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Article — Published Version

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Review of International Economics

Provided in Cooperation with:

John Wiley & Sons

Suggested Citation: Martínez-Zarzoso, Inmaculada; Voicu, Anca M.; Vidovic, Martina (2020) : Production networks in Europe: A natural experiment of the European Union enlargement to the east, Review of International Economics, ISSN 1467-9396, Wiley, Hoboken, NJ, Vol. 28, Iss. 5, pp. 1143-1163,
<https://doi.org/10.1111/roie.12484>

This Version is available at:

<https://hdl.handle.net/10419/230138>

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Production networks in Europe: A natural experiment of the European Union enlargement to the east

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Funding information

Ministry of Economy

Abstract

This paper focuses on the 2004 enlargement of the European Union to the East and treats it as a natural experiment to investigate two issues: first, whether there has been a trade creation effect in final and intermediate goods and second, to what extent this effect has been more pronounced for final or for intermediate goods. Using difference-in-differences analysis, we find that the effect of the 2004 EU enlargement has been positive for both intermediate and final goods trade, and it is in general greater for final goods. Using a generalized gravity model of trade that controls for the multilateral resistance and bilateral time-invariant factors, we estimate an increase in bilateral trade of 28% for final goods and 24% for intermediates. However, the effects are heterogeneous by sub-sector and indicate that the main trade gains were for non-durable consumer goods and food and beverages primary and processed products.

JEL CLASSIFICATION

F14

1 | INTRODUCTION

Proximity plays an important role for trade relations, in particular, when the products traded are intermediates that are used in several stages of the production process. In addition, the size of the market and relative factor endowments or economic behavior are equally influential

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(Egger, Pfaffermayr, & Schmidt, 2007). International trade in parts and components has intensified in the last decades as a result of increasing globalization and reducing trade costs. This development has been of special relevance in East Asia, starting in the 1990s, but also to some extent in Europe. Several authors investigated the importance of trade and production networks as a means of fostering economic growth and development in Asia (Kimura, Takahashi, & Hayakawa, 2007; Ng & Yeats, 2001) and in Europe (Egger & Egger, 2005; Feenstra, 1998). Other authors focused on the welfare effects of regionalism (Egger & Pfaffermayr, 2013; Frankel, Stein, & Wei, 1996; Krugman, 1991a, 1991b) and those of the European Agreements including an assessment of the trade effects, but without distinguishing between trade in final and intermediate goods (Caporale, Rault, Sova, & Sova, 2009; Egger & Larch, 2011; Spies & Marques, 2009). Spies and Marques' (2009) paper uses an augmented gravity model that rely on the inclusion of country pair fixed effects in order to avoid biases found in previous studies. The specification used by the authors leads to evidence that the free trade agreements (FTAs) with the Central Eastern European Countries (CEECs) have led to significant increases in intra-CEECs trade. Their results show that once the omitted variable bias was corrected, the FTAs with the CEECs resulted in 7% to 20% more new trade compared to the scenario that included only time-invariant country pair effects.

Since the second half of the 2000s a few attempts have been made to investigate whether, as in Asia in the 1990s, a similar pattern of emergence of production fragmentation has occurred on the European continent, and, in particular, following the accession of the CEECs into the European Union (EU) (Curran & Zignago, 2012; Kaminski & Ng, 2005; Kaplan, Kohl, & Martínez-Zarzoso, 2017; Martínez-Zarzoso, Voicu, & Vidovic, 2015; Zeddies, 2011; among others).

It is no surprise that Western and Eastern European countries are considered natural trading partners due to their proximity and historical ties. Indeed, the Europe Agreements in the early 1990s already established bilateral free trade between the EU and each individual CEECs in most industrial products (Egger & Egger, 2005). However, a number of artificial trade barriers, different from tariffs and non-tariff barriers still remained. Namely, behind-the-border trade barriers such as administrative burdens or differences in products standards that deter international trade to a non-negligible extent (Hornok, 2010; Wilson, Mann, & Otsuki, 2003, 2005). Since tariffs and non-tariff barriers were already eliminated in the 1990s, the accession¹ of eight² CEECs into the EU in 2004, of Romania and Bulgaria in 2007 and of Croatia in 2013 provides a quasi-natural experimental setting that can be used to investigate the importance of behind-the-border barriers across integrated markets (Hornok, 2010). In particular, this setting can be used to infer whether these barriers affect intermediates and final products differently. According to the theory of fragmentation (Jones, Kierzkowski, & Lurong, 2005) income and trade cost variables prove to be important in affecting the magnitude of trade in intermediates and final goods. Specifically, these variables are expected to have a stronger impact on trade in parts and components than on trade in final goods. In this study we use a difference-in-differences (DID) strategy and estimate a generalized gravity model of trade to investigate the effects that the accession of the CEECs into the EU had on bilateral trade of final and intermediate products.³ We also investigate whether our results support the abovementioned theory.

To our knowledge this is one of the first papers that show evidence of the effect of the 2004 EU enlargement for bilateral trade in intermediate and final products separately. We depart from Kaplan et al. (2017) in that we use different trade data. The data in our paper come from trade statistics and not from input-output tables (IO). Value added trade figures based on IO rely on technical coefficients that are only available for some years, hence some figures are interpolated. In addition, our data cover a more recent period and provide more time variability. We restrict the data to trade in manufactured goods and, hence, trade in services is not considered, given the heterogeneity of the services sector and the lack of data for some of the countries considered.

The main results indicate that, using DID analysis, the effect of the 2004 EU enlargement has been positive for both intermediate and final goods trade, being the effect more pronounced for final goods. Using the gravity model of trade that controls for the multilateral resistance and bilateral time-invariant factors, we estimate an increase in bilateral trade of 28% for final goods and 24% for intermediates. However, the effects are heterogeneous by sub-sector and indicate that the main trade gains were for non-durable consumer goods and food and beverages primary and processed products.

The rest of the paper is structured as follows. Section 2 discusses the related literature, while Section 3 outlines the empirical strategy. Section 4 discusses the main results, Section 5 illustrates the robustness of our findings and Section 6 concludes.

2 | EU ENLARGEMENT AND TRADE FRAGMENTATION

In the early 1990s, several researchers have shown that Eastern Europe had a strong trading potential and, have made a case for the European enlargement toward the East (Baldwin, 1994; Brenton & Gros, 1995; Hamilton & Winters, 1992; Wang & Winters, 1992). In addition to the political reason that motivated their research, the authors provided an economic rationale that led to further research. A common finding of these studies has been that East-West trade deviated significantly from what normal trade relations would predict based on the estimates of trade elasticity with respect to economic size as measured by the countries' gross domestic product (GDP) and geographic proximity as measured by the distance between trading partners. They further argued that the dismantling of central planning, the opening up of trade with Western Europe and the adoption of a market type economic system will lead to large increases in trade between the Eastern and Western parts of the European continent. More than a decade later, Egger et al. (2007) complemented earlier findings by explaining the real causes (e.g., trade elasticities, market size, relative factor endowments) of West-East, intra-East, and intra-West increases in bilateral trade through the different stages of transition. Their research is based on a substantial panel of European trade flows and suggests that East-West trade displays convergence in behavior to intra-West standards between the second and fourth stages of transition. No such convergence is observed for intra-East trade.

Although the Europe Agreements in the early 1990s liberalized trade between the EU members and the CEECs, the elimination of the remaining trade barriers following the 2004 EU enlargement to the East and the extension of the EU-wide customs union to the Central Eastern and Baltic states, further encouraged trade and investment flows between the new entrants and the incumbents for several reasons (Hornok, 2010). First, prior to their accession into the EU, Central Eastern and Baltic states liberalized trade among each other through regional agreements that involved different subsets of countries (Egger & Egger, 2005). Once they joined the EU, they adopted the EU's common external tariffs while the internal tariffs were reduced to zero. This may have allowed for further increases in trade between the old and the new EU members at the expense of trade with non-EU trade partners. Second, the accession of the CEECs into the EU led to an elimination of tariffs in the agri-food sector, an important industry for the CEECs that was previously subject to high tariffs, leading to even larger East-West trade integration. Third, the accession of the CEECs into the EU eliminated behind the border barriers leading to simplifications of customs procedures, technical regulations and harmonization of product standards that should allow for easier trade between incumbents and new entrants. Fourth, the reduction in trade costs associated with integration allowed for segmentation of production processes, better exploitation of comparative advantage and location allowing the CEECs to become more integrated into regional production networks (Kaminski & Ng, 2001; Martínez-Zarzoso, Voicu, & Vidovic, 2015). Finally, the recent literature indicates that deeper agreements have a greater positive

trade effects than shallow ones (Baier & Bergstrand, 2007; Baier, Bergstrand, & Clance, 2018; Baier, Yotov, & Zylkin, 2019; Dür, Baccini, & Elsig, 2014; Egger & Nigai, 2015). Baier et al., (2018) find -using total exports for a global sample of countries over almost five decades- that the effect of Customs Unions (CU) for total trade are more than twice the effect of FTA and that, whereas CU membership affects mainly the intensive margin of trade,⁴ FTA membership affects equally the intensive and extensive margins. Using a smaller sample of 52 countries, Baier et al. (2019) account and test for bilateral heterogeneity in the effect of economic integration agreements on trade flows and find considerable evidence that different pairs of countries are affected differently by the same agreement. Also the direction of trade matters, being the effects mostly asymmetric. The authors acknowledge that FTAs can have very different effects across industries, and suggest this as a new avenue for further research. None of the above works distinguish between effect on intermediate and final goods.

A few papers so far have examined the effect of the 2004 EU enlargement on trade. Being the EU a deep trade agreement that extends cooperation beyond trade issues, the extension of this cooperation to the East could have also helped to promote trade. Antimiani and Costantini (2013) use a dynamic gravity model to estimate the effect of EU enlargement on trade by focusing on the role of technological innovation. The authors find that the EU enlargement benefited more new EU members and mainly high-tech sectors than low-tech sectors. Similarly, Hornok (2010) treats the 2004 enlargement as a quasi-natural experiment, and using a difference in differences strategy, shows that the effect of integration is greater for the new EU members than for the old ones, and that the EU enlargement reduced the technological gap between the old and the new members, since trade of more technology-intensive industries grew fastest. Most recently, Kaplan et al. (2017) focus on the effect of accession of 10 CEECs into the EU on value-added trade. The authors find that EU enlargement has primarily caused Eastern entrants to become more integrated in value chains with other CEECs in both manufacturing and services. Although trade increased following the accession of the CEECs into the EU, the EU-15 countries increased value-added exports to Eastern entrants in manufacturing but not in services, while the Eastern entrants increased value added exports to the West in services but not in manufacturing.

According to Kaminski and Ng (2001), trade between East and West, prior to the CEECs accession into the EU, mainly consisted of final goods. In recent years, trade in parts has been the most rapidly growing component of international trade leading to cross-border supply chains and allowing companies to operate different stages of the production process in different countries.

Martínez-Zarzoso et al. (2015) examine the effect of accession of the CEECs into the EU in 2004 and 2007 on the trade in intermediate and final goods between the CEECs and the OECD countries and whether the increased exports of final goods from the CEECs to the OECD countries is due to increase in new intermediate products from the EU. The authors find that the EU enlargement increased trade in both parts and components and final goods between the old and the new members, while trade varieties increased only in intermediate products.

We build on the above-mentioned studies using the gravity equation and applying the difference in difference strategy to examine the effect of EU enlargement to the East on trade in final and intermediate goods separately.

3 | EMPIRICAL STRATEGY

In this section we present the two modeling frameworks used to estimate the effect of the accession into the EU on bilateral exports. First a DID strategy is presented and second the gravity model of trade is outlined.

The DID estimation strategy in this paper consists of calculating averages of bilateral trade before and after a given policy event occurs (e.g., EU enlargement) for a control group (countries not involved but similar) and a treatment group (countries joining the EU in 2004). We do this in order to examine whether the differences (in trade) are significant for the treatment group in comparison to the control group after the event. Therefore, we consider the 2004 EU enlargement as a natural experiment where the treatment group includes country pairs of EU15 countries that trade with any of the countries that gained accession in 2004, while the control group includes country pairs of EU15 countries that trade with a country that gained accession in 2007 or 2013. Using Bulgaria, Romania and Croatia as the control group is ideal because they have gone through the same transformation process as the 2004-accession countries but did not enter the EU in 2004. The only drawback is that the announcement of the accession of Bulgaria and Romania in 2004 could have also created some anticipatory trade effects, but this can only cause a downward bias in our estimates. As a robustness check, we estimate a model assuming an anticipation effect.

Moreover, as a second estimation framework we use the gravity model of trade, nowadays a well-established workhorse model of bilateral trade (Feenstra, 2004). According to the underlying theory that has been reformulated and extended by Anderson and van Wincoop (2003) and in line with Gylfason, Martínez-Zarzoso, and Wijkman (2015), the model used in this paper assumes constant elasticity of substitution and product differentiation by place of origin. In addition, prices differ among locations due to symmetric bilateral trade costs. The reduced form of the model is given by

$$X_{ijkt} = \frac{Y_{it} Y_{jt}}{Y_t^W} \left(\frac{t_{ijkt}}{P_{it} P_{jt}} \right)^{1-\sigma} \quad (1)$$

where X_{ijkt} are bilateral exports of product k from country i to country j in year t , and Y_{it} , Y_{jt} and Y_t^W are the GDPs in the exporting country, the importing country, and the world in year t , respectively. t_{ijkt} denotes trade cost between the exporter and the importer in year t for a given sector k and P_{it} and P_{jt} are the so-called multilateral resistance terms (MRTs) that account for relative trade costs with respect to the rest of the world. σ is the elasticity of substitution between all goods.

The empirical specification of the model in Equation (1) in log-linear form is given by

$$\ln X_{ijkt} = \ln Y_{it} + \ln Y_{jt} - \ln Y_t^W + (1-\sigma) \ln t_{ijkt} - (1-\sigma) \ln P_{it} - (1-\sigma) \ln P_{jt} \quad (2)$$

The estimation of Equation (2) requires some assumptions concerning trade costs and MRTs. The trade cost function is assumed to be a linear function of a number of trade barriers, namely the time invariant determinants of trade flows such as distance, common border, common language, whether a country is landlocked and time-varying EU variable. Based on the recent gravity literature the MRTs are modeled as the time-varying country-specific dummies.

Substituting the trade cost function into Equation (2) suggests estimating

$$\ln(X_{ijkt}) = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 \text{Landl}_i + \alpha_5 \text{Landl}_j + \alpha_6 \text{Border}_{ij} + \alpha_7 \text{EU}_{ikt} + u_{ijkt} \quad (3)$$

where D_{ij} denotes geographical distance from country i to country j ; Landl_i and Landl_j take the value of one when countries i or/and j are, respectively, landlocked, zero otherwise; Border_{ij} takes the value of one when the trading countries share a border, zero otherwise; and EU_{ikt} takes the value of one when the trading countries are members of the EU, zero otherwise. k denotes the sectoral dimension.

Baltagi, Egger, and Pfaffermayr (2003) suggested analyzing bilateral trade flows by estimating the gravity equation with a full set of interaction effects that control for all sorts of unobserved

heterogeneity.⁵ In this generalized gravity equation, the exporter-time and importer-time fixed effects will also absorb the size variables from the gravity model as well as all other observable and unobservable country-specific characteristics.

Following Baltagi et al. (2003) and Baier and Bergstrand (2007), in Equation (4) we introduce a set of country-time dummies, φ_{it} and τ_{jt} to control for the abovementioned MRTs. Hence, we are not able to estimate the coefficients of the income variables, the effects of which are subsumed into the dummies. Moreover, instead of adding the usual time-invariant gravity variables to control for differences in trade costs (distance, etc.), we use time-invariant bilateral fixed effects. And to control for global trends that are sector specific we added common time dummies that vary by sector. The equation is given by

$$\ln(X_{ijkt}) = \gamma_{ij} + \beta_1 EU_{ijkt} + \varphi_{it} + \tau_{jt} + \theta_{kt} + u_{ijkt}. \quad (4)$$

There is also a concern that the effect of trade agreements on trade flows is endogenous. Common characteristics among countries joining a FTA may contribute both to selection into the agreement as well as enhance trade flows in comparison to other trading partners. This can be particularly true for Eastern EU enlargement. As argued by Baier and Bergstrand (2007), country-pair fixed effects also mitigate the endogeneity of the EU effects.

Two remaining issues related to the estimation of gravity models of trade that may give rise to biased estimates are the presence of zero trade flows and the presence of heteroskedasticity in the error term. For those reasons, the gravity model has also been estimated using a Poisson Pseudo Maximum Likelihood (PPML) estimator.⁶ In this case, the dependent variable is introduced in levels and zero trade values are also taken into account. Another argument in favor of this approach is that according to Santos Silva and Tenreyro (2006) estimating the gravity model in its log-linear form rather than in levels can lead to very misleading conclusions in the presence of heteroskedasticity (which is especially likely in the case of sectoral trade data) as the log transformation affects the disturbances in the sense that the errors will be generally correlated with the covariates in the case of heteroskedasticity (Santos Silva & Tenreyro, 2006; Martínez-Zarzoso and Márquez-Ramos, 1998). The PPML estimator overcomes this challenge as it does not assume homoskedasticity and is thus valid with general forms of heteroskedasticity. In line with these developments, the specification for the generalized gravity model is as follows:

$$X_{ijkt} = \text{Exp} [\gamma_{ij} + \beta_1 EU_{ijkt} + \varphi_{it} + \tau_{jt} + \theta_{kt}] * \varepsilon_{ijkt} \quad (5)$$

where the variables have been described below Equation (3). The Model has been estimated separately for final and for intermediate goods and the main results are presented in the next section.

4 | MAIN RESULTS

We first estimate Equation (3) for bilateral exports using 28 EU countries (11 CEECs + Malta and Cyprus + EU15 countries, see Table 1 in Appendix A for a list of countries) over the period 1995 to 2015. The information on disaggregated exports at the 2–3 digit-level BEC⁷ is from the OECD database, the GDP data are from the World Development Indicators database, and the distance and the other gravity variables are drawn from CEPII.⁸

The main results are presented in Table 1. The first four columns show the results for exports of final products from the CEECs to the EU countries and the last four columns show the results for exports of intermediate products from the CEECs to the EU countries. Columns 1, 3, 5, and 7 in Table 1

TABLE 1 Impact of EU enlargement on trade in final and intermediate goods: DID estimation

Dep. var.	Exports of final goods			Exports of intermediate goods				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	1995–2006			1995–2012				
Ind. variables								
Period	0.470*** [0.0719]	0.0891 [0.0766]	0.845*** [0.0552]	−0.00985 [0.0533]	0.598*** [0.0828]	0.162*** [0.0570]	0.986*** [0.0522]	0.0484 [0.0644]
CEECSi	1.232*** [0.0440]	0.336*** [0.0451]	1.232*** [0.0499]	0.279*** [0.0510]	1.272*** [0.0496]	0.634*** [0.0401]	1.272*** [0.0606]	0.638*** [0.0365]
Diff	0.289*** [0.101]	0.377*** [0.0779]	0.292*** [0.0677]	0.458*** [0.0578]	0.132 [0.108]	0.166*** [0.0623]	0.111 [0.0766]	0.216*** [0.0495]
$Ln Y_{it}$		0.995*** [0.0122]		1.096*** [0.0108]		1.043*** [0.0139]		1.074*** [0.0114]
$Ln Y_{jt}$		0.804*** [0.0114]		0.810*** [0.00638]		0.857*** [0.00981]		0.873*** [0.00865]
$Ln D_{ij}$		−1.319*** [0.0292]		−1.397*** [0.0244]		−1.555*** [0.0330]		−1.610*** [0.0264]
$Landl_i$		−0.0788 [0.0392]		−0.152*** [0.0217]		−0.0490 [0.0305]		−0.0963*** [0.0317]
$Landl_j$		−0.675*** [0.0476]		−0.631*** [0.0310]		−0.573*** [0.0407]		−0.490*** [0.0337]
$Border_{ij}$		1.120*** [0.0457]		1.072*** [0.0415]		1.200*** [0.0537]		1.216*** [0.0426]
Year		−0.0274*** [0.00794]		−0.00816 [0.00503]		−0.0229*** [0.00668]		0.00210 [0.00455]

(Continues)

TABLE 1 (Continued)

Exports of final goods				Exports of intermediate goods				
Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	1995–2006			1995–2012	1995–2006			1995–2012
Constant	5.546*** [0.0387]	47.44*** [15.90]	5.546*** [0.0393]	8.412 [9.960]	5.985*** [0.0421]	39.70*** [13.42]	5.985*** [0.0452]	−10.33 [9.068]
Observations	20,602	20,602	32,215	32,215	23,244	23,244	36,219	36,219
R ²	0.051	0.505	0.072	0.548	0.043	0.594	0.057	0.602

Notes: Period is a dummy that takes the value of one after accession of the CEECs in 2004. CEEC8 takes the value of one for the 8 CEECs that access the EU in 2004. The control group is represented by Rumania and Bulgaria in columns 1,2, 5 and 6; Croatia is added in the other columns. Diff denotes the effect of accession on the *treated*, the CEECs accessing the EU in 2004. The dependent variable is disaggregated bilateral exports at current prices; $\ln Y_{it}$ and $\ln Y_{jt}$ are exporters' and importers' GDPs, respectively; $\ln D_{ijt}$ is geographical distance, $Land_{ijt}$ is a dummy that takes the value of one if country $i(j)$ is landlocked. $Border_{ijt}$ is a dummy that takes the value of one when countries share a border. $Year$ is a time trend. Robust standard errors are reported in brackets. Sectoral fixed effects are included in the models with covariates; the coefficients are not shown to save space.

* $p < .05$; ** $p < .01$; *** $p < .001$.

present the result of performing a DID analysis with the treatment dummy—accession in 2004—as the only explanatory variable in Equation (3), while columns 2, 4, 6, and 8 show the results with the additional covariates. In columns 1, 2, 5, and 6 only Romania and Bulgaria are included in the control group. In columns 3, 4, 7, and 8, Croatia is added to the control group.

The estimated coefficient on the DID estimator (*Diff*) should be interpreted as the difference in means for the treatment group with respect to the control group. Considering the exports of final goods (columns 1–4), the coefficient on the *Diff* variable indicates that the average bilateral exports from any 2004's accession country to any EU—country are around 33% ($e^{0.289}-1$) higher than the average bilateral exports of final goods between any 2004's accession country and any EU15 country (column 1). Since our control and treatment groups could not be randomly selected, we add the usual gravity-covariates, namely incomes, distance, landlocked, common border dummies, sectoral fixed effects, and a time trend in column 2. The *Diff* coefficient increases from 0.289 to 0.377 and the explanatory power of the model, as expected, increases considerably (from 5% to 50% as measured by the R^2). Finally, the results in columns 3 and 4 that include Croatia in the control group show a similar effect. The coefficient on the *Diff* variable is statistically significant at the 1% level and the results in column 4 show that the accession of CEECs in 2004 led to an increase in bilateral exports of final goods by 58% ($e^{0.458}-1$, column 4).

When we consider exports of intermediate goods from CEECs to the EU, the accession effect is smaller than for final goods, and only statistically significant in the models including a full set of gravity covariates and controls (columns 6 and 8 without and with Croatia in the control group, respectively). The magnitude of the effect is about 18 (24)% increase in exports of intermediate goods.

In Table 2 we estimate four versions of the gravity model of trade. The traditional specification for final goods is shown in Column 1. In column 2 we add time invariant exporter and importer fixed effects. Column 3 includes instead bilateral fixed effects and finally in column 4, we control for the so-called MRTs by adding country-and-time fixed effects in addition to the bilateral (country-pair) fixed effects. Again, the first four columns show the results for exports of final products from the CEECs to the EU countries and the last four columns show the results for exports of intermediate products from the CEECs to the EU countries. The coefficient on the EU dummy for the preferred specification (column 4) for final goods shows a trade increase of around 28% ($e^{0.249}-1$) after controlling for multilateral resistance.

With respect to trade in intermediate goods, columns 5–8 present estimates comparable to those for trade in final goods obtained in columns 1–4 with respect to the sign and statistical significance of gravity variables. However, we observe that the estimates of the accession effect are always lower for intermediates. Indeed, the coefficient on the EU dummy in the preferred specification (column 8) shows a 24% ($e^{0.214}-1$) increase in trade of intermediate goods for the treatment group when we control for the MRTs.

Contrary to the theoretical predictions, the results indicate that the accession effect is lower for intermediates than for final goods. Considering that the accession has reduced the behind-the-border barriers to trade, our results indicate that a reduction in these barriers made trade in final goods less difficult than trade in intermediates. It is worth mentioning that the distance and border estimated elasticities are higher in magnitude for intermediate than for final goods, according to the results in columns 1 and 5. Therefore, after controlling for bilateral time-invariant factors, that is, those related to geographical and cultural characteristics, deeper economic integration seems to facilitate more trade in final goods.

5 | ROBUSTNESS

A number of studies have found that trade flows have increased for countries joining a FTA before the actual enforcement of the agreement took place confirming the existence of anticipatory trade effects

TABLE 2 Impact of EU enlargement on trade in final and intermediate goods: Gravity model with multilateral resistance terms

Exports of final goods				Exports of intermediate goods				
Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ind. vsar.	Traditional	O-D FE	Pair FE	MRT	Traditional	O-D FE	Pair FE	MRT
EU_{ijt}	0.976*** [0.0188]	0.611*** [0.0208]	0.402*** [0.0308]	0.249*** [0.0674]	0.746*** [0.0191]	0.446*** [0.0217]	0.319*** [0.0293]	0.214*** [0.0642]
$Ln Y_{it}$	1.238*** [0.00502]	0.985*** [0.0683]	1.437*** [0.102]		1.155*** [0.00519]	1.166*** [0.0688]	1.533*** [0.0946]	
$Ln Y_{jt}$	0.788*** [0.00452]	1.012*** [0.0658]	1.357*** [0.103]		0.871*** [0.00473]	0.980*** [0.0683]	1.302*** [0.0943]	
$Ln D_{ij}$	-1.391*** [0.0145]	-1.569*** [0.0177]			-1.696*** [0.0153]	-1.710*** [0.0186]		
$Landl_i$	-0.275*** [0.0166]				-0.208*** [0.0178]			
$Landl_j$	-0.904*** [0.0176]				-0.781*** [0.0187]			
$Border_{ij}$	0.876*** [0.0230]	0.751*** [0.0242]			1.031*** [0.0257]	1.059*** [0.0262]		
Observations	85,286	85,286	85,286	85,286	97,922	97,922	97,922	97,922
R^2	0.684	0.784	0.282	0.353	0.675	0.770	0.217	0.259
Number of id			4,529	4,529			5,530	5,530

Notes: The dependent variable is disaggregated bilateral exports at current prices; EU takes the value of one when countries i and j are EU members; $\ln Y_{it}$ and $\ln Y_{jt}$ are exporters' and importers' GDPs, respectively; $\ln D_{ij}$ is geographical distance, $Landl_i$ ($Landl_j$) is a dummy that take the value of one if country i (j) is landlocked. $Border_{ij}$ is a dummy that takes the value of one when countries share a border. Robust standard errors are reported in brackets. O-D denotes origin and destination fixed effects (FE). MTR denotes multilateral resistance terms modeled with origin-and-time and destination-and-time fixed effects. Sectoral fixed effects that vary over time are included in all models. Coefficients of FE not reported.

* $p < .05$; ** $p < .01$; *** $p < .001$.

for accession countries (see e.g., Coulibaly, 2007; Lakatos & Nilsson, 2017; Magee, 2008; Mölders & Volz, 2011).

In order to test whether the positive effects on trade flows following the accession of CEECs into the EU that we found in Table 1 were due to anticipation of the EU enlargement, we estimate the empirical model assuming that the increase in trade started to take place in 2002. That is, we recode the period dummy to indicate that the EU enlargement took place in 2002 or 2003. The results in Table 3

TABLE 3 Impact of EU enlargement on trade in final and intermediate goods: Anticipation effect

Dep. var.	Exports of final goods		Exports of intermediate goods	
	(1)	(2)	(3)	(4)
Ind. var.	2002_DID	2002_DID	2002_DID	2002_DID
Antic	0.0241 [0.0828]	−0.0718 [0.0659]	0.0404 [0.0810]	−0.127** [0.0582]
CEE8i	1.291*** [0.0462]	0.453*** [0.0437]	1.287*** [0.0482]	0.681*** [0.0282]
Diff	0.0597 [0.105]	−0.0190 [0.0803]	0.0444 [0.114]	0.0182 [0.0738]
$\ln Y_{it}$		0.998*** [0.0120]		1.046*** [0.0136]
$\ln Y_{jt}$		0.804*** [0.00924]		0.858*** [0.00833]
$\ln D_{ij}$		−1.316*** [0.0349]		−1.554*** [0.0371]
$Landl_i$		−0.0928*** [0.0265]		−0.0566* [0.0315]
$Landl_j$		−0.674*** [0.0364]		−0.573*** [0.0373]
$Border_{ij}$		1.123*** [0.0493]		1.201*** [0.0547]
Year		0.00709* [0.00372]		0.00666 [0.00459]
Constant	5.677*** [0.0406]	−21.63*** [7.333]	6.147*** [0.0328]	−25.90*** [9.103]
Observations	20,602	20,602	23,244	23,244
R^2	0.042	0.503	0.035	0.594

Notes: *Antic* is a dummy that takes the value of one in 2002 and 2003, two years before the accession of the CEECs countries in 2004. *CEE8* takes the value of one for the 8 CEECs that access the EU in 2004. The control group is represented by Rumania and Bulgaria. *Diff* denotes the *anticipation* effect of accession on the *treated*, the CEECs accessing the EU in 2004. The dependent variable is disaggregated bilateral exports at current prices; $\ln Y_{it}$ and $\ln Y_{jt}$ are exporters' and importers' GDPs, respectively; $\ln D_{ij}$ is geographical distance, $Landl_i$ ($Landl_j$) is a dummy that take the value of one if country i (j) is landlocked. $Border_{ij}$ is a dummy that takes the value of one when countries share a border. *Year* is a time trend. Robust standard errors are reported in brackets. Sectoral fixed effects are included in the models with covariates; the coefficients are not shown to save space.

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 4 Impact of EU enlargement on trade in final and intermediate goods: Results for specific sectors with log-log model

Final goods exports								
Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)		
BEC code	61	62	63	112	122	522		
EU	−0.122 [0.146]	−0.705*** [0.122]	0.393*** [0.139]	0.783*** [0.181]	0.728*** [0.123]	0.448*** [0.170]		
Observations	14,410	15,359	14,946	13,192	15,193	12,186		
R ²	0.427	0.523	0.429	0.432	0.531	0.462		
Number of id	755	761	761	750	760	742		
Intermediate goods exports								
Dep. var.	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
BEC code	21	22	31	42	53	111	121	322
EU	−0.133 [0.161]	0.143 [0.0878]	−0.690** [0.318]	0.642*** [0.119]	0.459*** [0.121]	0.570*** [0.186]	0.138 [0.174]	−2.312*** [0.870]
Observations	13,269	15,607	9,478	15,268	15,332	13,058	13,435	2,475
R ²	0.273	0.613	0.288	0.507	0.567	0.304	0.331	0.609
Number of id	742	762	658	761	761	754	746	346

Notes: The dependent variable is disaggregated bilateral exports at current prices; EU takes the value of one when countries *i* and *j* are EU members. See Table A3 for a description of the BEC product codes.

p* < .05; *p* < .01; ****p* < .001.

TABLE 5 Impact of EU enlargement on trade in final and intermediate goods: Results for specific sectors. Gravity model estimated with PPML

Final goods exports								
Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)		
BEC Code:	61	62	63	112	122	522		
EU	0.0560 [0.118]	−0.831*** [0.137]	0.685*** [0.120]	0.564*** [0.182]	0.577*** [0.0977]	0.254 [0.199]		
Observations	14,410	15,359	14,946	13,192	15,193	12,186		
R ²	0.984	0.987	0.974	0.960	0.987	0.959		
Intermediate goods exports								
Dep. var.	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
BEC Code:	21	22	31	42	53	111	121	322
EU	−0.223 [0.181]	0.0628 [0.0743]	−0.293 [0.268]	0.387** [0.193]	−0.166 [0.175]	1.019*** [0.134]	−0.238* [0.143]	−1.954*** [0.555]
Observations	13,269	15,607	9,478	15,268	15,332	13,058	13,435	2,475
R ²	0.887	0.996	0.979	0.986	0.992	0.974	0.983	0.984

Notes: The dependent variable is disaggregated bilateral exports at current prices; EU takes the value of one when countries *i* and *j* are EU members. All the estimations done with the Stata command: *ppml_panel_sg*. See Table A.3 for a description of the BEC product codes. Multi-dimensional FE not reported (origin-and-time, destination-and-time, origin-destination)

p* < .05; *p* < .01; ****p* < .001.

show that there was no anticipation effect for exports of final goods nor for imports of intermediates. The coefficient on Diff is statistically insignificant in all models.

Next, we estimated the gravity model separately for each sector at 2 and 3 digit level BEC to see if the effects vary across sectors and if there is an aggregation effect. The results of the gravity model with MRTs are shown in Tables 4 and 5. The results in Table 4 are obtained using a log-log model while the estimates in Table 5 are obtained via PPML Estimator that accounts for zero values of the dependent variable and heteroskedasticity.

According to the estimated coefficients in Table 5 there is a positive EU effect for sectors 63, 112 and 122, within the final goods and for sectors 42 and 111, within the categories belonging to intermediate goods.

We further estimate the generalized gravity model separately for exports to and imports from the EU15. The results in Table 6 indicate that the enlargement effect is only statistically significant for exports of final goods to the EU15, whereas it is not possible to identify an effect for the corresponding exports of intermediate goods, nor for imports from the EU15.

Finally, we estimated the effect of the EU enlargement on exports of final and intermediate goods for the three countries that accessed the EU in 1995, that is, Austria, Finland, and Sweden using a similar difference in differences strategy as the one used in Table 1. We considered two samples periods: one from 1990 to 2000 and the other from 1990 to 2004. The control group in this case comprises the exports of the EU-12 countries. The results, shown in Table A4 in the Appendix A, indicate that exports of final goods of these three countries to the EU-28 were significantly higher after 1995 in all four specifications (with and without covariates and for both periods). According to the results in column (2), exports of final goods were 27% higher for the new EU countries in the 5 years after accession in comparison with the 5 years before and discounting the change in export of similar countries (EU-12) that did not experience any change in 1995. The change increases to 34% when the sample is extended until 2004 (see column 4). For intermediate goods instead, which results are shown in columns (5) to (8) of the same table, we find that accession effects on exports are smaller in magnitude and are found in three out of four cases, that is, when the sample period extends until 2000 (with and without covariates, in columns (5) and (6)) and when the sample period extends until 2004, but only without covariates (column 7). This indicates that the effects of EU enlargement on exports of intermediate goods disappear 5 years after accession. These results differ from what we found in case of the Eastern EU enlargement.

TABLE 6 Results for exports to and from the EU-15

	(1)	(2)	(3)	(4)
	F_to EU15	I_to EU15	F_from EU15	I_from EU15
EU	0.574*** [0.191]	0.214 [0.174]	0.150 [0.215]	−0.104 [0.133]
Observations	57,739	66,523	59,398	69,114
R ²	0.983	0.995	0.983	0.995

Notes: The dependent variable is disaggregated bilateral exports at current prices; EU takes the value of one when countries *i* and *j* are EU members. All the estimations done with the Stata command: *ppml_panel_sg*. F denotes Final goods and I intermediate goods. Multi-dimensional FE not reported (origin-sector-time, destination-sector-time, origin-destination).

p* < .05; *p* < .01; ****p* < .001.

6 | CONCLUSIONS

This paper uses a DID strategy and a generalized gravity model to investigate the effect of accession of the CEECs into the EU on bilateral exports of final goods and imports of intermediate products. We find evidence that there are positive trade effects of the 2004 EU enlargement toward the east. These are materialized in a trade creation effect in exports of both intermediate and final goods. Furthermore, the DID results indicate that when similar countries are taken as the control group, the accession effect is more pronounced in final than in intermediate goods trade (45–58% trade creation effect in final goods vs. 18–24% in intermediate goods) and increases after some years for both type of goods. When using the generalized gravity model to control for multilateral resistance and bilateral time-invariant factors, we find that the estimated trade creation effect has been slightly higher in final goods (28%) than in intermediate goods (24%). Several explanations support our findings as follows.

The CEECs accession to the EU's internal market resulted in a trade creation effect in general, for at least three main reasons. First, there has been a number of administrative barriers to trade that have been eliminated following CEECs accession into the EU. These reflect the reduced costs of passing customs at the frontier resulting in less time delays, less formalities, leading to an overall simplification of customs procedures in intra-EU trade. The second is the reduction in technical barriers to trade. The Single Market is proven to reduce these technical barriers through mutual recognition of different technical regulations, minimum requirements and harmonization of rules and regulations.⁹ Last, but not least, come the reduced risk and uncertainty (e.g., the possibility of agents defaulting in the link between producers and consumers) as well as the lower political risk associated with EU membership (e.g., CEECs democracies are thought to be more stable hence benefiting from more credibility from their western counterpart following accession into the EU).

The reason why the trade creation effect has been more pronounced in trade in final goods as opposed to trade in intermediate products, at least in the initial years (2004–2006) could be that the CEECs trade before 1989 has traditionally consisted of final products. While trade liberalization in the 1990s has significantly changed that pattern while creating an environment and the conditions for trade in intermediate products to develop, trade in final goods however, has remained predominant to this day. In addition, it should be noted that geographic proximity and sea access play an important role in determining trade in intermediate goods and their absence affects trade to a higher extent than in the case of final goods. We expect that the reduction in trade costs and the integration process itself will further foster the fragmentation of production processes while leading to a better exploitation of comparative advantages and location. The complete integration of the CEECs into the EU will continue to stimulate not only the exploitation of comparative advantages but also the production of new goods that was previously not supported by the command economy system.

ACKNOWLEDGMENTS

The author acknowledges the support and collaboration of Project ECO2017-83255-C3-3-P financed by the Spanish Ministry of Economy, Industry and Competition (AEI, FEDER, EU) and from project UJI-B2017-33. We also would like to thank Peter Egger and the anonymous referee for their helpful comments and the participants in the INFER Annual Conference held at the University of Goettingen for their suggestions, which have been incorporated into the paper.

ENDNOTES

¹ The accession also implied that all the new members have to adopt the EU common external tariff for trade flows with third countries.

- ² The eight CEECs that were granted accession into the EU in 2004 are the following: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia.
- ³ Hornok (2010) uses a similar analysis but does not distinguish between final and intermediates.
- ⁴ The intensive margin measures the average exports per product of the already exported goods and the extensive margin measures exports in products that were not exported before.
- ⁵ That is, origin-time, destination-time and pair FE. Although the authors did not call this specification structural gravity model, the trade elasticities and, more generally, the parameters on country-pair-time trade-cost variables of some structural gravity models could be estimated consistently with such a model. However, in a Melitz model with country-pair-specific exporting fixed costs (as in Helpman, Melitz, & Rubinstein, 2008), the three types of fixed effects in Baltagi et al. (2003) would not guarantee consistent parameter estimation on trade-cost variables, because these variables would be correlated with the country-pair-time-specific average productivity of firms, the latter being endogenous. We thank the referee and the editor for pointing this out.
- ⁶ For the implementation of this estimation method, the newly available Stata command `ppml_panel_sg` (Zylkin, 2016), also used in Larch, Wanner, Yotov, and Zylkin (2017) was employed.
- ⁷ BEC = Broad Economic Categories.
- ⁸ Tables A1 and A2 in the Appendix A show the list of countries and the definition of the variables and Table A3 shows the classification of products into final and intermediates.
- ⁹ A detailed discussion of the above as well as their effect on trade is provided by Brenton et al. (2001).

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How to cite this article: Martínez-Zarzoso I, Voicu AM, Vidovic M. Production networks in Europe: A natural experiment of the European Union enlargement to the east. *Rev Int Econ*. 2020;28:1143–1163. <https://doi.org/10.1111/roie.12484>

APPENDIX A

TABLE A1 List of countries in the dataset

Abbreviation	Economic area	Members
EU	European union	EU15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom Accession in 1995: Austria, Finland and Sweden Accession in 2004: Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Slovakia, Slovenia, Cyprus and Malta Accession in 2007: Bulgaria, Romania Accession in 2013: Croatia
CEECs	Central and Eastern European Countries and the Baltic Countries	Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia

TABLE A2 Definitions of variables

Variable	Definition
Reporter	EU–28 countries
Partner	EU–28 countries
X_{ijk}	Disaggregated exports of final and/or intermediate products from CEECs to EU countries
Y_i	GDP of reporter country i
Y_j	GDP 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, and "0" otherwise
CEEC8	Binary variable that takes the value "1" if reporter and partner countries belong to CEECs and "0" otherwise
EU95	Binary variable that takes the value "1" for countries that access EU in 1995 and "0" otherwise
PERIOD	Binary variable that takes the value "1" in 2004 and onwards and "0" otherwise
EU	Binary variable that takes the value "1" if both countries are members of EU and "0" otherwise

TABLE A3 Classification by broad economic categories (BEC)

<i>1—Food and beverages</i>
11—Primary (I) (111: Mainly for industry, 112: Mainly for household consumption)
12—Processed (F) (121: Mainly for industry, 122: Mainly for household consumption)
<i>2—Industrial supplies not elsewhere specified</i>
21—Primary (I)
22—Processed (F)
<i>3—Fuels and lubricants</i>
31—Primary (I)
32—Processed (I)
<i>4—Capital goods (except transport equipment), and parts and accessories thereof</i>
41—Capital goods (except transport equipment) (C)
42—Parts and accessories (I)
<i>5—Transport equipment and parts and accessories thereof</i>
51—Passenger motor cars (NC)
52—Other (F) (521: Industrial, 522: Non-industrial)
53—Parts and accessories (I)
<i>6—Consumer goods not elsewhere specified</i>
61—Durable (F)
62—Semi-durable (F)
63—Non-durable (F)
<i>7—Goods not elsewhere specified (NC)</i>

Source: United Nations Statistics Division (2017), Manual of the Fifth Revision of the BEC, p. 8. <https://unstats.un.org/unsd/trade/classifications/>. (I) denotes intermediate, (F) final, (C) capital goods and (NC) not classified goods.

TABLE A4 Impact of EU accessions in 1995 on trade in final and intermediate goods: DID estimation

Exports of Final Goods				Exports of Intermediate Goods				
Dep. variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	1990–2000			1990–2004				
Ind. variables								
Period	–0.0994** [0.0499]	–0.134* [0.0718]	–0.128*** [0.0334]	–0.129** [0.0529]	–0.0858** [0.0431]	–0.0472 [0.0674]	–0.0536 [0.0496]	–0.0699 [0.0579]
EU95	–1.379*** [0.0756]	–0.585*** [0.0690]	–1.379*** [0.0707]	–0.508*** [0.0577]	–0.645*** [0.0876]	0.180** [0.0839]	–0.645*** [0.0859]	0.192** [0.0871]
Diff	0.753*** [0.0918]	0.243*** [0.0849]	0.916*** [0.0882]	0.296*** [0.0619]	0.599*** [0.114]	0.220** [0.0931]	0.564*** [0.105]	0.0686 [0.104]
$Ln Y_{it}$		1.083*** [0.0131]		1.154*** [0.00805]		1.005*** [0.0118]		1.036*** [0.0127]
$Ln Y_{jt}$		0.882*** [0.0102]		0.880*** [0.00802]		0.847*** [0.00994]		0.839*** [0.00988]
$Ln D_{ij}$		–1.038*** [0.0350]		–1.024*** [0.0233]		–1.223*** [0.0354]		–1.235*** [0.0283]
$Landl_i$		–0.234*** [0.0773]		–0.300*** [0.0513]		–0.689*** [0.113]		–0.517*** [0.0660]
$Landl_j$		–0.959*** [0.0392]		–0.896*** [0.0306]		–0.976*** [0.0446]		–0.879*** [0.0379]
$Border_{ij}$		0.929*** [0.0482]		0.946*** [0.0449]		0.875*** [0.0575]		0.840*** [0.0551]
Year		–0.0600*** [0.0107]		–0.0641*** [0.00593]		–0.0655*** [0.0117]		–0.0586*** [0.00596]

(Continues)

TABLE A 4 (Continued)

Exports of Final Goods				Exports of Intermediate Goods				
Dep. variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	1990–2000		1990–2004		1990–2000		1990–2004	
Constant	8.233*** [0.0362]	111.8*** [21.32]	8.233*** [0.0299]	118.9*** [11.84]	8.326*** [0.0301]	125.3*** [23.31]	8.326*** [0.0419]	111.4*** [11.76]
Observations	24,343	20,756	36,031	32,444	27,444	23,668	40,676	36,900
R ²	0.013	0.537	0.008	0.545	0.002	0.406	0.001	0.402

Notes: The dependent variable is disaggregated bilateral exports at current prices; *EU95* takes the value of one for the 3 countries that access the EU in 1995. *Diff* denotes the effect of accession on the treated, the three countries accessing the EU in 1995. *ln Y_{it}* and *ln Y_{it}* are exporters' and importers' GDPs, respectively; *ln D_{ij}* is geographical distance, *Landl_i* (*Landl_j*) is a dummy that take the value of one if country *i* (*j*) is landlocked. *Border_{ij}* is a dummy that takes the value of one when countries share a border. *Year* is a time trend. Sectoral fixed effects also included, coefficients not reported to save space. Robust standard errors are reported in brackets.

p* < .05; *p* < .01; ****p* < .001.