC 7 and 8 respectively). Data reported under the SITC 7 provide sufficient information to separate parts and components and relate them to the corresponding final products. The SITC 8 product category data do not fully capture fragmentation as some components are

recorded under other SITC categories. The examples are final products such as clothing and furniture. Similar to more recent studies (Athukorala, 2006; Kimura et *al*, 2007 and Hayakawa and Yamashita, 2011), we use not only the product description of final products and components from the SITC 7 and 8 categories (Revision 3) to classify products but also the correspondence between the Broad Economic Classification (BEC) and the SITC classification. The latest SITC revision (Revision 3) has made the separation of final products and components more accurate than before.

Using also trade statistics, Navaretti, Haaland and Venables (2002) assessed the extent of the EU involvement into global production networks. They found that the shares of parts and components in total EU manufacturing (both imports and exports) have grown for trade with all geographic areas over the period 1990-1997. The highest shares were for trade within the EU and with North America. In particular within the EU, there has been significant growth of networking with the CEECs following their gradual economic integration with Western Europe since 1989. According to the study, the shares of parts and components in total EU manufacturing by the Eastern European countries increased from 4.5% to 15.3% for exports and from 5.8% to 12.3% for imports between 1990 and 1997. The authors concluded that although high-income countries display a higher share of trade in parts and components with the EU than low-income countries, some of the less developed areas that are geographically close and integrated into the EU are increasing their involvement in global production networks.

A number of recent studies used the standard gravity trade model to examine the main factors responsible for the growth of fragmentation of trade (Athukorala and Yamashita, 2006; Kimura et *al.*, 2007; Bergstrand and Egger, 2008; Baldwin and

Taglioni, 2011; and Hayakawa and Yamashita, 2011). Focusing on trade in components, Athukorala and Yamashita (2006) analyzed bilateral exports and imports for a sample of 36 countries in East Asia, EU, and North and South America for the period 1992 to 2001. Their augmented gravity model results show that the signs on the coefficients on the main gravity variables such as GDP and distance are consistent with the theory (positive and negative signs, respectively) and are statistically significant. The magnitude of the coefficients however, is not homogeneous across different types of trade flows (components, final goods and total trade) and between exports and imports under each type of trade flow. The authors find evidence that fragmentation of trade is growing faster than final-goods trade and there is higher dependence on this new kind of specialization in East Asia than in Europe and North America.

Kimura et *al*. (2007) use bilateral trade data for machinery for a sample of 56 countries and three years (1987, 1995, and 2003). Their results are similar to those of Athukorala and Yamashita (2006) in that for both final goods and parts equations, the coefficients on the standard gravity variables are statistically significant and have the expected signs. There are differences however, in the signs of the coefficients on the income gap for East Asia (they obtain a positive coefficient indicating that large income gaps generate large flows of parts and components) and for Europe (they obtain a negative coefficient indicating that income gap reductions increase trade in parts and components). These results are highly consistent with their argument that different approaches are suitable for analyzing fragmentation as well as trade in parts and components in East Asia and in Europe: in the Asian model vertical division of labor

driven by fragmentation prevails, while in the European model horizontal product differentiation dominates.

Bergstrand and Egger (2008) develop a theoretical rational for estimating gravity equations for trade in intermediate goods and using a subsample of 160 OECD countries over the period 1990 to 2000, they estimate gravity models for trade in final and intermediate goods and also for FDI separately. They apply an instrumental variable technique to estimate the effect of intermediate goods trade on the ratio of FDI to final goods trade where trade in intermediate goods is instrumented with its corresponding bilateral trade costs. Consistent with their theoretical predictions, they find a positive and significant effect of trade in intermediate goods on the ratio of FDI to final goods trade.

Baldwin and Taglioni (2011) mainly focus on the role played by the income variables in the gravity equation of intermediate goods trade and find that GDP as a measure of economic mass works less well for bilateral trade flows characterized by relatively high shares of intermediates trade.

More closely related to our work, Hayakawa and Yamashita (2011) use gravity equations to estimate the determinants of trade in final and intermediate goods separately and focus on the evaluation of the heterogeneous effects of Free Trade Agreements (FTA) on each type of trade. Interestingly, their results indicate that FTAs have a positive and significant effect on trade in final goods in both, the short and the long run, that materialize in higher trade in the first six years following the agreement. In contrast, the FTA effect on trade in intermediate goods is only positive and significant in the long run and higher bilateral trade associated with the FTAs is observed after six years following the implementation of the agreements.

Our work builds on the abovementioned studies and uses the gravity model to estimate the effects of the EU enlargements on trade in parts and components and final goods between the CEECs and the OECD countries.

3. Data Description and Stylized Facts

Our study draws upon several data sources. The bilateral flows on external trade are from the European Commission's EUROSTAT database. Based on the SITC Revision 3, and using a detailed level of disaggregation (5 digit SITC), we identified parts and components and their corresponding final products within the machinery and transport equipment group (SITC 7) and miscellaneous manufacture articles group (SITC 8). Based on the literature on production networks, we identified 12 product categories: power generating (SITC 71) and specialized (SITC 72) machinery, metalworking (SITC 73) and general industrial (SITC 74) machinery, office machines (SITC 75), telecommunications and sound recording equipment (SITC 76), electrical goods (SITC 77), road vehicles (SITC 78), other transport equipment (SITC 79), furniture (SITC 82), measuring instruments (SITC 874) and photographic equipment, optical goods and watches (SITC 88). In order to select relevant parts and components, we first referred to the United Nations' Broad Economic Category (BEC) classification system. The BEC classification system groups traded goods according to their main end use and it is defined in terms of the SITC system. Among seven major categories, industrial supplies (BEC 2), capital goods (BEC 4), and transport equipment (BEC 5) include a subcategory for 'parts and components'. The corresponding subcategories are BEC 22, 42 and 53. We chose only the items under these subcategories that also correspond to the SITC 7 and SITC 8 categories that we study. The final list of parts and components includes 276

items. All other codes within the selected categories correspond to final goods (514 items). Our identification of parts and components follows work by Athukorala (2006), Kimura et *al.* (2007) and Hayakawa and Yamashita (2011). In the empirical application we use imports of parts and components from the OECD+CEEC countries to the CEECs and exports of final goods from the CEECs to the OECD+CEEC countries[4].

GDP data measured at current prices and expressed in millions of Euros are from the EUROSTAT's national accounts database, while data on population are from the OECD National Accounts Statistics. Information on country-pair specific variables such as distance between countries i and j, whether they have the same colonial origin, share a common border or share a common language are from the CEPII[5]. Additional covariates include controls for regional trading arrangement[6]. Our sample consists of 32 countries (30 OECD members and Bulgaria and Romania) for which complete data were available over the period 1999 to 2009. Summary statistics of all the variables are shown in Table 1.

Table 1. Summary statistics

We analyzed the evolution of the extensive margin of trade in both intermediate and final goods between the CEECs and the OECD countries in our sample. The extensive margin is calculated as the sum of the number of different items (SITC 5-digits)

[4] The list of countries as well as parts and components are provided in Tables A1 and A2 in the online Appendix available at http://works.bepress.com/inma_martinez_zarzoso/20/.
[5] CEPII stands for Centre d'Etudes Prospectives et d'Informations Internationales. It is a French leading institute for research on the international economy.
[6] The description of all variables is given in Table A3 in the online Appendix at http://works.bepress.com/inma_martinez_zarzoso/20/.

traded with each origin/destination per year. Hence, an increase in the number of items over time is observed when a new item (with no bilateral trade in the previous year) is recorded for a given bilateral trade relationship[7]. There has been a slight increase in the number of new intermediate products imported by each CEEC from the OECD countries from 1999 to 2003, and for Bulgaria and Romania this trend continued until 2006. After 2006, the number of traded varieties of parts and components started to decrease for all CEECs and especially after 2008 which may have been a consequence of the Great Recession that started in September of 2007.

With regards to the number of new intermediate products imported from the EU, the figures increased steadily over the years, especially after 2003. This suggests that the entry of the CEECs into the EU may have stimulated imports of new varieties of parts and components that were not imported before. However, we find just the opposite when we examine the imports of intermediate goods from non-EU OECD countries. The number of intermediate products imported decline significantly in 2004 and this decline was greater for smaller economies (Czech Republic, Hungary and Slovakia) than for the bigger countries (Bulgaria, Poland and Romania). In summary, regardless of the group of countries from which CEECs are importing parts and components, the pattern of behavior of all CEECs is similar.

Next, we examine the evolution of exported varieties of final goods by each CEEC to various groups of OECD countries. The figures indicate that between 1999 and 2003, exports of varieties of final goods from the CEECs to all OECD countries, EU

[7] Figures 1-6 in the online Appendix available at http://works.bepress.com/inma_martinez_zarzoso/20/ show the evolution over time of the extensive margins of intermediate and final goods trade between the CEECs and the OECD, EU and non-EU countries.

members only and non-EU OECD countries followed a smooth upward trend. The evolution over time of exported varieties of final goods by each of the CEECs to the OECD countries indicates that from 1999 to 2003 exports of all CEECs display an upward trend. Between 2003 and 2005, the number of exported varieties of final goods declined for some countries and slowed down for others. The explanation for this observed trend is the accession into the EU of Czech Republic, Hungary, Poland and Slovak Republic in May 2004. Joining the 'Rich Man's Club', namely the EU, is responsible for significant reorientation of CEECs' trade from non-EU member states towards the EU nations. Between 2005 and 2007, exports of all CEECs continued an upward trend, and apart from Romania and Hungary all the other CEECs experienced a decrease in their exports after 2007. The Great Recession could certainly be held responsible for the drop in exports and the general slowdown in economic activity around the world.

When we examine the extensive margin of trade in final products from the CEECs to the EU members, we find a similar increasing trend in exports of new final goods for all CEECs between 1999-2003 with a particularly sharp increase in trade between 2003 and 2004. This should not be surprising since all of the CEECs in our sample were preparing for accession into the EU in 2004. After a slight decrease in exports from the CEECs to the EU countries between 2004 and 2005, the exports of final goods for most CEECs followed and increasing trend after their accession into the EU at least until the onset of the Great Recession in 2007.

In contrast to an increase in exported varieties of final goods from the CEECs to the EU countries between 2003 and 2004, we find that exported varieties of final goods

from the CEECs to non-EU countries decreased sharply during the same period. After accession into the EU in May 2004 by the Czech Republic, Hungary, Poland and Slovak Republic, the EU became their main export market, and exported varieties slightly increased between 2004 and 2006. Again, we observe a decrease in exported varieties after 2006.

Next, we also analyzed the evolution of the volume of imports and exports and observed similar trends over time[8]. After accession, the volume of bilateral trade increased between CEECs and the EU members and decreased between CEECs and non-EU-OECD countries.

Finally, in terms of shares with respect to total trade in categories 7 and 8, the importance of imports of intermediate goods has also grown for most CEEC trade with EU destination and decreased for non-EU destinations, but remains low (between 6 and 15%) in comparison to Asian countries (Athokorala, 2006; Athukorala and Yamashita, 2006).

4. Empirical Analysis

4.1 Model Specification and main hypothesis

The theoretical foundations of fragmentation, discussed above, suggest that this phenomenon can be justified by well-established trade theories. Therefore, in line with Bergstrand and Egger (2008) and Baldwin and Taglioni (2011) we opted for using a gravity model of trade, which is nowadays the most commonly accepted framework for modeling bilateral trade flows (Anderson, 1979; Bergstrand, 1985; Anderson and van

[8] See Tables A.7. and A.8. in the online Appendix available at http://works.bepress.com/inma_martinez_zarzoso/20/.

Wincoop, 2003; Helpman, Melitz, and Rubinstein, 2008). According to the underlying theory, trade between two countries is explained by nominal incomes and the populations of the trading partners, by the distance between the economic centers of the exporter and the importer, and by a number of trade impeding and trade facilitating factors that capture whether the trading partners belong to the same regional integration agreements and whether they share a common language or a common border. Consistent with this approach, and in order to investigate the effect of production networks, we augment the traditional model of a country's exports of final goods with a measure of imports of intermediate goods. Adding the time dimension, the gravity models of trade, one for the volume of imports of intermediate goods, $MInt_{ijkt}$, and other for the volume of exports of final goods X_{ijkt} of product *k* from country *i (CEEC)* to country *j* (OECD country) in period *t* in current Euros are given as

$$MInt_{ijkt} = \alpha_0 \; Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} YH_{it}^{\alpha_3} YH_{jt}^{\alpha_4} DIST_{ij}^{\alpha_5} F_{ij}^{\alpha_7} \; u_{ijkt} \tag{1}$$

$$X_{ijkt} = \beta_0 \; Y_{it}^{\beta_1} Y_{jt}^{\beta_2} YH_{it}^{\beta_3} YH_{jt}^{\beta_4} DIST_{ij}^{\beta_5} MInt_{ijk,t-1}^{\beta_6} F_{ij}^{\beta_7} \; u_{ijkt} \tag{2}$$

where Y_{it} (Y_{jt}) indicate the GDPs of the reporter (partner) in period *t*, YH_{it} (YH_{jt}) are reporter (partner) GDPs per capita in period *t* and $DIST_{ij}$ is the geographical distance between the capitals (or economic centers) of countries *i* and *j*. $MInt_{ijk,t-1}$ denotes the volume of imports of intermediate goods in the previous period, F_{ij} denotes other factors that impede or facilitate trade (common language, a colonial relationship, or a common border). Finally, u_{ijkt} is an idiosyncratic error term that is assumed to be well behaved.

Usually the model is estimated in log-linear form[9]. Taking logarithms and adding time and sectoral dummies, we specify the augmented versions of models (1) and (2), as

$$LMInt_{ijkt} = \alpha_0 + \phi_t + \lambda_k + \alpha_1 LY_{it} + \alpha_2 LY_{jt} + \alpha_3 LYH_{it} + \alpha_4 LYH_{jt} + \alpha_5 LDIST_{ij} + \\ + \alpha_7 EU_{ijt} + \alpha_8 CONTIG_{ij} + \alpha_9 LAND_i + \alpha_{10} LAND_j + \alpha_{11} CEEC_{ij} + \eta_{ijkt} \quad (3)$$

$$LX_{ijkt} = \beta_0 + \gamma_t + \tau_k + \beta_1 LY_{it} + \beta_2 LY_{jt} + \beta_3 LYH_{it} + \beta_4 LYH_{jt} + \beta_5 LDIST_{ij} + \beta_6 LMInt_{ijk,t-1} + \\ + \beta_7 EU_{ijt} + \beta_8 CONTIG_{ij} + \beta_9 LAND_i + \beta_{10} LAND_j + \beta_{11} CEEC_{ij} + \upsilon_{ijkt} \quad (4)$$

where L denotes variables in natural logarithms, *CONTIG* and *LAND* are dummy variables that take the value of 1 if the partner countries share a border or are landlocked respectively, and the other explanatory variables are described above. ϕ_t are specific time effects that control for omitted variables common to all trade flows but which vary over time. λ_k and τ_k are industry fixed effects. Finally, η_{ijkt} and υ_{ijkt} are idiosyncratic error terms that are assumed to be well behaved.

Next, trading-partner effects could also be specified as fixed effects, δ_{ij} and κ_{ij} being trading-partner unobservable effects that according to Baier and Bergstrand (2007) is a way to control for the potential endogeneity of the formation of free trade agreements. In this case, the influence of the variables that are time invariant cannot be directly estimated. This is the case for distance and contiguity; therefore, their effects are subsumed into the country dummies.

With respect to the specification of the multilateral resistance terms, as theoretically suggested by Anderson and van Wincoop (2003), we consider a modification to the previous specification that include country-and-time effects to account for time-variant, multilateral price terms, as proposed by Baldwin and Taglioni

[9] We also estimate the model in its original multiplicative form.

(2006) and Baier and Bergstrand (2007). As stated by Baldwin and Taglioni (2006), including time-varying country dummies should completely eliminate the bias stemming from the 'gold-medal error' (the incorrect specification or omission of the terms that Anderson and van Wincoop (2003) called *multilateral trade resistance*). The main shortcoming of this approach is that it involves estimation of N_xT+N_MT (N_x=*exporters,* N_M=*importers*, T=years) dummies for unidirectional trade. Nevertheless, with N and T relatively large, there remain many degrees of freedom.

The specification which accounts for the potential endogeneity of the EU dummy and for the multilateral price terms in a panel data framework is given by

$$LMInt_{ijkt} = \alpha_0 + \delta_{ij} + \lambda_k + \alpha_1 EU_{ijt} + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \varepsilon_{ijkt} \quad (5)$$

$$LX_{ijkt} = \beta_0 + \kappa_{ij} + \tau_k + \beta_1 EU_{ijt} + \beta_2 LMInt_{ijk,t-1} + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \mu_{ijkt} \quad (6)$$

where $P_{it}^{1-\sigma}$ and $P_{jt}^{1-\sigma}$ are time-variable, multilateral (price) resistant terms that are proxied with country-and-time dummies, and ε_{ijkt} and μ_{ijkt} denote the error terms that are assumed to be independent and identically distributed. The other variables are defined as in equations (3) and (4), above. Income and income-per-capita variables cannot be estimated because they are collinear with the exporter-and-time and importer-and-time dummy variables.

Two remaining issues related to the estimation of gravity models of trade that may give rise to biased estimates are the presence of zeros in the dependent variable (bilateral trade) and the omission of the extensive margin of trade. To approach these problems we consider an alternative specification that is based on Helpman et *al*. (2008). The authors develop a theory of international trade that predicts positive, as well as zero,

trade flows across pairs of countries and accounts for firm heterogeneity while allowing the number of exporting firms to vary across destination countries. The model yields a generalized gravity equation which corrects for the self-selection of firms into export markets and their impact on trade volumes. The authors derive from this theory a two-stage estimation procedure that decomposes the impact of trade resistance measures on trade volumes into intensive (trade volume per exporter) and extensive (number of trading firms) margins. The authors propose a system of equations consisting of a selection equation in the first stage and a trade-flow equation in the second. They show that the traditional estimates are biased and that the bias is primarily due to the omission of the extensive margin, rather than due to selection into trade partners. In line with Helpman et *al*. (2008), we also estimate the proposed system of equations. The first equation specifies a latent variable that is positive only if country *i* imports parts and components or exports final goods to country *j*. The second equation specifies the log of bilateral imports or exports from country *i* to country *j* as a function of standard variables (income, distance, common language), dyadic random effects, and a variable, $\omega_{ijkt,}$ that is an increasing function of the fraction of country *i's* firms that export to or import from country *j*. The resulting equations are

$$\rho^{1}_{ijkt} = P(MInt_{ijkt}) = \Phi(\vartheta_0 + \psi_t + \delta_{ij} + \lambda_k + \vartheta_1 LY_{it} + \vartheta_2 LY_{jt} + \vartheta_3 LYH_{it} + \vartheta_4 LYH_{jt} + \vartheta_5 EU_{ijt}) \tag{7}$$

$$LMInt_{ijkt} = \alpha_0 + \omega^{1}_{ijkt} + \alpha_5 LDIST_{ij} + \alpha_6 MInt_{ijkt} + \alpha_7 EU_{ijt} + \alpha_8 CONTIG_{ij} + \alpha_9 LAND_j + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \varepsilon_{ijt} \tag{8}$$

$$\rho^{2}_{ijkt} = P(X_{ijkt}) = \Phi(\theta_0 + \zeta_t + \theta_1 LY_{it} + \theta_2 LY_{jt} + \theta_3 LYH_{it} + \theta_4 LYH_{jt} + \\ + \theta_5 MInt_{ijk,t-1} + \theta_6 EU_{ijt} + \kappa_{ij} + \tau_k) \quad (9)$$

$$LX_{ijkt} = \beta_0 + \omega^{2}_{ijkt} + \beta_5 LDIST_{ij} + \beta_6 MInt_{ijk,t-1} + \beta_7 EU_{ijt} + \beta_8 CONTIG_{ij} + \\ + \beta_9 LAND_{j} + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \mu_{ijt} \quad (10)$$

where τ_{ij} and ς_{ij}, are dyadic country-pair effects to control for unobserved heterogeneity, and ψ_t , φ_t denote time-specific effects.

The new variables, ω^{1}_{ijkt} and ω^{2}_{ijkt} are inverse functions of firm productivity. The error terms in all equations are assumed to be normally distributed. Clearly, the error terms in equations (7) and (8) and error terms in equations (9) and (10) are correlated. Helpman et al. (2008) construct estimates of the ω^{m}_{ijkt} using predicted components of Equation (7) or equation (9). They propose a second stage non-linear estimation that corrects for both sample-selection bias and firm heterogeneity bias. They also decompose the bias and find that correcting only for firm heterogeneity addresses almost all the biases in the standard gravity equation. They implement a simple linear correction for unobserved heterogeneity (ω^{m}_{ijkt}) proxied with a transformed variable ($\hat{z}^{*m}_{ijkt}$) given by,

$$\hat{z}^{*m}_{ijkt} = \Phi^{-1}(\hat{\rho}^{m}_{ijkt}) \quad (11)$$

where $z^{*m}_{ijkt} = \frac{z^{m}_{ijkt}}{\sigma^{\eta}_{ijkt}}$ and Φ are the cumulative distribution functions (cdf) of the unit-normal distribution. $\hat{\rho}^{m}_{ijkt}$ are the predicted probabilities of imports and exports (m=1, 2) between country *i* and country *j*, using the estimates from the panel-probit from Equations (7) and (9). We also decompose the bias and use the inverse Mills ratio as a proxy for sample selection, and the linear prediction of exports and imports down-

weighted by their standard errors as proxies for firm heterogeneity, all obtained from Equations (7) and (9). The main difference between the Heckman and the Helpman et al. (2008) procedures is the inclusion of (ω_{ijkt}^{m}) as a proxy for firm heterogeneity in the Helpman et al. (2008) procedure, since the inverse Mills ratio, also called non-selection hazard, is included in both approaches as a way to correct for selection of firms into export markets. The exclusion variables that permit identification are the pair-dummy variables that are included in the selection equation but not in the second step equation.

Our main hypothesis is that the increase in exported final goods from the CEECs to the OECD countries can be explained in part by the increase in new intermediate products imported from the EU, and in part by the induced reduction in trade costs due to full accession of the CEECs into the EU in 2004 and 2007. Therefore, we expect to disentangle a direct and an indirect effect of the reduction of artificial trade costs on trade. First, deeper integration should increase the extensive and intensive margins of trade in intermediates. Second, the availability of new imported intermediates and the increase of already imported parts and components should also explain the increase in exports of final goods, as well as the emergence of new products exported from the CEECs to the OECD countries, and especially to the EU.

4.2 Estimation Results

We first estimate the standard gravity models as specified in Eqs. (3) and (4) for data on 6 CEECs' exports to 32 destinations (6 CEECs+ the OECD countries) during the period 1999 to 2009. Table 2 reports the baseline estimation results for disaggregated imports of intermediates and exports of final goods. The models in columns 1 and 2 show the results for the imports of intermediate goods using the pooled OLS (only for

comparative purposes) and the within fixed effects, respectively[10]. Time-fixed effects are included in both models. Individual (country-pair) effects (modeled as fixed) are included in the model in column 2 to control for unobservable heterogeneous effects across trading partners. Restricting the analysis to within variation eliminates the bias due to unobserved heterogeneity that is common to each trading-pair.

Table 2. Determinants of Imports of Intermediate goods and Exports of Final Goods by the CEECs – Linear Models

We estimate the models using robust standard errors clustered across panels (exporter-importer-sector). The coefficient on the EU dummy variable in column 2 indicates that imports of intermediates by CEECs following their accession into the EU have increased by about 17 percent {exp[0.158]-1)*100} with the member countries.

Columns 3 to 6 in Table 2 show the results for disaggregated exports of final goods by the CEECs. We report both the OLS and the fixed effects results for two alternative specifications; the first does not include imports of intermediates as an explanatory variable (columns 3 and 5), and the second does (columns 4 and 6). Only the OLS results in column 3 show that the effect of accession (the coefficient on the EU variable) is positive and significant indicating that the accession of the CEECs into the EU fostered exports of final goods to the EU countries. However, the estimated coefficient on the EU variable is considerably reduced (0.063 instead of 0.294) once we add imports of intermediate goods in model 4 and it becomes negative and statistically

[10] A Hausman test indicates that the dyadic unobservable effects are correlated with the error term, hence the random effects approach, ignoring this correlation, leads to inconsistent estimators. The problem can be handled by using the fixed effects approach, which essentially eliminates the dyadic unobservable effects.

significant once bilateral fixed effects are added (models 5 and 6). This could possibly be due to the fact that we do not properly control for multilateral resistance effects in this estimation. With respect to the imports of intermediate goods which is the second variable of interest, the estimated within-coefficient in column 6 is positive and statistically significant and it suggests that a ten-percent increase in imports is associated with a 1.08 percent increase in exports by the CEECs', holding other things unchanged. The effect is slightly lower compared to the OLS result in column 4 which is obtained without controlling for country-pair unobserved heterogeneity.

Table 3 shows results for models that include not only country-pair fixed effects but also time-varying nation dummies (Equations 5 and 6). According to Baier and Bersgtrand (2007) and Baldwin and Taglioni (2006), the estimates in Table 3 should be unbiased, since the multilateral price variables are correctly modeled. We use the two-way fixed effect within-estimator with robust standard errors and estimate Equations 5 and 6 for disaggregated imports of intermediates (column 2) and disaggregated exports of final goods (column 3).

Table 3: Determinants of Imports of Intermediates and Exports of Final Goods with Well-Specified Multilateral Resistance Terms - Linear Models

Compared with the results obtained in Table 2 (column 6), the EU effect implies an increase in imports of parts by about 55 percent {exp[0.436]-1)*100} after accession (compared to 17 percent according to Table 2). In addition, the coefficient on the EU for final goods is positive and statistically significant and indicates that a sizeable increase in exports is due to accession (exports of final goods are 194 percent higher than before

accession). The effect of intermediate imports on exports of final goods remains unchanged.

Summarizing, controlling for multilateral resistance in the most recently recommended way indicates that there is a considerably larger EU effect for exports of final products than for imports of intermediates and that the effect of production networks is still sizable.

Table 4 presents the results from estimating Equations 8 and 10[11] where we account for selection bias and firm heterogeneity (see Helpman et al., 2008). In each case we first estimated a random-effects probit model with exporter and importer effects and time effects (Equations 7 and 9). From these estimates we obtained the linear prediction terms down-weighted by their standard errors (ZHAT, where Z=x,m) and the inverse Mills ratio (IMILLS). These two elements were incorporated as regressors in the second-step estimations (Equations 8 and 10). The results from the second step estimations considering only firm heterogeneity are shown in column 2 for parts and components and in column 4 for final goods. The results from the second step estimations considering selection effects and firm heterogeneity are given in columns 3 (for parts) and 6 (for final goods). All second stage models include country-and-time fixed effects.

In all models the coefficients on mhat and xhat are positive and statistically significant at the 1-percent level indicating that the increase in imports and exports has been due in part to trade diversification (new varieties traded with new country partners) and that the effect is greater for exports of final goods. The coefficient on the inverse Mills ratio (IMILLS) is also statistically significant and negatively signed showing evidence of selection effects. The estimates shown in the second and last column of Table

[11] Results for the first step estimation (Equations 7 and 9) are available upon request from the authors.

4 indicate that the increase in exports of final goods is partly explained by an increase in the intensive margin of imports (0.087) and partly by an increase in the extensive margin of exports (0.954).

Table 4: Determinants of Imports of Intermediates and Exports of Final Goods with Heckman Sample Selection and Firm Heterogeneity

With respect to the EU effect, the results in Table 4 indicate that there is a positive effect on both imports of intermediates and exports of final goods that is now slightly higher than before for imports of intermediates (those imports increase by about 59 percent with accession) and much lower than before for exports of final goods (those exports increase by about 48 percent with accession). A possible explanation of the discrepancy with respect to results in Table 3 is that the Helpman et al. (2008) method distinguishes between trade margins and accounts for the effect of the extensive margin (trade diversification) whereas the Baldwin and Taglioni (2006) method does not consider the effect of the extensive margin on total trade.

As a check of robustness, we have also estimated the model in its multiplicative form using the method proposed by Santos and Tenreyro (2006) (pseudo Poisson Maximum Likelihood) for the second step estimations which controls for zero trade flows and heteroskedasticity[12]. The main conclusions remain, since the estimates are similar in magnitude.

5. Conclusions

[12] Results can be found in Table A.4 in the online Appendix at http://works.bepress.com/inma_martinez_zarzoso/20/.

This paper presents evidence of the significant dynamism of the CEECs trade flows in the last decade. It shows that these economies have been very active and involved in production sharing networks, especially with EU countries. The CEECs have been able to increase their extensive and intensive margins of trade in parts and components and also in final goods. These countries appear to be an important destination for the EU exports of parts and components and have also improved their position as exporters of final goods.

Concerning the results of the extended gravity models, a number of conclusions follow. First, the accession of these countries to the EU has been a clear driving force behind this development. As predicted by trade theories, a reduction in the trade cost (associated with the integration process) has favored the segmentation of production processes and led to a better exploitation of comparative advantages and location. Second, integration into the EU has stimulated not only the exploitation of comparative advantages but also the production of new goods that were previously not produced. Third, due to just in time production process, geographic proximity and sea access are also important determinants of trade in intermediate goods and their absence deters trade to a higher extent than in the case of final goods.

For further research it would be desirable to incorporate into the model elements such as infrastructure and communication networks that facilitate trade by allowing the continuity of the value chain.

References

Antimiani, A. and Costantini, V. (2010). 'Trade performances and technology in the enlarged European Union', Departmental Working Papers of Economics - University 'Roma Tre' 0111, Department of Economics - University Roma Tre.

Anderson, J.E. and Van Wincoop, E. (2003). 'Gravity with gravitas: a solution to the border puzzle', *American Economic Review*, Vol. 93, pp. 170-192.

Anderson, J.E. (1979). 'A theoretical foundation for the gravity equation', *American Economic Review*, Vol. 69, pp. 106-116.

Athukorala, P. and Yamashita, N. (2006). 'Production fragmentation and trade integration: East Asia in a global context', *North American Journal of Economics and Finance,* Vol. 17, pp. 233–256.

Athukorala, P. (2006). 'Product fragmentation and trade patterns in East Asia', *Asian Economic Papers,* Vol. 4, No. 3, pp. 1-27.

Baier, S. L. and Bergstrand, J. H. (2007). 'Do free trade agreements actually increase members' international trade', *Journal of International Economics,* Vol. 71, pp. 72-95.

Baldone, S., Sdogati, F. and Tajoli, L. (2001). 'Patterns and determinants of international fragmentation of production: evidence from outward processing trade between the EU and Central Eastern European countries', *Review of World Economics,* Vol. 137, No. 1, pp. 80-104.

Baldwin, R. and Venables, A. (2010). 'Relocating the value chain: off-shoring and agglomeration in the global economy', *Working Paper*, London: CEPR.

Baldwin, R. and Taglioni, D. (2006). 'Gravity for dummies and dummies for gravity equations', *National Bureau of Economic Research Working Paper 12516,* Cambridge.

Baldwin, R. and Taglioni (2011). 'Gravity chains: Estimating bilateral trade flows when parts and components trade is important', *National Bureau of Economic Research* Working Paper 16672.

Bergstrand, J.H. (1985). 'The gravity equation in international trade: some microeconomic foundations and empirical evidence', *The Review of Economics and Statistics,* Vol. 67, pp. 474-481.

Bergstrand, J. H. and Egger, P. (2008). 'The growth of FDI relative to trade: Measurement, determinants and consequences of international trade flows in intermediates', University of Notre Dame, mimeo.

Egger, H. and Egger, P. (2005). 'The determinants of EU processing trade', *World Economy*, Vol. 28, No. 2, pp. 147-168.

Hayakawa, K. and Yamashita, N. (2011). 'The role of Preferential Trade Agreements (PTAs) in facilitating global production networks' IED Discussion Paper 280.2011.2.

Helpman, E., Melitz, M. and Rubinstein, Y. (2008). 'Estimating trade flows: trading partners and trading volumes', *The Quarterly Journal of Economics*, Vol. 123, No. 2, pp. 441-487.

Hornok, C. (2010). 'Trade-enhancing EU enlargement and the resurgence of East-East trade' *Focus on European Economic Integration* Q3/10, pp. 79-94.

Hummels, D., Ishii, J. and Yi, K-M. (2001). 'The nature and growth of vertical specialization in world trade', *Journal of International Economics*, Vol. 54, No. 1, pp. 75-96.

Jones, R. and Kierzkowski, H. (1990). '*The role of services in production and international trade: a theoretical framework*,' in Jones, R. and Krueger, A. (eds) *The political economy of international trade: Essays in honor of Robert E. Baldwin* (Oxford: Basil Blackwell).

Kaminski, B. and Ng, F. (2005), 'Production disintegration and integration of Central Europe into global markets', *International Review of Economics and Finance,* Vol. 14, No. 3, pp. 377-390.

Kaminski, B. and Ng, F. (2001). 'Trade and production fragmentation: Central European economies in European Union networks of production and marketing', *The World Bank Policy Research Working Paper Series*, *WPS 1/2611*.

Kimura, F., Takahashi, Y. and Hayakawa, K. (2007). 'Fragmentation and parts and components trade: comparison between East Asia and Europe', *North American Journal of Economics and Finance*, Vol. 18, pp. 23–40.

Melitz, M.J. (2003). 'The impact of trade on intra-industry reallocations and aggregate industry productivity', *Econometrica,* Vol. 71, No. 6, pp. 1695-1925.

Navaretti, G. B., Haaland, J.I. and Venables, A. (2002). 'Multinational corporations and global production networks: the implications for trade policy", *Report prepared for the European Commission Directorate General for Trade*, London: CEPR.

Ng, F. and Yeats, A.J. (2001). '*Production sharing in East Asia: who does what for whom, and why?'* in Cheng, L.K. and Kierzkowski, H. (eds) *Global production and trade in East Asia* (pp. 63-109) (Boston: Kluwer Academic Publishers).

Ng, F. and Yeats, A.J. (2003). 'Major trade trends in East Asia: what are their implications for regional cooperation and growth?', *Policy Research Working Paper 3084*, Washington DC: World Bank.

Santos Sylva, J.M.C. and Tenreyro, S. (2006). 'The log of gravity', *The Review of Economics and Statistics*, Vol. 88, No. 4, pp. 641-658.

Sturgeon, T. J. (2001). 'How do we define value chains and production networks?', *IDS Bulletin*, Vol. 32, No. 3, pp. 9-18.

Yeats, A.J. (2001). '*How big is global production sharing*?', in Arndt, S.W. and Kierzkowski, H. (eds) *Fragmentation: new production patterns in the world economy* (Oxford: Oxford University Press).

Zeddies, G. (2010). 'Determinants of international fragmentation of production in the European Union', *Empirica*, online first, August 15, 2010.

TABLES
Table 1. Summary statistics

Variable	Obs	Mean	Std. Dev	Min	Max
xf	112530	5127050	4.20E+07	0	2.40E+09
mp	94116	5364679	4.21E+07	0	2.32E+09
lxf	63997	12.094	3.338	0	21.599
lm	75707	12.029	3.290	0	21.566
lyi	112530	11.094	0.840	9.406	12.801
lyj	111210	12.625	1.540	9.011	16.257
lyhi	112530	1.666	0.578	0.391	2.652
lyhj	111210	2.992	0.786	0.391	4.389
eu	112530	0.267	0.442	0	1
ceesj	112530	0.161	0.368	0	1
ld	112530	7.481	1.119	4.088	9.821
landj	112530	0.177	0.382	0	1
landi	112530	0.500	0.500	0	1
contig	112530	0.102	0.303	0	1

Table 2. Determinants of Imports of Intermediate goods and Exports of Final Goods by the CEECs – Linear Models

	M_parts	**M_parts**	**X_finals**	**X_finals**	**X_finals**	**X_finals**
	ols	fe	ols1	ols2	fe1	fe2
	b/se	b/se	b/se	b/se	b/se	b/se
lyi	0.921***	1.182***	0.777***	0.581***	0.677***	0.756***
	(0.058)	(0.087)	(0.076)	(0.083)	(0.125)	(0.141)
lyj	1.489***	1.095***	0.853***	0.733***	0.909***	0.621***
	(0.017)	(0.074)	(0.020)	(0.028)	(0.085)	(0.102)
lyhi	-0.132		1.036***	1.217***		
	(0.145)		(0.188)	(0.205)		
lyhj	0.311***		-0.011	-0.147***		
	(0.047)		(0.049)	(0.057)		
ld	-1.489***		-1.258***	-1.146***		
	(0.026)		(0.030)	(0.039)		
landi	0.067		0.118	-0.098		
	(0.117)		(0.147)	(0.159)		
landj	0.652***		-0.317***	-0.355***		
	(0.063)		(0.068)	(0.074)		
contig	0.212***		0.503***	0.422***		
	(0.066)		(0.070)	(0.074)		
eu	**0.486*** **	**0.158*** **	**0.294*** **	**0.063**	**-0.078** **	**-0.190*** **
	(0.044)	(0.031)	(0.047)	(0.049)	(0.040)	(0.043)
ceesj	**1.339*** **		**0.894*** **	**0.822*** **		
	(0.099)		(0.104)	(0.115)		
lm(-1)				**0.158*** **		**0.108*** **
				(0.011)		(0.0110)
R-squared	0.584	0.649	0.485	0.518	0.526	0.564
N	75076	75076	63436	41963	63436	41963
ll	-162856.8	-156413.9	-145348.4	-93099.6	-142620.5	-90920.04
rmse	2.118541	1.946625	2.393705	2.226326	2.296179	2.118145
aic	325845.7	313315.8	290828.8	186313.2	285729	182310.1
bic	326454.6	315567.1	291426.6	186805.9	287939.1	184341.5
sitc3-d	yes	yes	yes	yes	yes	yes
t-dummies	yes	yes	yes	yes	yes	yes
x-m dummies	no	yes	no	no	yes	yes

Note: The dependent variable is bilateral imports of intermediates and bilateral exports of final goods measured at current prices; lyi and lyj are importers' and exporters' GDPs, respectively; lyhi and lyhj are importers' and exporters' GDPs per capita, respectively; ld is distance; lm are imports of intermediates; land, contig, eu and ceecs are dummies equal to 1 when countries are landlocked, share a border, or belong to the EU or to the group of CEECs, respectively; b denotes estimated coefficient and se robust standard errors clustered by sector-exporter-and-importer. * p<0.10, ** p<0.05, *** p<0.01.

Table 3. Determinants of Imports of Intermediates and Exports of Final Goods with Well-Specified Multilateral Resistance Terms - Linear Models

With x-m, x-t and m-t fixed effects and time-varying EU effects

	Parts	**Finals**	**Finals**
Linear regression	b	b	b
average_EU	0.436***	1.069***	1.078***
lm (t-1)			0.108***
Nobs	75076	63997	42277
R-squared	0.656	0.5313	0.5707
Root MSE	1.9373	2.296	2.1165

Note: The dependent variables are bilateral imports of intermediates (Parts) and bilateral exports of final goods (Finals) measured at current prices; lm are imports of intermediates; EU is a dummy equal to 1 when countries belong to the EU, b denotes estimated coefficient. * p<0.10, ** p<0.05, *** p<0.01.

Table 4. Determinants of Imports of Intermediates and Exports of Final Goods with Heckman Sample Selection and Firm Heterogeneity

	Parts and c omponents		**Final Goods**		
	Firm hetero	Firm hetero+ Sample selec	Firm hetero	Firm hetero+ Imported parts	Firm hetero+ Sample selec+ Imported parts
	b/se	b/se	b/se	b/se	b/se
eu	**0.304*** **	**0.465*** **	**0.529*** **	**0.404*** **	**0.390*** **
	(0.095)	(0.094)	(0.142)	(0.143)	(0.145)
ceesj	-0.689***	-0.353*	0.165	0.357	0.475*
	(0.012)	(0.067)	(0.270)	(0.269)	(0.279)
ld	-0.767***	-0.448***	-0.099	-0.128	-0.101
	(0.074)	(0.073)	(0.087)	(0.087)	(0.087)
landi	0.307***	0.200**	0.833***	0.849***	0.852***
	(0.096)	(0.095)	(0.155)	(0.155)	(0.155)
landj	-2.961***	-1.141***	-0.950**	-1.078***	-0.873**
	(0.261)	(0.276)	(0.380)	(0.378)	(0.405)
contig	0.857***	0.454***	0.118	0.184*	0.157
	(0.086)	(0.085)	(0.101)	(0.100)	(0.108)
lm (-1)				**0.064*** **	**0.063*** **
				(0.012)	(0.012)
mhat	**0.063*** **	**0.087*** **			0.007
	(0.007)	(0.007)			(0.011)
xhat			**1.183*** **	**1.014*** **	**0.954*** **
			(0.065)	(0.072)	(0.085)
limr		-0.758***			-0.126*
		(0.047)			(0.067)
R-squared	0.626	0.632	0.557	0.559	0.550
N	73558	73558	41963	41963	40894
ll	-155070.4	-154438.6	-91126.01	-91075.39	-88975.39
rmse	1.998268	1.981191	2.132943	2.130397	2.142223
aic	311044.7	309783.1	183064	182964.8	178768.8
bic	315205.8	313953.3	186573.7	186483.1	182293.8
x-m effects	no	no	no	no	no
x-t and m-t effects	yes	yes	yes	yes	yes

Note: The dependent variables are the bilateral imports of intermediates and the bilateral exports of final goods measured at current prices; lyi and lyj are importers' and exporters' GDPs, respectively; lyhi and lyhj are importers' and exporters' GDPs per capita, respectively; ld is distance; lm are imports of intermediates; landi, landj, contig, eu and cees are dummies equal to 1 when countries are landlocked, share a border, or belong to the EU or to the group of CEECs, respectively. Robust standard errors clustered by sector-exporter-and-importer are reported below each coefficient. * p<0.10, ** p<0.05, *** p<0.01.