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Inmaculada Martínez-Zarzoso
Anca M. Voicu
Martina Vidovic

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

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CEECS INTEGRATION INTO REGIONAL AND GLOBAL PRODUCTION NETWORKS

Inmaculada Martínez-Zarzoso [a)]

Georg-August University of Göttingen and University Jaume I

Anca M. Voicu [b)] and Martina Vidovic [c)]

Rollins College

Abstract

This paper examines the involvement of the CEECs into regional and global production networks over the period 1999 to 2009. We employ a theoretically justified gravity model which incorporates the extensive margin of trade and accounts for firm heterogeneity. We first estimate the model for highly disaggregated exports (SITC 5-digits) in final goods, and then augment it by including the corresponding imported intermediate products from the OECD together with the usual control variables. Next, we estimate the model for each trade margin (extensive and intensive) separately to evaluate the effects of economic integration on exports and imports of each category of goods. Our results indicate that the CEECs have indeed become more integrated into regional production networks and this has had a positive impact in terms of increasing trade volumes and trade varieties between the two parts of the European continent.

Keywords: exports; gravity equation; panel data; production networks; economic integration; trade flows.
JEL classification: F10, F14, D31

a) Financial support from the Spanish Ministry of Science and Technology is grateful acknowledged (ECO2010-15863). E-mail: martinei@eco.uji.es.

b) Email: avoicu@rollins.edu.

c) Email: mvidovic@rollins.edu.

CEECS INTEGRATION INTO REGIONAL AND GLOBAL PRODUCTION NETWORKS

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 since 2004 the CEECs 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. Following accession, the CEECs have become 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 what goods are inputs to 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 trade costs reductions on production networks by examining the extensive and the intensive margin of trade. Second, we specifically analyze the effects of economic integration on trade in intermediate products. 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 first estimate the model with highly disaggregated trade data for CEECs imports of parts and components from OECD countries, and second, for CEECs exports of final goods to OECD countries over the period 1999 to 2009 and augment it by including a measure of imported intermediate products from OECD countries together with the usual control variables. Next, we estimate the model for each trade margin (extensive and intensive) separately by distinguishing also between final and intermediate goods. 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 novelty of this paper is that it specifically links parts and components with their corresponding final goods by using trade data disaggregated at the 5 digit Standard International Trade Classification (SITC) level, and it specifically estimates 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, which has increased trade volumes and 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 the 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 changes 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 took place mainly within multinational enterprises (MNEs) led to the development of production networks[1]. Vertical fragmentation of production/distribution results in a reduction in production costs due to differences in factor prices in different locations (mainly labor

[1] 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).

costs) and a reduction in service-link costs. All of these became possible by recent worldwide efforts to reduce trade impediments, to foster advances in information and telecommunication technologies and to reduce transportation costs. Due to the cost and 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 that created 'twin plants' in the Mexico – US border region 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 (Kaminski and Ng, 2005; Zeddies, 2010). Kaminski and Ng (2005) provide empirical support for the conclusion that the Central East European countries have become integrated into global, mainly EU-based networks of production and distribution. The authors further note that network related trade registered significant growth and underwent the following changes: simple assembly operations have been replaced by processing and specialization in production of parts; the CEECs-10[2] network firms have expanded beyond EU markets, and by 1999 the CEECs-10 have become a net exporter of network products and parts. Trade in parts and components for the OECD nations that include the CEECs-10 now accounts for approximately 30% of OECD's total trade (Yeats, 2001).

Jones and Kierzkowski (1990) were the first to propose a theory that explains international production fragmentation based on differences in comparative advantage in different locations. According to the factor endowment theory also known as the Hecksher-Ohlin theory of international trade, more labor intensive stages of production will locate to labor abundant, lower wage countries, while more capital intensive stages of production will take place in capital abundant countries. However, based on 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. 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 different indicators. First, production fragmentation by MNEs can be measured by the outward processing trade (OPT) statistics. OPT is a situation where phases of production of a firm's main manufacturing activities are shifted

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

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). Studies by Baldone et al. (2001) and Egger and Egger (2005) empirically analyzed outward processing trade for European countries.

A second form of measure of international fragmentation of production involves independent firms acting as a network. This is an example of vertical specialization that can be realized by market relationships without the participation of the principal company 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. The authors find that for 10 OECD countries as well as Mexico, Ireland, Taiwan and Korea, as of 1990, total vertical specialization accounted for 30 percent of world exports, and between 1970 and 1990, growth in vertical specialization accounted for one third of the growth of world exports. Yi (2003) finds a similar pattern for the US alone.

A number of studies used foreign trade statistics that classify goods in parts and components and finished products to measure vertical specialization (Ng and Yeats, 2001, 2003; Yeats, 2001; Kaminski and Ng, 2001; Athukorala, 2006; Zeddies, 2010). This particular classification has been applied to a subset of products mainly machinery and equipment (SITC 7 and 8 categories). Data reported under the SITC 7 (the machinery and transport equipment sector) provide sufficient information to separate parts and components and relate them to their final product. With SITC 8 product category (miscellaneous manufactured articles), 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. Our study uses data on final products and components from the SITC 7 and 8 categories (Revision 3). This latest revision has made the separation of final products and components easier than before. Using also trade statistics, Navaretti, Haaland and Venables (2002) assessed the extent of the EU involvement in 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 with North America and within the EU. However, within the EU, there has been significant growth of networking with Central East European countries 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.

Currently two published studies have 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). Athukorala and Yamashita focused their study on trade in components and analyzed bilateral trade flows, including 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 at the 1 percent level. Distance also remains an important determinant of trade flows. 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 increasing more rapidly than final-goods trade and there is higher dependence on this new kind of specialization in East Asia than in Europe and North America. They conclude that while international production fragmentation was a key factor ensuring the dynamism of the East Asian economies and increasing intra-regional economic ties, it has certainly not eliminated or even reduced this region's dependence on the world economy.

Kimura et *al.* (2007) argue that different approaches are suitable for analyzing fragmentation and parts and components trade in East Asia than in Europe. The authors believe that the vertical fragmentation theory is well suited for explaining international production/distribution networks in East Asia while horizontal product differentiation models are better suited for intra-industry trade in Europe. Their study uses bilateral trade data for machinery for 56 countries and for the years 1987, 1995, and 2003. Their estimation results are similar to those of Athukorola 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 (positive; large income gaps generate large flows of parts and components) and Europe (negative; small income gaps increase the incentives to trade parts and components). This result is highly consistent with the Asian model, where vertical division of labor driven by fragmentation prevails, and the European model, where horizontal product differentiation dominates. Our work builds on these two studies and uses the gravity model to examine the 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 data base. Based on the SITC Revision 3, and using a detailed level of desegregation (4-5 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). Items designated as 'part' or 'components' are taken as parts and components, while final goods are complements of corresponding parts and components. For example, 72591 and 72599 are defined as 'parts of the machinery of subgroup 7251 and 7252', and 7251 and 7252 represent 'paper-mill and pulp-mill machines, paper cutting machines and other machinery for the manufacturing of paper articles'. Our identification of parts and components follows work by Athukorala (2006) and Kimura et *al.* (2007). We represent the trade in parts and components as imports of parts and components from the EU and the OECD countries to the CEECs, and trade in final goods as exports of final goods from the CEECs to the EU and the OECD countries. The list of countries as well as definitions of parts and final goods are provided in Tables A1 and A2 in the Appendix A.

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[3]. Additional covariates include controls for regional trading arrangement. The description of all variables is given in Table A3 in the Appendix A. 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 and correlations are shown in Table 1.

Table 1. Summary statistics and correlations

Variable	Obs	Mean	Std. Dev.	Min	Max
lxf	108274	10.800	3.194	0.000	21.749
lm	153675	10.008	3.091	0.000	18.983
lyi	268026	11.094	0.840	9.406	12.801
lyj	264882	12.625	1.540	9.011	16.257
lyhi	268026	1.666	0.578	0.391	2.652
lyhj	264882	2.992	0.786	0.391	4.389
ld	268026	7.481	1.119	4.088	9.821
eu	268026	0.267	0.442	0	1
ceesj	268026	0.161	0.368	0	1
landj	268026	0.177	0.382	0	1
landi	268026	0.500	0.500	0	1
contig	268026	0.102	0.303	0	1

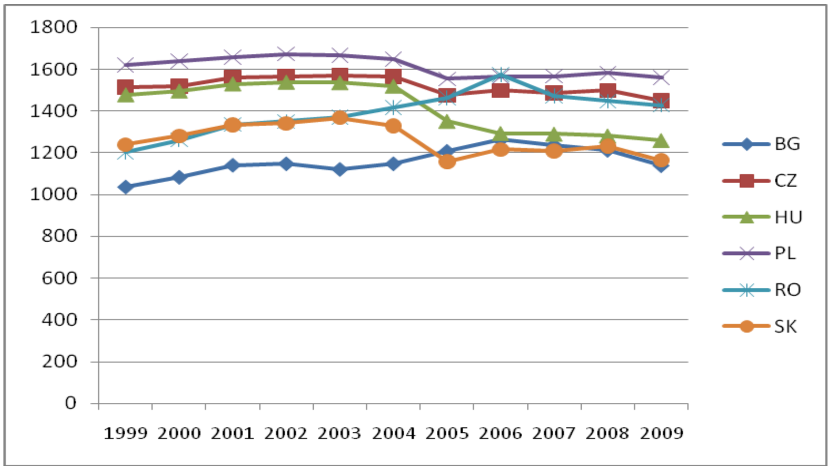
[3] *CEPII stands for* Centre d'Etudes Prospectives et d'Informations Internationales. *It is a French leading institute for research on the international economy.*

	lxf	lm	lyi	lyj	lyhi	lyhj	eu	ld	landj	landi	contig
lxf	1										
lm	0.282	1									
lyi	0.203	0.135	1								
lyj	0.064	0.229	0.004	1							
lyhi	0.269	0.141	0.556	0.008	1						
lyhj	0.018	0.155	0.118	0.580	0.105	1					
eu	0.241	0.193	0.303	-0.046	0.506	0.086	1				
ld	-0.181	-0.168	0.086	0.547	-0.101	0.302	-0.278	1			
landj	0.019	0.015	-0.017	-0.516	0.022	-0.180	0.029	-0.507	1		
landi	0.103	0.023	-0.247	-0.027	0.563	-0.030	0.091	-0.201	0.041	1	
contig	0.142	0.116	-0.064	-0.342	0.064	-0.409	0.128	-0.606	0.403	0.121	1

Figures 1-6 summarize the evolution of the extensive margin of trade in both intermediate and final goods between the CEECs and the OECD countries in our sample. Figure 1 indicates that there has been a slight increase in the number of new intermediate products imported by each CEEC country 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.

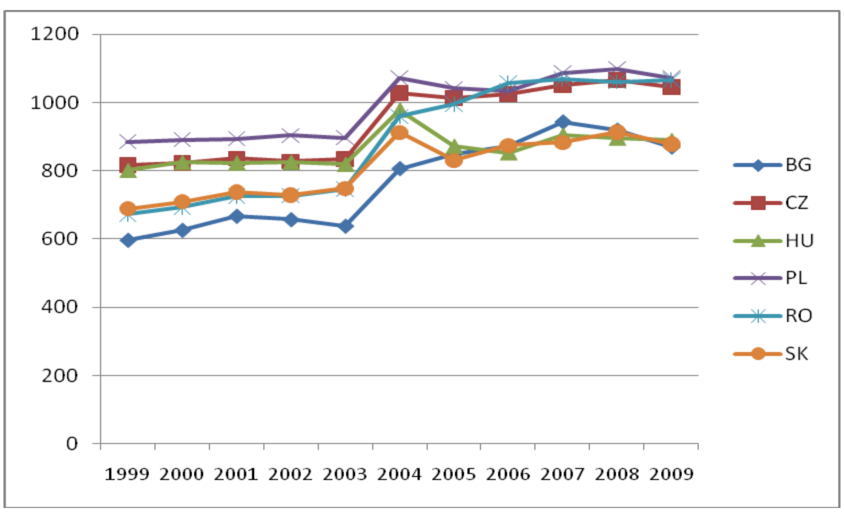
According to Figure 2, the number of new intermediate products imported from the EU increased steadily over the years, especially after 2003. This suggests that the entry of the CEECs into the EU may have stimulated imports of new varieties of parts and components that were not imported before. However, we find just the opposite when we examine the imports of intermediate goods from non-EU OECD countries as shown in Figure 3. The number of intermediate products imported declined 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.

Figure 1. Evolution of the extensive margin of intermediate goods imported by CEECs from the OECD countries, 1999-2009



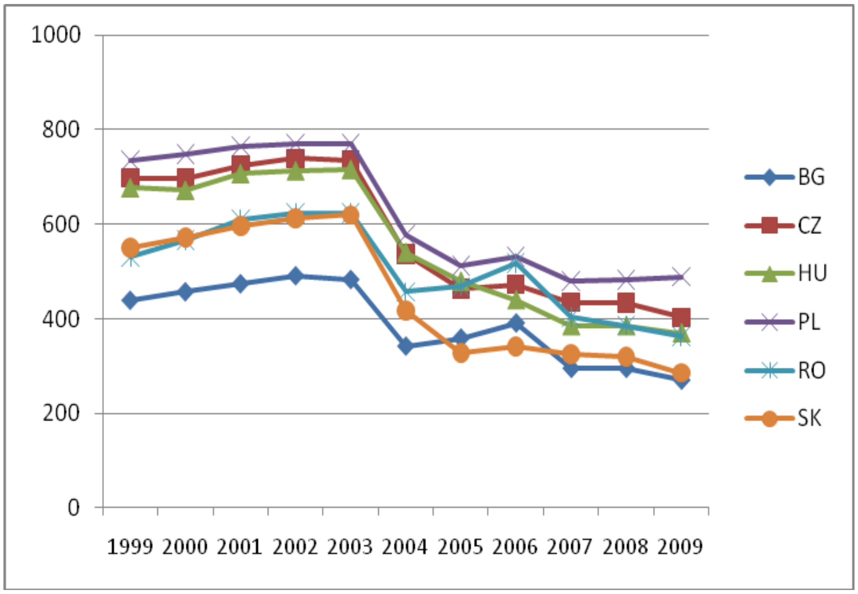
Source: authors' calculations based on EUROSTAT data.

Figure 2. Evolution of the extensive margin of intermediate goods imported by CEECs from the EU, 1999-2009



Source: authors' calculations based on EUROSTAT data.

Figure 3. Evolution of the extensive margin of intermediate goods imported by CEECs from non-EU OECD countries, 1999-2009

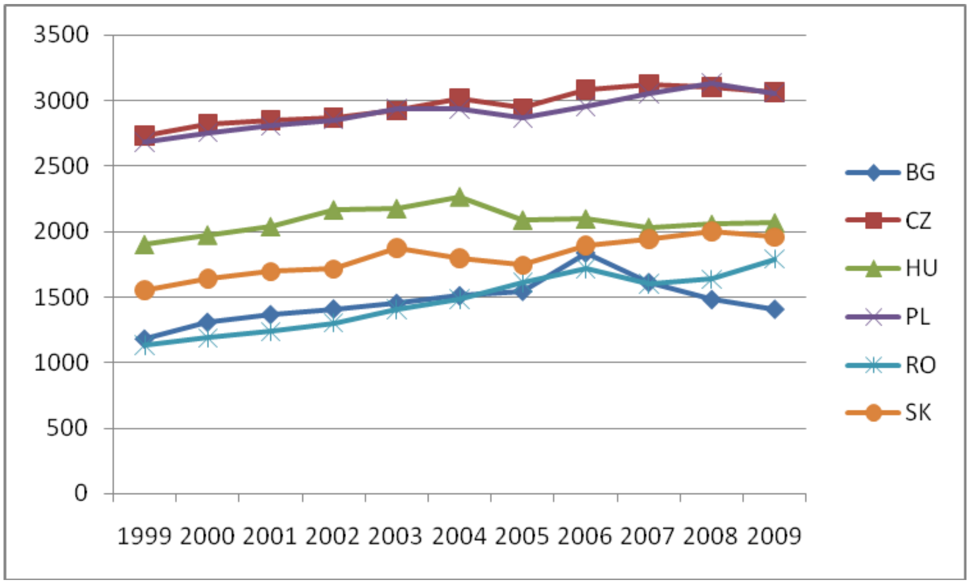


Source: authors' calculations based on EUROSTAT data.

Figures 4 – 6 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 members only and non-EU OECD countries followed a smooth upward trend. Figure 4 shows the evolution over time of exported varieties of final goods by each of the CEECs to the OECD countries. 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 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.

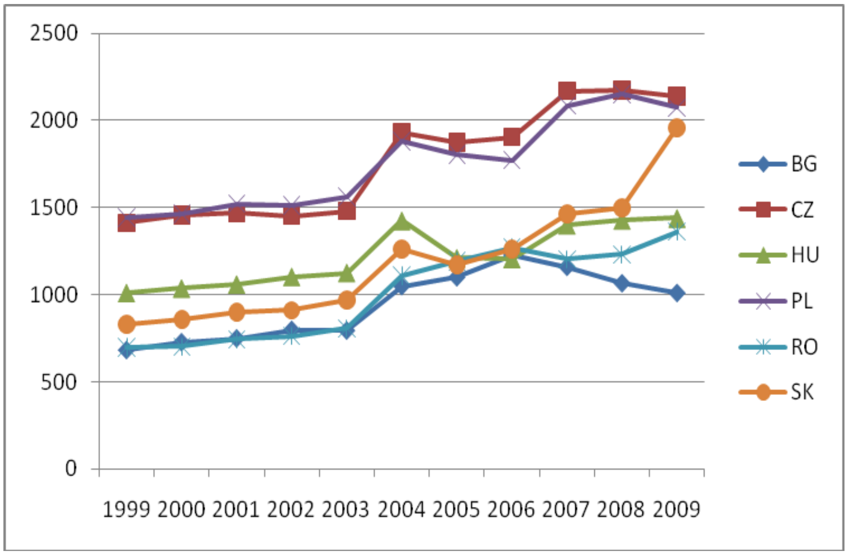
Figure 4. Evolution of the extensive margin of final goods exported by the CEECs to the OECD countries, 1999 – 2009



Source: authors' calculations based on EUROSTAT data.

When we examine the extensive margin of trade in final products from the CEECs to the EU members, we find that 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 as shown in Figure 5. This should not be surprising since all 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.

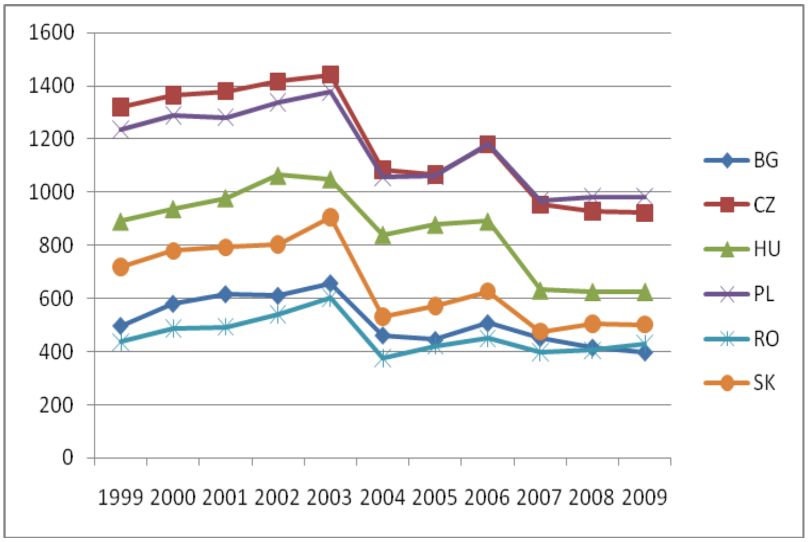
Figure 5. Evolution of the extensive margin of final goods exported by the CEECs to the EU countries, 1999 – 2009



Source: authors' calculations based on EUROSTAT data.

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 as shown in Figure 6. 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.

Figure 6. Evolution of the extensive margin of exported final goods exported by the CEECs to non-EU OECD countries, 1999 – 2009



Source: authors calculations based on EUROSTAT data.

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 any of the well-established trade theories. Therefore, 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 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 $MInt_{ijt}$, and other for the volume of exports of final goods X_{ijt} from country *i (CEEC)* to country *j* (OECD country) in period *t* in current Euros are given as

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

$$X_{ijt} = \beta_0 \; Y_{it}^{\beta_1} Y_{jt}^{\beta_2} YH_{it}^{\beta_3} YH_{jt}^{\beta_4} DIST_{ij}^{\beta_5} MInt_{ijt}^{\beta_6} F_{ij}^{\beta_7} \; u_{ijt} \tag{2}$$

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*. F_{ij} denotes other factors that impede or facilitate trade (common language, a colonial relationship, or a common border). Finally, u_{ijt} is an idiosyncratic error term that is assumed to be well behaved.

Usually the model is estimated in log-linear form[4]. Taking logarithms, we specify the augmented versions of models (1) and (2), as

$$\begin{aligned} LMInt_{ijkt} &= \beta_0 + \phi_t + \delta_{ijk} + \alpha_1 LY_{it} + \alpha_2 LY_{jt} + \alpha_3 LYH_{it} + \alpha_4 LYH_{jt} + \alpha_5 LDIST_{ij} + \\ &+ \alpha_7 EU_{ijt} + \alpha_8 \, CONTIG_{ij} + \alpha_9 LAND_i + \alpha_{10} LAND_j + \eta_{ijkt} \end{aligned} \tag{3}$$

$$\begin{aligned} LX_{ijkt} &= \beta_0 + \gamma_t + \kappa_{ijk} + \beta_1 LY_{it} + \beta_2 LY_{jt} + \beta_3 LYH_{it} + \beta_4 LYH_{jt} + \beta_5 LDIST_{ij} + \beta_6 LMInt_{ijt} + \\ &+ \beta_7 EU_{ijt} + \beta_8 \, CONTIG_{ij} + \beta_9 LAND_i + \beta_{10} LAND_j + \upsilon_{ijkt} \end{aligned} \tag{4}$$

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

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

effects that control for omitted variables common to all trade flows but which vary over time. δ_{ijk} and κ_{ijk} are trading-partner unobservable effects that proxy for multilateral resistance factors. When these effects are specified as fixed effects, the influence of the variables that are time invariant cannot be directly estimated. This is the case for distance; therefore, its effect is subsumed into the country dummies. Finally, η_{ijkt} and υ_{ijkt} are idiosyncratic error terms that are assumed to be well behaved.

With respect to the specification of the country-pair effects, we not only consider the usual fixed-versus-random-effects approach, but also a modification to the previous specification that includes country-and-time effects to account for time-variant, multilateral price terms, as proposed by Baldwin and Taglioni (2006) and Baier and Bergstrand (2007). As stated by Baldwin and Taglioni, 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, in our case 418 dummies. Nevertheless, with N and T relatively large, there remain many degrees of freedom.

The specification which accounts for the multilateral price terms in a panel data framework is given by

$$LMInt_{ijkt} = \alpha_{0ijk} + \alpha_1 EU_{ijt} + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \varepsilon_{ijkt} \tag{5}$$

$$LX_{ijkt} = \beta_{0ijk} + \beta_1 EU_{ijt} + \beta_2 LMInt_{ijkt} + \sum_{1}^{NT} P_{it}^{1-\delta} + \sum_{1}^{NT} P_{jt}^{1-\delta} + \mu_{ijkt} \tag{6}$$

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. An alternative specification is based on Helpman et *al*. (2008) who developed 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 enables one to decompose 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 (number of exporters), 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, ω_{ijt}, 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

$$r_{ijkt} = P(MInt_{ijkt}) = \vartheta_0 + \psi_t + \vartheta_1 LY_{it} + \vartheta_2 LY_{jt} + \vartheta_3 LYH_{it} + \vartheta_4 LYH_{jt} + \vartheta_5 LDIST_{ij} + \\ + \vartheta_6 EU_{ijt} + \vartheta_7 CONTIG_{ij} + \vartheta_8 LAND_i + \vartheta_9 LAND_j + \tau_{ij} + \sigma_{ijt} \quad (7)$$

$$LMInt_{ijkt} = \delta_0 + \omega_{1ijt} + \varphi_t + \lambda_1 LY_{it} + \lambda_2 LY_{jt} + \lambda_3 LYH_{it} + \lambda_4 LYH_{jt} + \lambda_5 LDIST_{ij} + \\ + \lambda_6 MInt_{ijkt} + \lambda_7 EU_{ijt} + \lambda_8 CONTIG_{ij} + \lambda_9 LAND_j + \pi_{ij} + \varepsilon_{ijt} \quad (8)$$

$$\rho_{ijkt} = P(X_{ijkt}) = \theta_0 + \zeta_t + \theta_1 LY_{it} + \theta_2 LY_{jt} + \theta_3 LYH_{it} + \theta_4 LYH_{jt} + \theta_5 LDIST_{ij} + \\ + \theta_6 MInt_{ijt} + \theta_7 EU_{ijt} + \theta_8 CONTIG_{ij} + \theta_9 LAND_{ij} + \theta_{10} LAND_j + \varsigma_{ij} + \eta_{ijt} \quad (9)$$

$$LX_{ijkt} = \alpha_0 + \omega_{2ijt} + \phi_t + \gamma_1 LY_{it} + \gamma_2 LY_{jt} + \gamma_3 LYH_{it} + \gamma_4 LYH_{jt} + \gamma_5 LDIST_{ij} + \\ + \gamma_6 MInt_{ijkt} + \gamma_7 EU_{ijt} + \gamma_8 CONTIG_{ij} + \gamma_9 LAND_j + \upsilon_{ij} + \mu_{ijt} \quad (10)$$

where τ_{ij}, σ_{ijt}, ς_{ij}, and η_{ijt} are dyadic country-pair effects (specified as random in Equations (7) and (9) and as fixed in equations (8) and (10)) to control for unobserved heterogeneity, and ψ_t , φ_t, ϕ_t and ζ_t denote time-specific effects.

The new variables, ω_{1ijt} and ω_{2ijt} 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_{ijt}s 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_{ijt}), proxied with a transformed variable ($\hat{z}^*_{ijt}$) given by,

$$\hat{z}^*_{ijt} = \phi^{-1}(\hat{\rho}_{ijt}) \text{ or } \hat{z}^*_{ijt} = \phi^{-1}(\hat{r}_{ijt})$$

where $z^*_{ijt} = \frac{z_{ijt}}{\sigma^{\eta}_{ijt}}$ and ϕ (.) is the cumulative distribution function (cdf) of the unit-normal distribution. $\hat{\rho}_{ijt}$ and $\hat{r}_{ijt}$ are the predicted probabilities of imports and exports from country *i* to country *j*, using the estimates from the random-effects-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 (ω_{ijt}), 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_{ijt}) 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 variable that permits identification is the landlocked dummy of the exporter country.

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, and 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 columns1 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.[5] 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 (multilateral resistance factors modeled by Anderson and van Wincoop (2003)). Restricting the analysis to within variation eliminates the bias due to unobserved heterogeneity that is common to each trading-pair.

[5] 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.[6] The estimated increase without controlling for production networks is about 30 percent {exp[0.261]-1)*100}.

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

	OLS-Parts	FE-xm-Parts	OLS-Finals	OLS-Finals	FE-xm-Finals	FE-xm-Finals
Lyi	0.425	0.871	0.74	0.702	-0.01	-0.208
	4.588	7.346	9.249	7.575	-0.096	-1.719
Lyj	0.996	0.981	0.625	0.402	0.285	0.047
	35.597	8.919	30.407	13.479	3.857	0.517
Lyhi	0.433		0.231	0.145		
	1.849		1.155	0.637		
Lyhj	0.295		-0.115	-0.133		
	4.360		-2.479	-2.266		
Ld	-1.250		-0.813	-0.662		
	-30.669		-26.156	-16.064		
Landi	-0.367		0.444	0.535		
	-2.017		2.844	3.000		
Landj	0.226		-0.114	-0.300		
	2.145		-1.497	-3.506		
Contig	0.097		0.319	0.214		
	0.808		3.866	2.298		
Eu	0.384	0.248	0.495	0.323	0.261	0.159
	6.751	5.74	10.521	5.919	7.487	3.862
Ceecj	0.815		0.500	0.489		
	5.344		4.803	4.139		
Lm				0.172		0.157
				18.779		17.113
R-squared	0.226	0.27	0.171	0.173	0.199	0.195
N	153030	153030	107484	79526	107484	79526
Ll	-370153.4	-365615.9	-267237	-197119.7	-265298.4	-195959.7
Rmse	2.71817	2.640294	2.90797	2.88603	2.858358	2.847411
Aic	740348.7	731629.8	534516.1	394283.3	530994.8	392315.4
Bic	740557.4	733607.6	534717.4	394487.6	532902.2	394153.6

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. t-statistics constructed using robust standard errors are reported below each coefficient.

Since we have data for 2046 trading pairs over 11 years, we tested for the presence of autocorrelation and heteroskedasticity. The results of the Wooldridge test for autocorrelation in panel data and the Likelihood Ratio (LR) test for heteroskedasticity indicate that both problems are present in the data. Hence, given the strong rejection of the null hypothesis in both tests, we estimate the model in column 2 using robust standard errors clustered across panels (exporter-importer-sector). The coefficient on the EU dummy variable indicates that imports of intermediates by CEECs following their accession into the EU have increased by about 28 percent {exp[0.248]-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). Both the OLS and the fixed effects results indicate that the effect of accession (the coefficient on the EU variables) 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 (0.159 instead of 0.261) once we add imports of intermediate goods in models 4 and 6. This indicates that without controlling for the effects of production networks, the effects of integration on exports may be overestimated. The coefficient on the EU dummy indicates that exports of final goods by CEECs following their accession into the EU have increased by about 17 percent {exp[0.159]-1)*100} with the member countries, when controlling for production networks.[6]

[6] The estimated increase without controlling for production networks is about 30 percent {exp[0.261]-1)*100}.

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 1.57 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

Variable	Parts	Final goods
EU	0.471	0.176
	7.271	1.419
lm		0.095
		21.795
R-squared	0.445	0.323
N	153675	79783
Log Likelihood	-345925.2	-189475
rmse	2.302479	2.610698
aic	693020.4	380113.5
bic	698836.8	385518.6
xt,mt fe	yes	yes
x-m fe	yes	yes

Note: The dependent variables are bilateral imports of intermediates and bilateral exports of final goods measured at current prices; ld is distance; lm are imports of intermediates; eu is a dummy equal to 1 when countries belong to the EU. t-statistics constructed using robust standard errors are reported below each coefficient.

Compared with the results obtained in Table 2 (Model 6), the EU effect implies an increase in imports of parts by about 60{exp[0.471]-1)*100} percent after accession (compared to 28 percent according to Table 2). In addition, the coefficient on the EU for final goods is now slightly higher in magnitude but less statistically significant. It is significant at the 5 percent level when we consider one tail alternative. The effect of intermediate imports on exports of final goods is slightly lower than before, indicating that a 10 percent increase in imports of the corresponding intermediates increases final good exports by about 0.95 percent (instead of 1.57). Summarizing, controlling for multilateral resistance in the most recently recommended way indicates that there is a considerably larger EU effect for intermediates than for final goods and that the effect of production networks is still sizable.

To account for selection bias and firm heterogeneity (Helpman et al., 2008), Table 4 presents the results from estimating Equations 7, 8, 9 and 10. Results of the first step estimations for the imports of intermediates and for the exports of final goods are shown in columns 1 and 4. In each case we 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 5 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 and 7 (for final goods). All second stage models include fixed effects and time dummies.

In all models the coefficients on mhat and xhat are positive and statistically significant at the 1-percent level. The coefficient on the inverse Mills ratio (IMILLS) is also statistically significant showing evidence of selection effects. The estimates shown in the last column of Table 4 are comparable to those in column 2 in Table 3. We observe that the total effect of an increase in imported intermediates on exports of final goods can now be divided into intensive margin effects (0.065) and extensive margin (0.027). Therefore, the total effect of imports of intermediates on exports of final goods is around 0.092, whereas previously it was 0.095 (see Table 3 column 2). Hence, the total effect is very similar using two different estimation methods.

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

	PARTS			**FINAL GOODS**			
	Probit	Firm Heterogeneity	Sample selection &Firm Heterogeneity	Probit	Firm Heterogeneity	Sample selection &Firm Heterogeneity	Sample selection &Firm Heterogeneity
Dep var: Indep. Var	Imports	Log(Imports)	Log(Imports)	Exports	Log(Exports)	Log(Exports)	Log(Exports)
lyi	-3.309			0.47			
	-12.454			1.383			
lyj	0.502			0.843			
	3.095			3.667			
lyhi	3.933			-0.193			
	15.224			-0.583			
lyhj	0.048			-0.652			
	0.306			-2.91			
lm				0.031	0.057	0.057	0.065
				24.081	11.642	11.535	12.997

eu	-0.054	0.449	0.384	-0.294	0.774	0.758	0.661
	-4.745	7.982	6.846	-21.649	7.162	7.005	6.072
ld	-0.055	-0.393	-0.328	-0.884	-0.07	-0.092	-0.068
	-0.321	-15.44	-12.965	-3.737	-1.893	-2.441	-1.809
landi	-3.063			-0.657			
	-6.498			-3.412			
landj	0.38	-1.69	-1.035	1.259	-2.084	-2.122	-2.069
	0.549	-10.953	-6.708	3.343	-8.259	-8.401	-8.205
contig	0.615	0.552	0.211	-0.501	0.116	0.08	0.01
	3.534	19.843	7.262	-2.051	2.679	1.799	0.225
ceecj	0.807	-0.272	0.264	1.132	1.372	1.276	1.499
	7.929	-1.636	1.586	6.908	5.27	4.86	5.708
mhat		0.041	0.044				0.027
		33.397	35.993				9.917
xhat					0.064	0.066	0.051
					24.746	24.967	16.392
imills			2.356			0.302	1.023
			39.139			3.047	8.568
R-squared	0.29	0.431	0.436		0.318	0.319	0.319
N	264882	153030	153030	153018	79526	79526	79526
ll	-126527	-346471.9	-345751.8	-91806.75	-189244.2	-189239.3	-189194
rmse		2.33162	2.320681		2.620754	2.620609	2.619134
aic	253456	693813.8	692375.6	184015.5	379356.4	379350.6	379262
bic	255563.9	698137	696708.8	186013.1	383385.6	383398.3	383319
xt, mt fe	no	yes	yes	no	Yes	yes	yes
x-m fe	yes	no	no	yes	No	no	no

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; 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. t-statistics constructed using robust standard errors are reported below each coefficient.

With respect to the EU effect, we are now able to distinguish between the effect on the extensive margin of trade (new varieties traded) and the effect on the intensive margin (average quantity traded of existing varieties). The results in Table 4 indicate that there is a negative EU effect on the extensive margin of intermediates and final goods, indicating that the probability of importing (exporting) from EU countries decreases after accession. However the EU effect on the intensive margin is now higher than before for exports of final goods (those exports increase by about 94 percent with accession) and slightly lower for imports of intermediates (those imports increase by about 47 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 whereas the Baldwin and Taglioni (2006) method considers only the effect on total trade.

As a check of robustness, we have also estimated the model in its multiplicative form using the method proposed by Santos Silva and Tenreyro (2006) (pseudo Poisson Maximum Likelihood) which controls for zero trade flows and heteroskedasticity. The main conclusions remain, but the estimates are somewhat lower in magnitude.[7]

5. Conclusions

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 EU parts and components exports 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

[7] The results are available upon request from the authors.

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.

As 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.

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Appendix

Table A1 Economic Organizations of countries in the dataset

Abbreviation	Title	Members
EU	European Union	Admitted before 1999: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom , Admitted in 2004: Czech Republic, Hungary, Poland, Slovak Republic Admitted in 2007: Bulgaria, Romania
OECD	Organization for Economic Co-operation and Development	Admitted before 1999: Austria, Australia, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States Admitted in 2000: Slovakia
CEECs	Central Eastern European Countries	Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia

Table A2 Definitions of variables

Variable	Definition
Reporter	CEECs countries
Partner	EU and OECD countries
Y_i	GDP of reporter country i.
Y_j	GDP of partner country j.
YH_i	GDP per capita of reporter country i.
YH_j	GDP per capita of partner country j.
D_{ij}	The distance expressed in kilometers between reporter’s i and partner’s j capital cities.
$LAND_i$:	Binary variable that takes the value of “1” if the reporter country is landlocked, meaning they don’t have access to sea or coastline, and “0” otherwise.
$LAND_j$	Binary variable that takes the value of “1” if the partner country is landlocked and “0” otherwise.
$CONTIG_{ij}$	Binary variable that takes the value “1” if the reporter country “i” and partner country “j” share a common border.
$CEEC_{sj}$	Binary variable that takes the value “1” if reporter and partner countries belong to CEECs and “0” otherwise.
EU_j	Binary variable that takes the value “1” if both countries are members of EU.

Table A3 List of Parts and Components and Final goods according to the Standard Industrial Classification (SITC) System Revision 3

Division	Codes for Parts and Components	Codes for Final Goods
Power-generating machinery and equipment	7119, 7128, 71319, 7139, 7149, 7169, 71819, 71878, 71899	7111, 7112, 7121, 71311, 7132, 7133, 7138, 71441, 7148, 716, 71811, 71871, 71449, 71891, 71892, 71893
Machinery specialized for particular industries	72119, 72129, 72139, 72198, 72199, 7239, 72449, 72467, 72468, 72488, 7249, 7259, 72689, 7269, 72719, 72729, 72819, 72839, 7285	7211, 72121, 72122, 72123, 72126, 7213, 72191, 72195, 72196, 7231, 7232, 7233, 7234, 7443, 7244, 72451, 72452, 72453, 72454, 7248, 7247, 7751, 7251, 7252, 72681, 72631, 7265, 7266, 72711, 72127, 72722, 7281, 7283, 72721, 7284
Metalworking machinery	7359, 73719, 73739, 73749	731, 733, 7371, 73721, 7373, 7374
General industrial machinery and equipment, n.e.s., and machine parts, n.e.s	74128, 74135, 74139, 74149, 74159, 74172, 74190, 7429, 74380, 7439, 74419, 7449, 74519, 74529, 74539, 74593, 74597, 7469, 7479, 7499	7412, 74131, 74132, 74133, 74134, 74136, 74137, 74138, 7414, 7415, 74171, 7417, 7418, 742, 7435, 7436, 74414, 74415, 74411, 74412, 74413, 7442, 7444, 7447, 7448, 7451, 7452, 77530, 7453, 7456, 74591, 74595, 746, 747, 7483, 748, 749
Office machines and automatic data processing machines	7591, 7599	751, 752
Telecommunications and sound recording and reproducing apparatus and equipment	7649	7641, 7642, 7643, 7648, 761, 762
Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof	77129, 77238, 7728, 77429, 77549, 77579, 77589, 77629, 77688, 77689, 77817, 77819, 77829, 77833, 77835, 77848, 77869, 77879, 77883, 77885	771, 7723, 7724, 7725, 7726, 7742, 7754, 7757, 7758, 7761, 7762, 7763, 7764, 77681, 7781, 7782, 77831, 77834, 7784, 7786, 7787, 77882, 77884
Road vehicles	7841, 7842, 7843, 78535, 78536, 78537, 78689	772, 781, 782, 783, 7851, 7852, 78531, 7861, 7862, 78683, 78685

Other transport equipment	79199, 7929	7911, 7912, 7916, 7917, 7918, 7921, 7922, 7923, 7924, 7925, 7928
Furniture and parts thereof	82119, 8218	8211, 8213, 8215, 8217
Measuring, checking, analyzing and controlling instruments and apparatus, n.e.s.	87424, 87426	87422, 87425
Photographic apparatus, equipment and supplies and optical goods, n.e.s; watches and clocks	88114, 88115, 88123, 88124, 88134, 88136, 8859	88111, 88113, 88121, 88122, 88131, 88132, 88133, 88135, 885
Optical goods, n.e.s	88422	88421

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