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

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

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## **Abstract**

This paper examines the effect of the two most recent European Union enlargements on CEECs trade of intermediate and final products separately. A theoretically justified gravity model which incorporates the extensive margin of trade and accounts for firm heterogeneity is estimated using highly disaggregated trade data for the period 1999 to 2009. We hypothesize that the CEECs have a comparative advantage on the assembly of final goods and evaluate the effect of the EU-accession on CEECs imports in intermediates products and on CEECs export of final goods to OECD countries. To capture the importance of production networks, imported intermediate products from the OECD are added as a determinant of the corresponding exports of final goods. We find a positive and significant effect of accession on CEECs trade of intermediate and final goods. In particular, deeper integration and the consequent elimination of “behind the border” trade barriers have had a positive impact not only in terms of increasing trade volumes, but also in terms of increasing 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

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

## **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 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 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 margin 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<sup>1</sup>. 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 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.

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<sup>1</sup> To our knowledge Antimiani and Constantini (2010) and Hornok (2010) are the only two papers 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 enlargement impact on exports of final goods is positive and greater for new EU members than for old EU members.

## **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) leads to the development of production networks<sup>2</sup>. Vertical fragmentation of production/distribution results in a reduction in production costs due to differences in factor prices in different locations (mainly labor costs) and a reduction in service-link costs. All of these became possible thanks to the 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

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<sup>2</sup> 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).

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) provides evidence showing that Central and 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 a number of changes. First, simple assembly operations have been replaced by processing and specialization in production of parts. In addition, the CEECs-10<sup>3</sup> network' firms have expanded beyond EU markets, and by 1999 the CEECs-10 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 that explains international production fragmentation based on differences in comparative advantages in different locations that was 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

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<sup>3</sup> CEECs-10 include Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

Heckscher-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 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. 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 including 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 third strand of the literature uses instead foreign trade statistics to classify goods into parts and components and finished products and to measure vertical specialization (Ng and Yeats, 2001, 2003; Yeats, 2001; Kaminski and Ng, 2001; Athukorala, 2005; Zeddies, 2010). Most studies focus on a subset of products within the categories machinery and transport equipment and miscellaneous manufacture articles (SITC<sup>4</sup> 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. As 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 concordance 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

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<sup>4</sup> Standard International Trade Classification.

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 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.

A number of recent 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; Bergstrand and Egger, 2008; Baldwin and Taglioni, 2011; and Hayakawa and Yamashita, 2011). Athukorala and Yamashita (2006) focus their study on trade in components and 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. 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 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. 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 and in Europe. The authors argue that the vertical fragmentation theory is well suited to explain international production/distribution networks in East Asia while horizontal product differentiation models are better suited to explain intra-industry trade in Europe. Their study uses bilateral trade data for machinery for a sample of 56 countries and three years (1987, 1995, and 2003). Their estimation 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 (a positive coefficient is obtained indicating that large income gaps generate large flows of parts and components) and Europe (a negative coefficient is obtained indicating that income gap reductions increase trade in 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.

Bergstrand and Egger (2008) motivate a theoretical rationale to estimate gravity equations of intermediate goods and constructed a comprehensive dataset of final and intermediate

goods bilateral trade flows for 160 countries from 1990 to 2000. Using a subsample of OECD countries they estimate gravity models for trade in final and intermediate goods and also for FDI separately. They use an instrumental variable technique to estimate the effect of intermediate goods trade on the ratio of FDI to final goods trade, in which trade in intermediate goods was instrumented with its corresponding bilateral trade costs. They find a positive and significant effect of trade in intermediate goods on the ration of FDI to final goods trade which is consistent with their theoretical predictions.

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) used 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 of trade in final goods in both the short and the long run that materializes in higher trade the first six year after 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 to the FTA is observed after three years of the entry into force of the agreement. 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 data base. 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 machinery (SITC 72), 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. The list of countries as well as parts and components 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<sup>5</sup>. 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**

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. The extensive margin is calculated as the sum of the number of different items (SITC 5-digits) 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 past year) is recorded for a given bilateral trade relationship. Figure 1 indicates that there has been a

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<sup>5</sup> CEPII stands for Centre d'Etudes Prospectives et d'Informations Internationales. It is a French leading institute for research on the international economy.

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.

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

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.

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

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

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**

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 an 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**

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**

Next, we also analysed the evolution over time of the volume of imports and exports observing similar trends over time (see Appendix 4). The volume of trade increased after accession for bilateral trade between CEECs and EU members and decreased between CEECs and non-EU-OECD countries.

Finally, in terms of shares with respect to total trade in categories 6 and 7, 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 in comparison to Asian countries (between 6 and 15%).

## 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 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

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

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

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,  $u_{ijt}$  is an idiosyncratic error term that is assumed to be well behaved.

Usually the model is estimated in log-linear form<sup>6</sup>. Taking logarithms and adding time and sectoral dummies, we specify the augmented versions of models (1) and (2), as

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

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

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.  $\phi_t$  are specific time effects that control for omitted variables common to all trade flows but which vary over time.  $\lambda_k$  and  $\tau_k$  are industry fixed effects. Finally,  $\eta_{ijkt}$  and  $v_{ijkt}$  are idiosyncratic error terms that are assumed to be well behaved.

Next, trading-partner effects could also be specified as fixed effects,  $\delta_{ij}$  and  $\kappa_{ij}$  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

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<sup>6</sup> We also estimate the model in its original multiplicative form.

directly estimated. This is the case for distance and contiguity; therefore, its effect is subsumed into the country dummies.

With respect to the specification of the multilateral resistance terms, theoretically suggested by Anderson and van Wincoop (2003) we consider a modification to the previous specification that includes in addition 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 (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  $N_x T + N_M T$  ( $N_x = \text{exporters}$ ,  $N_M = \text{importers}$ ,  $T = \text{years}$ ) 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

$$LMInt_{ijkt} = \alpha_0 + \delta_{ij} + \lambda_k + \alpha_1 EU_{ijt} + \sum_1^{NT} P_{it}^{1-\delta} + \sum_1^{NT} P_{jt}^{1-\delta} + \varepsilon_{ijkt} \quad (5)$$

$$LX_{ijkt} = \beta_0 + \kappa_{ij} + \tau_k + \beta_1 EU_{ijt} + \beta_2 LMInt_{ijkt} + \sum_1^{NT} P_{it}^{1-\delta} + \sum_1^{NT} P_{jt}^{1-\delta} + \mu_{ijkt} \quad (6)$$

where  $P_{it}^{1-\delta}$  and  $P_{jt}^{1-\delta}$  are time-variable, multilateral (price) resistant terms that are proxied with *country*-and-time dummies, and  $\varepsilon_{ijkt}$  and  $\mu_{ijkt}$  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.

A remaining problem related to the estimation of gravity models of trade is the presence of zeros in the dependent variable (bilateral trade) that may give rise to a selection sample bias. To approach this problem 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 enables 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,  $\omega_{ijt}$ , 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

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

$$LMInt_{ijkt} = \alpha_0 + \omega_{ijkt}^1 + \alpha_5 LDIST_{ij} + \alpha_6 MInt_{ijkt} + \alpha_7 EU_{ijt} + \alpha_8 CONTIG_{ij} + \alpha_9 LAND_j + \sum_1^{NT} P_{it}^{1-\delta} + \sum_1^{NT} P_{jt}^{1-\delta} + \varepsilon_{ijt} \quad (8)$$

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

$$LX_{ijkt} = \beta_0 + \omega_{ijkt}^2 + \beta_5 LDIST_{ij} + \beta_6 MInt_{ijkt} + \beta_7 EU_{ijt} + \beta_8 CONTIG_{ij} + \beta_9 LAND_j + \sum_1^{NT} P_{it}^{1-\delta} + \sum_1^{NT} P_{jt}^{1-\delta} + \mu_{ijt} \quad (10)$$

where  $\tau_{ij}$  and  $\zeta_{ij}$ , are dyadic country-pair effects to control for unobserved heterogeneity, and  $\psi_t$ ,  $\varphi_t$  denote time-specific effects.

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

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

where  $z_{ijkt}^{*m} = \frac{z_{ijkt}^m}{\sigma_{ijkt}^\eta}$  and  $\Phi$  is the cumulative distribution function (cdf) of the unit-normal

distribution.  $\hat{\rho}_{ijkt}^m$  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 ( $\omega_{ijkt}^m$ ) 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, 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 equations (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.<sup>7</sup> 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 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.

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<sup>7</sup> 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.<sup>8</sup> Results for the first step estimation (Equations 7 and 9) are available upon request from the authors.



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 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 (0.063 instead of 0.294) once we add imports of intermediate goods in model 4 and it shows a negative coefficient that is statistically significant once bilateral fixed effects are added. This could possibly do 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 Bergstrand (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 (Model 6), the EU effect implies an increase in imports of parts by about 55 percent  $\{\exp[0.436]-1\} \times 100$  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 197 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 export of final products than for imports of intermediates 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 8 and 10<sup>8</sup>. 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

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<sup>8</sup> Results for the first step estimation (Equations 7 and 9) are available upon request from the authors.

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 last column of Table 4 indicate that the increase in exports of final goods is partly explained by an increase in the intensive margin of imports (0.063) 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 Silva and Tenreyro (2006) (pseudo Poisson Maximum Likelihood) for the second step estimations which controls for zero trade flows and heteroskedasticity. Results in Table 5 show that the main conclusions remain, since the estimates are of similar in magnitude.

## **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 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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## TABLES

**Table 1. Summary statistics and correlations**

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

	xf	mp	lxf	lm	lyi	lyj	lyhi	lyhj	eu	ceecs	ld	landj	landi	contig
<b>xf</b>	1													
<b>mp</b>	0.108	1												
<b>lxf</b>	0.303	0.066	1											
<b>lm</b>	0.191	0.251	0.39	1										
<b>lyi</b>	0.084	0.058	0.222	0.184	1									
<b>lyj</b>	0.098	0.093	0.103	0.315	0.001	1								
<b>lyhi</b>	0.091	0.069	0.287	0.169	0.595	0.034	1							
<b>lyhj</b>	0.045	0.035	0.006	0.185	0.091	0.519	0.114	1						
<b>eu</b>	0.112	0.073	0.247	0.241	0.291	-0.021	0.473	0.094	1					
<b>ceecs</b>	-0.03	-0.027	0.06	-0.071	-0.033	-0.595	-0.011	-0.779	0.089	1				
<b>ld</b>	-0.08	-0.063	-0.251	-0.232	0.059	0.5	-0.059	0.278	-0.295	-0.428	1			
<b>landj</b>	-0.029	-0.023	0.036	0.077	-0.011	-0.439	-0.022	-0.097	0.019	0.403	-0.477	1		
<b>landi</b>	0.033	0.032	0.134	0.031	-0.152	-0.003	0.595	-0.001	0.1	0.011	-0.132	-0.023	1	
<b>contig</b>	0.082	0.079	0.183	0.155	-0.053	-0.284	0.024	-0.367	0.119	0.445	-0.554	0.349	0.068	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
<b>lyi</b>	0.921*** (0.058)	1.182*** (0.087)	0.777*** (0.076)	0.581*** (0.083)	0.677*** (0.125)	0.756*** (0.141)
<b>lyj</b>	1.489*** (0.017)	1.095*** (0.074)	0.853*** (0.020)	0.733*** (0.028)	0.909*** (0.085)	0.621*** (0.102)
<b>lyhi</b>	-0.132 (0.145)		1.036*** (0.188)	1.217*** (0.205)		
<b>lyhj</b>	0.311*** (0.047)		-0.011 (0.049)	-0.147*** (0.057)		
<b>ld</b>	-1.489*** (0.026)		-1.258*** (0.030)	-1.146*** (0.039)		
<b>landi</b>	0.067 (0.117)		0.118 (0.147)	-0.098 (0.159)		
<b>landj</b>	0.652*** (0.063)		-0.317*** (0.068)	-0.355*** (0.074)		
<b>contig</b>	0.212*** (0.066)		0.503*** (0.070)	0.422*** (0.074)		
<b>eu</b>	<b>0.486***</b> (0.044)	<b>0.158***</b> (0.031)	<b>0.294***</b> (0.047)	<b>0.063</b> (0.049)	<b>-0.078**</b> (0.040)	<b>-0.190***</b> (0.043)
<b>ceecs</b>	<b>1.339***</b> (0.099)		<b>0.894***</b> (0.104)	<b>0.822***</b> (0.115)		
<b>lm(-1)</b>				<b>0.158***</b> (0.011)		<b>0.108***</b> (0.0110)
<b>R-squared</b>	0.584	0.649	0.485	0.518	0.526	0.564
<b>N</b>	75076	75076	63436	41963	63436	41963
<b>ll</b>	-162856.8	-156413.9	-145348.4	-93099.6	-142620.5	-90920.04
<b>rmse</b>	2.118541	1.946625	2.393705	2.226326	2.296179	2.118145
<b>aic</b>	325845.7	313315.8	290828.8	186313.2	285729	182310.1
<b>bic</b>	326454.6	315567.1	291426.6	186805.9	287939.1	184341.5
<b>sitc3-d</b>	yes	yes	yes	yes	yes	yes
<b>t-dummies</b>	yes	yes	yes	yes	yes	yes
<b>x-m dummies</b>	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**

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

	<b>Parts</b>	<b>Finals</b>	<b>Finals</b>
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

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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 and se robust standard errors clustered by sector-exporter-and-importer. \* 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 components		Final Goods		Firm hetero+
	Firm hetero	Firm hetero+ Sample selec	Firm hetero	Firm hetero+ Imported parts	Sample selec+ Imported parts
	b/se	b/se	b/se	b/se	b/se
<b>eu</b>	<b>0.304***</b>	<b>0.465***</b>	<b>0.529***</b>	<b>0.404***</b>	<b>0.390***</b>
	(0.095)	(0.094)	(0.142)	(0.143)	(0.145)
ceecs <sub>j</sub>	-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)				<b>0.064***</b>	<b>0.063***</b>
				(0.012)	(0.012)
mhat	<b>0.063***</b>	<b>0.087***</b>			0.007
	(0.007)	(0.007)			(0.011)
xhat			<b>1.183***</b>	<b>1.014***</b>	<b>0.954***</b>
			(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 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. Robust standard errors clustered by sector-exporter-and-importer are reported below each coefficient. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

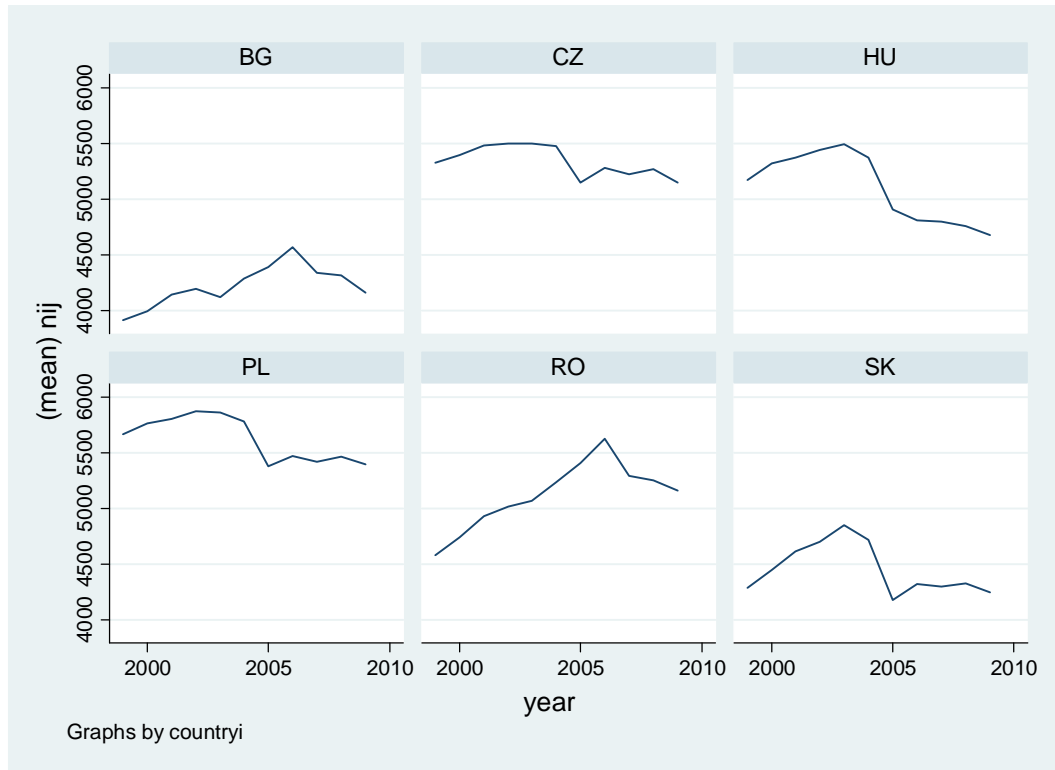
**Table 5: Determinants of Imports of Intermediates and Exports of Final Goods with Pseudo Poisson Maximum Likelihood (Heckman Sample Selection and Firm Heterogeneity)**

	<b>Parts</b>	<b>Final goods</b>
	Firm hetero+ Sample selec b/se	Firm hetero+ Sample selec b/se
<b>eu</b>	0.385*** (0.131)	<b>0.595***</b> (0.190)
<b>ceecs<sub>j</sub></b>	0.317 (0.373)	0.552 (0.374)
<b>ld</b>	-0.107* (0.056)	-0.032 (0.067)
<b>landi</b>	1.471*** (0.248)	0.833*** (0.155)
<b>land<sub>j</sub></b>	-0.290 (0.391)	-1.433*** (0.424)
<b>contig</b>	0.300*** (0.069)	-0.399*** (0.091)
<b>mhat</b>	0.133*** (0.016)	0.006 (0.009)
<b>xhat</b>		0.946*** (0.069)
<b>limills</b>	1.728*** (0.130)	-0.061 (0.052)
<b>R-squared</b>	0.798	0.722
<b>N</b>	91494	53847
<b>ll</b>	-2.55e+11	-1.39e+11
<b>aic</b>	5.09e+11	2.78e+11
<b>bic</b>	5.09e+11	2.78e+11
<b>x-m effects</b>	no	no
<b>x-t and m-t effects</b>	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 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. Robust standard errors clustered by sector-exporter-and-importer are reported below each coefficient. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

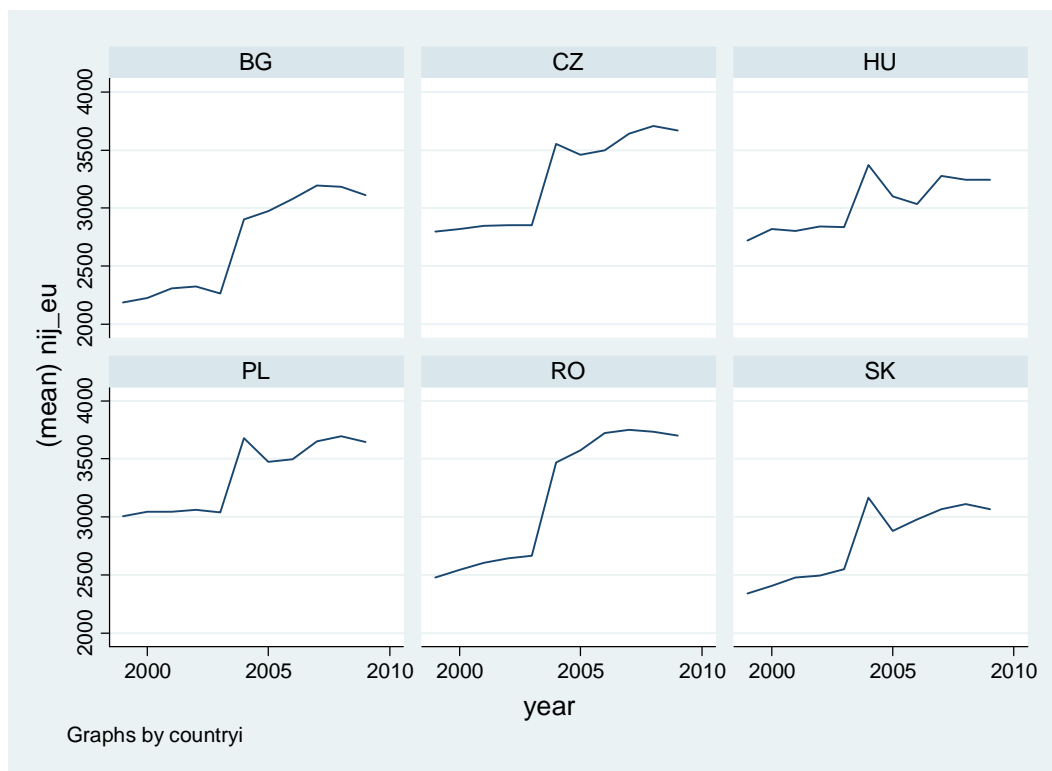
## FIGURES

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



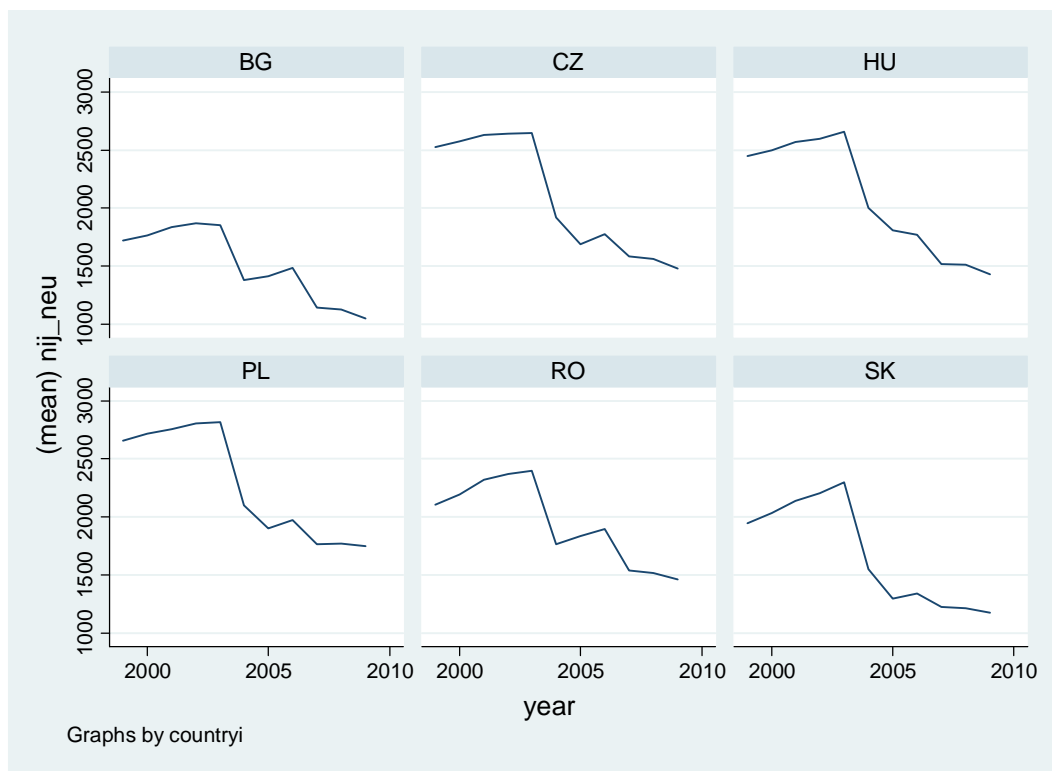
Source: authors' calculations based on EUROSTAT data. The figures show the number of 5-digits codes imported yearly by each country (BG: Bulgaria; CZ: Czech Republic; HU: Hungary; PL: Poland; RO: Romania; SK: Slovakia) from OECD+CEECs countries. The maximum number per destination is 274 (5-digit) codes classified as parts and components.

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



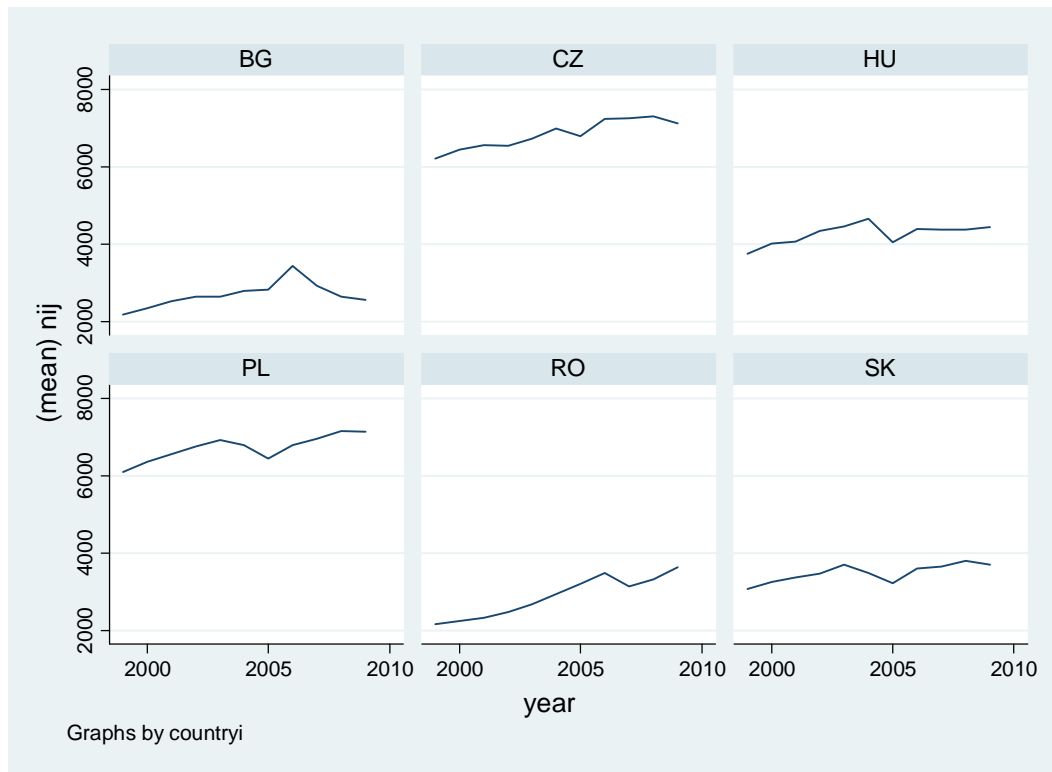
Source: authors' calculations based on EUROSTAT data. The figures show the number of 5-digits codes imported yearly by each country (BG:Bulgary; CZ: Czech Republic; HU: Hungary; PL: Poland; RO:Romania; SK: Slovakia) from EU+CEECs countries. The maximum number per destination is 274 (5-digit) codes classified as parts and components.

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



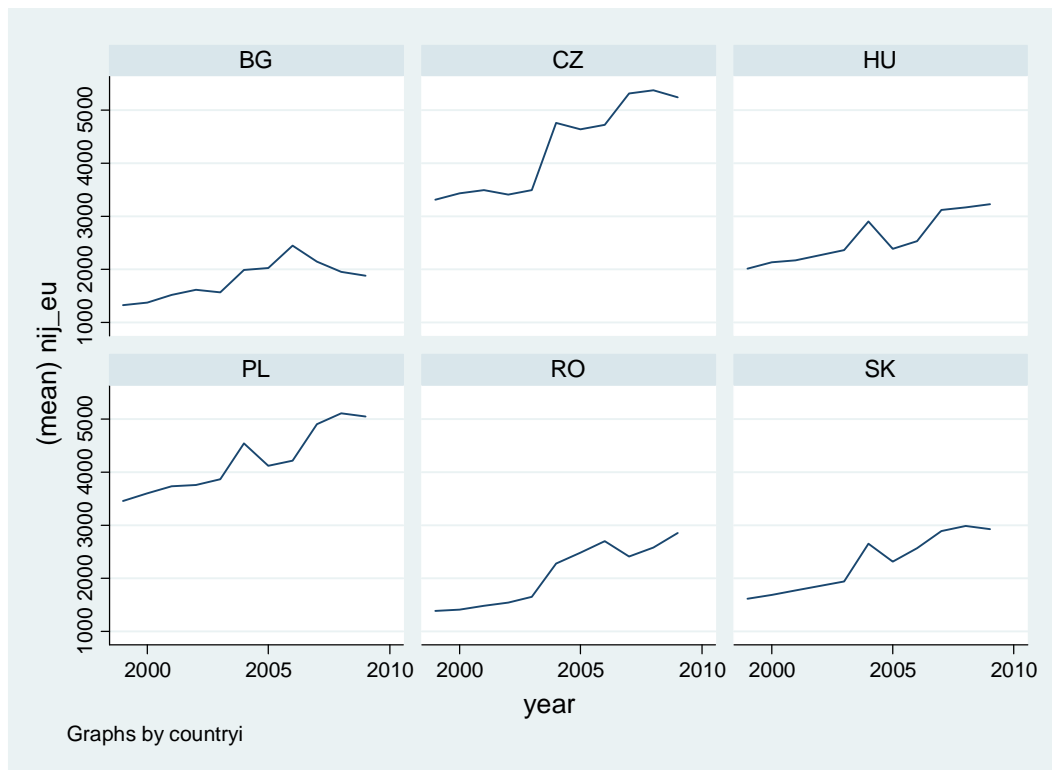
Source: authors' calculations based on EUROSTAT data. The figures show the number of 5-digits codes imported yearly by each country (BG: Bulgaria; CZ: Czech Republic; HU: Hungary; PL: Poland; RO: Romania; SK: Slovakia) from non-OECD countries. The maximum number per destination is 274 (5-digit) codes classified as parts and components.

**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. The figures show the number of 5-digits codes exported yearly by each country (BG: Bulgaria; CZ: Czech Republic; HU: Hungary; PL: Poland; RO: Romania; SK: Slovakia) to OECD+CEECs countries. The maximum number per destination is 514 (5-digit) codes classified as final products.

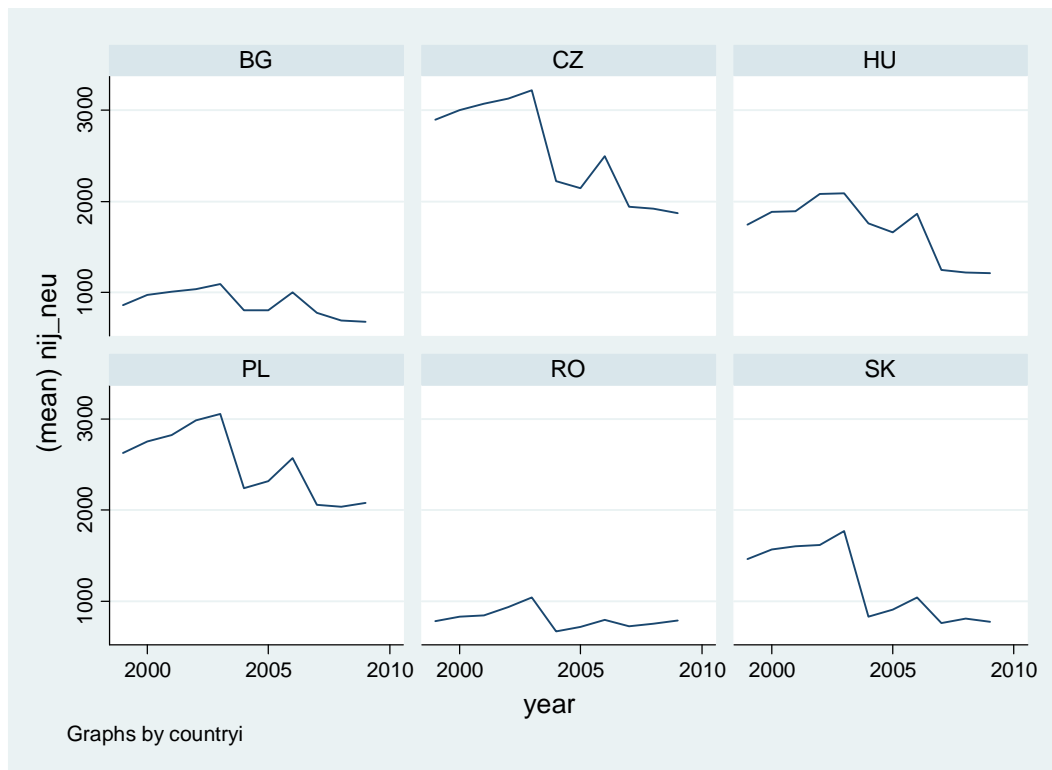
**Figure 5. Evolution of the extensive margin of final goods exported by the CEECs to the EU countries, 1999 – 2009**



Source: authors' calculations based on EUROSTAT data. The figures show the number of 5-digits codes exported yearly by each country (BG: Bulgaria; CZ: Czech Republic; HU: Hungary; PL: Poland; RO: Romania; SK: Slovakia) to EU+CEECs countries. The maximum number per destination is 514 (5-digit) codes classified as final products.



**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. The figures show the number of 5-digits codes exported yearly by each country (BG: Bulgaria; CZ: Czech Republic; HU: Hungary; PL: Poland; RO: Romania; SK: Slovakia) to non-EU OECD countries. The maximum number per destination is 514 (5-digit) codes classified as final products.

## Appendix

**Table A1 Economic Organizations of countries in the dataset**

<b>Abbreviation</b>	<b>Title</b>	<b>Members</b>
<i>EU</i>	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
<i>OECD</i>	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
<i>CEECs</i>	Central Eastern European Countries	Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia

**A2 List of Parts and Components according to the Standard Industrial Classification (SITC) System Revision 3**

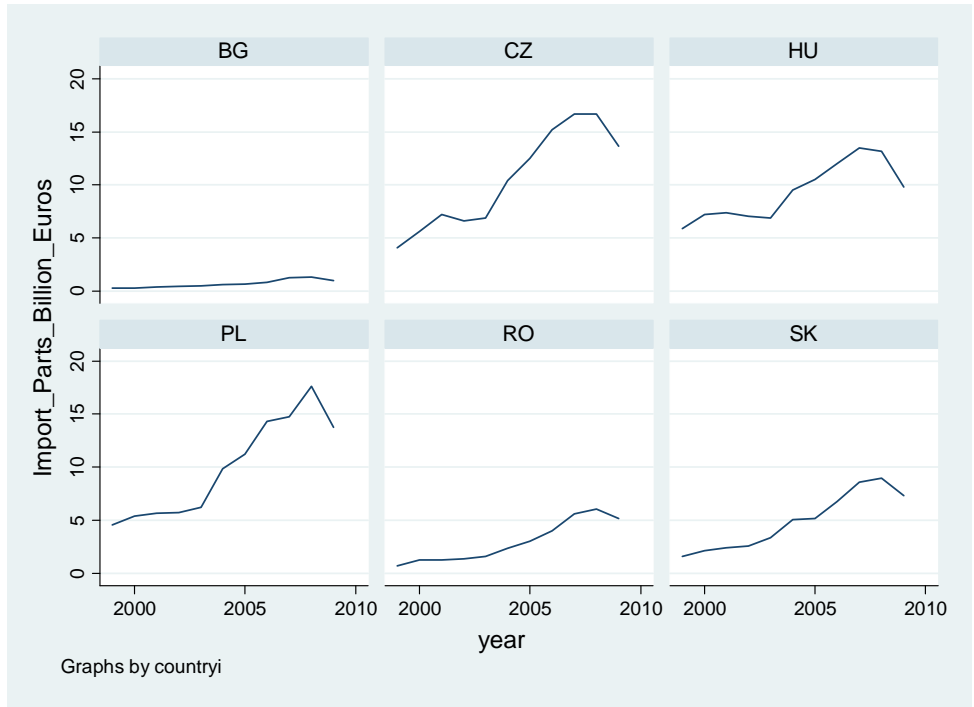
Division	Codes for Parts and Components
Power-generating machinery and equipment (SITC 71)	71191, 71192, 71280, 71311, 71319, 71321, 71322, 71323, 71332, 71333, 71391, 71392, 71441, 71449, 71481, 71489, 71491, 71499, 71690, 71819, 71878, 71899
Machinery specialized for particular industries (SITC 72)	72119, 72129, 72139, 72198, 72199, 72391, 72392, 72393, 72399, 72439, 72449, 72461, 72467, 72468, 72488, 72491, 72492, 72591, 72599, 72635, 72689, 72691, 72699, 72719, 72729, 72819, 72829, 72839, 72851, 72852, 72853, 72855
Metalworking machinery (SITC 73)	73511, 73513, 73515, 73591, 73595, 73719, 73729, 73739, 73749
General industrial machinery and equipment, n.e.s., and machine parts, n.e.s (SITC 74)	74128, 74135, 74139, 74149, 74159, 74172, 74190, 74291, 74295, 74380, 74391, 74395, 74419, 74491, 74492, 74493, 74494, 74519, 74529, 74539, 74568, 74593, 74597, 74610, 74620, 74630, 74640, 74650, 74680, 74691, 74699, 74710, 74720, 74730, 74740, 74780, 74790, 74810, 74821, 74822, 74839, 74840, 74850, 74860, 74890, 74991, 74999
Office machines and automatic data processing machines (SITC 75)	75910, 75980, 75990, 75991, 75993, 75995, 75997
Telecommunications and sound recording and reproducing apparatus and equipment (SITC 76)	76211, 76312, 76491, 76492, 76493, 76499
Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (SITC 77)	77129, 77220, 77231, 77232, 77233, 77235, 77238, 77241, 77242, 77243, 77244, 77245, 77249, 77251, 77252, 77253, 77254, 77255, 77257, 77258, 77259, 77261, 77262, 77281, 77282, 77311, 77312, 77313, 77314, 77315, 77316, 77317, 77318, 77322, 77323, 77324, 77326, 77328, 77329, 77423, 77429, 77549, 77557, 77579, 77589, 77611, 77612, 77621, 77623, 77625, 77627, 77629, 77631, 77632, 77633, 77635, 77637, 77639, 77641, 77642, 77643, 77644, 77645, 77646, 77649, 77681, 77688, 77689, 77812, 77817, 77819, 77822, 77823, 77824, 77829, 77831, 77833, 77834, 77835, 77848, 77869, 77879, 77883, 77885, 77886, 77889
Road vehicles (SITC 78)	78421, 78425, 78431, 78432, 78433, 78434, 78435, 78436, 78439, 78535, 78536, 78537, 78689
Other transport equipment	79199, 79291, 79293, 79295, 79297

(SITC 79)	
Furniture and parts thereof (SITC 82)	82111, 82112, 82119, 82180
Measuring, checking, analyzing and controlling instruments and apparatus, n.e.s. (SITC 874)	87412, 87414, 87424, 87426, 87439, 87449, 87454, 87456, 87469, 87479, 87490
Photographic apparatus, equipment and supplies and optical goods, n.e.s; watches and clocks (SITC 88)	88112, 88113, 88114, 88115, 88123, 88124, 88134, 88136, 88210, 88220, 88230, 88240, 88250, 88260, 88310, 88390, 88415, 88417, 88419, 88421, 88422, 88431, 88432, 88433, 88439, 88551, 88552, 88571, 88591, 88596, 88597, 88598, 88599

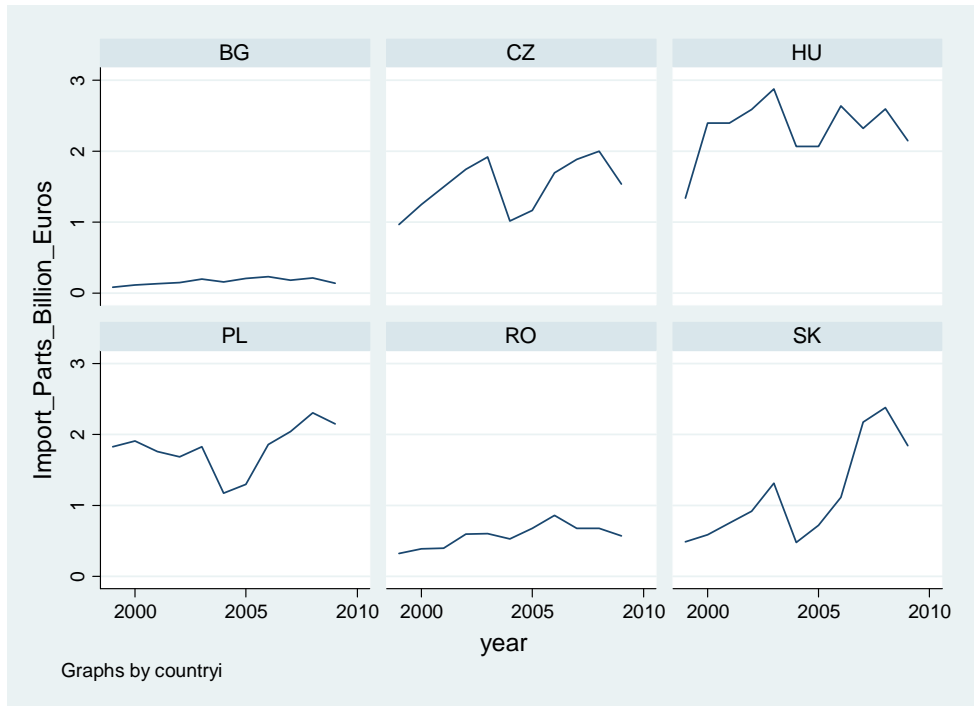
**Table A3 Definitions of variables**

<b>Variable</b>	<b>Definition</b>
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.

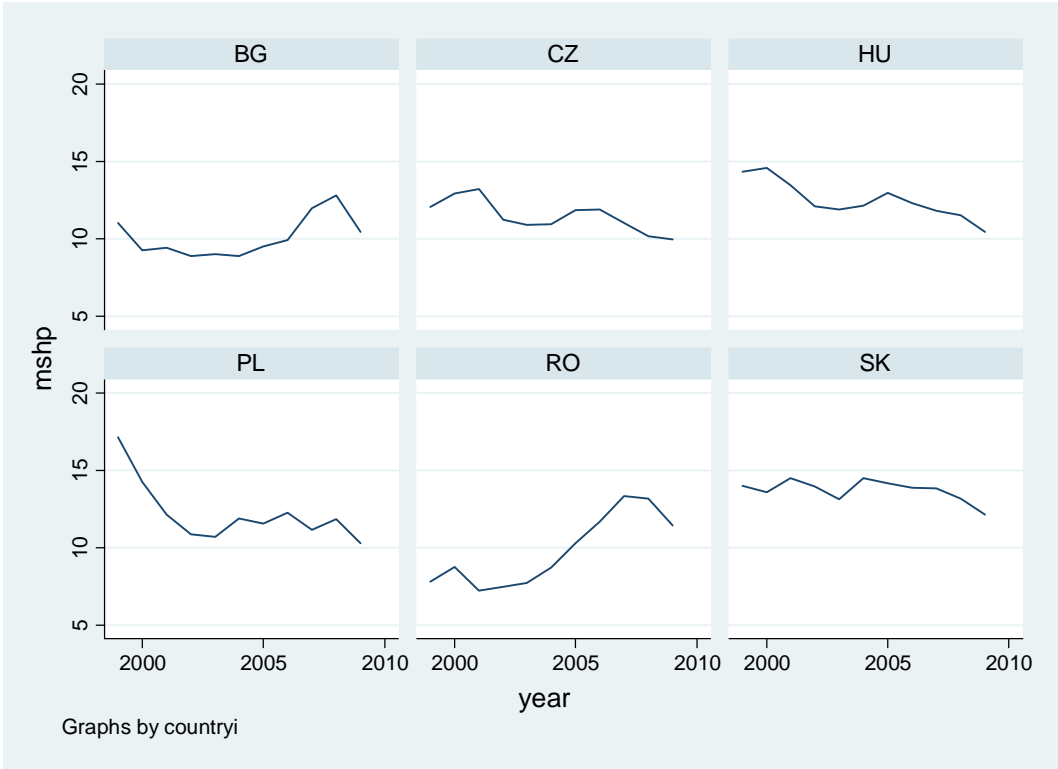
Appendix 4.A Imports of intermediates: total values and shares  
 Total imports of intermediates sectors 7 and 8 to the EU



Total imports of intermediates sectors 7 and 8 to non- EU countries

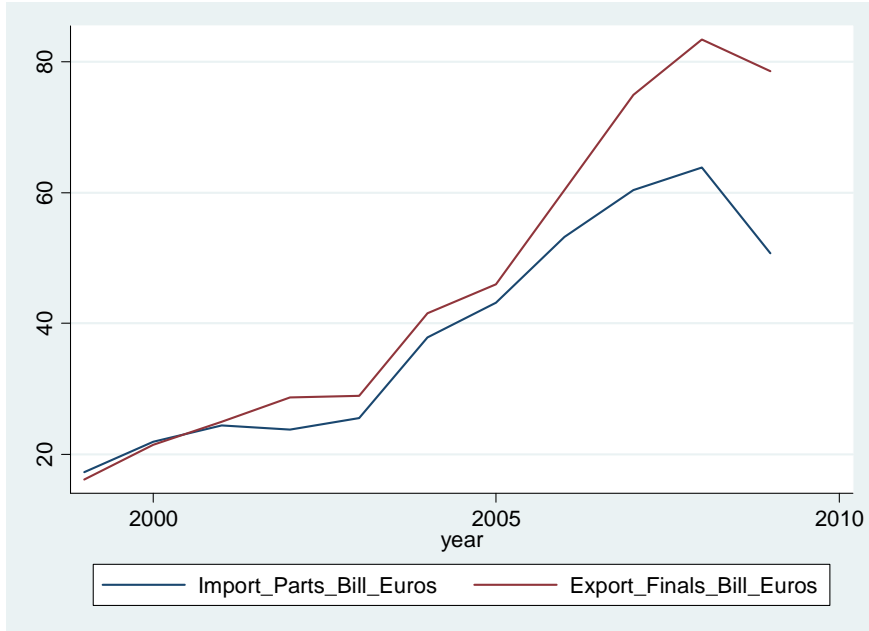


Share of M of intermediates on total exports (7, 8)



Appendix 4.B Exports of final goods and imports of intermediates for all CEECs: total values

To EU



To OECD non-EU

