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ORIGINAL ARTICLE

# Supply-chain trade and labor market outcomes: The case of the 2004 European Union enlargement<sup>†</sup>

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Email: lennart.kaplan@wiwi.uni-goettingen.de**Abstract**

The structure of international trade is increasingly characterized by fragmentation of production processes and trade policy. Yet, how trade policy affects supply-chain trade is largely unexplored territory. This paper shows how the accession of 10 Central and Eastern European Countries (CEECs) to the European Union affected European supply-chain trade. We find that accession primarily fostered CEECs' integration in global value chains of other entrants. Smaller integration benefits stem for East–West trade in services for lower-skill activities. These increases in value-added exports translate into sizeable job creation.

## 1 | INTRODUCTION

International fragmentation of production processes is changing the nature of international trade. Well-known case studies on the consumer electronics and the automobile industries illustrate that countries and industries are interconnected through global value chains (GVCs), in which every country contributes specialized (intermediate) goods and services (Dudenhöffer, 2005; Baldwin, 2006; Dedrick, Kraemer, & Linden, 2010). Several novel datasets on trade in value added enable research in international trade policy to move beyond conventional gross trade statistics (see, e.g., Johnson & Noguera, 2012a; Koopman, Wang, & Wei, 2014; Timmer, Dietzenbacher, Los, Stehrer, & De Vries, 2015).

By now, a large literature deals with the question how trade liberalization and the associated decrease in trade costs affects a country's exports, which ultimately refers to the demand for goods from this country (see, e.g., Baier, Bergstrand, & Feng, 2014; Head and Mayer, 2014; Kohl, 2014; Maggi, 2014). These studies typically employ a gravity equation to determine the impact of trade agreements on gross trade flows. However, such studies do not account for the problem of double counting in gross trade statistics, that is, when the value of German intermediate inputs used in Polish exports is ascribed to Poland, thereby overstating the latter's economic contribution. The purpose of this paper, therefore, is to shed light on how trade agreements shape their members' value-added trade.

<sup>†</sup> Earlier drafts of this paper were titled "The Effects of the CEECs' Accession on Sectoral Trade: Value Added Perspective."

Our central question is how reductions in trade costs influence a country's value-added exports (VAX)—which embody demand for the exporter's factors of production such as capital and labor throughout GVCs—and, in turn, how this translates into higher relative demand for the production factors used intensively in production.

We will apply this framework to the case of the 2004 EU enlargement, which involved intensive political debates about labor market impacts. Especially incumbents' manufacturing workers feared competition from the new members' low-skilled workforce.<sup>1</sup>

Hence, the main aim of this paper is threefold. First, to quantify and compare the effects of the 2004 EU enlargement on gross and value-added exports. Second, to investigate how the demand for production factors has changed as a result of this enlargement. Third, to analyze how these changes translate into employment effects.

Our paper is related to Noguera (2012a), who estimated the effect of trade agreements on trade in value added. However, we depart from his paper in two respects. We (i) focus on a specific agreement and (ii) more importantly, disentangle the mechanisms linking European integration with changes in members' production structures and labor market outcomes. To our knowledge, this is the first paper that estimates the effects of the EU enlargement on trade in value added and on the embodied demand of production factors.

In this spirit, the paper aims to determine how the European integration process has shaped economic fragmentation in Europe's GVCs.<sup>2</sup> The case of the CEECs' accession to the EU is highly relevant when considering supply-chain trade and trade policy, as increasingly more countries seek to form deep, comprehensive trade agreements with trade partners immediately relevant for their supply chains (e.g., Pacific Alliance, Transpacific Partnership, and Transatlantic Trade and Investment Partnership).

Our empirical strategy is to apply Baier and Bergstrand's (2007) version of the gravity equation—which accounts for both endogenous trade policy and phase-in effects over a 5-year period—to the time-series data of the World Input–Output Dataset (WIOD) on trade in value added for 40 countries and a Rest-of-the-World residual in the period 1995–2009 (Timmer et al., 2015).

We find that EU enlargement has primarily caused Eastern entrants to become more integrated in value chains with other CEECs both in manufacturing and services. In the case of EU15 countries, value-added exports to Eastern entrants increased in manufacturing, but not in services. In contrast, EU enlargement strengthened the entrants' value-added exports to the West in services, but not in manufacturing. These exports in services are to a large extent linked to low-skilled services, suggesting that enlargement has led to a decrease in labor-skill intensity of entrants' service exports to the incumbents. Later, we also apply the same framework to estimate how these integration processes translate into the creation of jobs. Our results indicate that 2004's accession led to a sizeable increase in jobs for entrants, while incumbents faced neutral to positive labor market effects.

The remainder of this paper is structured as follows. Section 2 reviews the literature on economic integration and economic fragmentation. The data and methodology are subsequently presented in Section 3. Our main results are presented in Section 4 and sensitivity analyses in Section 5. Section 6 discusses our findings and concludes.

## 2 | LITERATURE

### 2.1 | International fragmentation

Widespread industrialization and declining trade costs have given rise to an increase of trade in intermediate goods (Jones & Kierzkowski, 1990; Krugman & Venables, 1995; Feenstra and Hanson,

1996). As Baldwin (2006) and Grossman and Rossi-Hansberg (2006) explain, internationally traded goods and services have become “unbundled” into internationally tradable jobs, tasks, and skills. As a result, this phenomenon of economic fragmentation has caused the domestic value-added share in gross exports to drop by 10 to 15 percentage points between 1970 and 2008 (Johnson, 2014).

Case studies on specific export goods described the partly surprising division between gross trade and trade in value added. Influential examples are Dedrick et al.’s (2010) study on portable devices and Dudenhöffer’s (2005) on the Porsche Cayenne. These studies shed light on the different shares of value added that were captured by firms and nations. However, only specific tradable goods at one point in time were investigated, making it impossible to draw in-depth conclusions about the nature of economic fragmentation, its sectoral and factorial contributions and international trade policy. Yet, such data on the factor content of trade (e.g., capital and the skill levels of labor) are needed to assess national competitiveness (Trefler & Zhu, 2010) and have only recently become available thanks to comprehensive multi-country input–output tables (Timmer et al., 2015).

The novel data on value-added trade enables a re-assessment of trade theory and may help prevent drawing misleading conclusions from research based on gross trade statistics. Our focus here is especially on factorial specialization patterns as a result of trade integration. While specialization may arise owing to Ricardian trade based on technological advantages, recent research suggests that Heckscher–Ohlin–Vanek (HOV) trade—endowment driven specialization—is more relevant (Morrow, 2010; Egger, Marshall, & Fisher, 2011). However, HOV predictions performed ambiguously in past studies (Trefler, 1995). Particularly, the common assumption that all countries have a similar input–output structure (proxied by U.S. technology) masked specialization patterns in previous work (Schott, 2003). Our analysis circumvents this limitation because WIOD relies on national input–output tables.

Following HOV predictions, we expect that trade integration will push CEECs to specialize in goods and services that intensively use their relatively abundant factors of production, that is, lower-skilled labor. In contrast, EU15 countries are expected to specialize in goods and services that are intensive in capital and high-skilled labor. According to Stehrer, Foster, and De Vries (2012), advanced countries should be exporters of goods and services intensive in high-skilled labor activities, and off-shore medium-skilled manufacturing jobs. Today, increasingly more low- and medium-skill jobs seem to be sourced from abroad, so that economies pursuing “catching-up” strategies may be expected to shift to higher value-added activities.

## 2.2 | European trade integration

Our paper focuses on the specific example of the 10 new member states, which acceded to the European Union in 2004. In order to examine the effect of trade integration on VAX and its composition, a more detailed understanding is needed of the mechanisms linking regional integration processes with changes in members’ production structures.

Although tariff barriers were already reduced prior to the *de iure* enlargement, examining the EU accession 2004 is a particularly interesting natural experiment because of its asymmetric nature.

First, Western European incumbents preferentially liberalized trade towards imports from the CEECs in the framework of the Europe Agreements in the mid-1990s. While the prospective new member states could export most of their products to the West free of tariff directly after entering the agreements, exports from the incumbents to the entrants were subject to stricter regulations in sensitive sectors. This included a gradual phase-out of tariffs for instance in agriculture (European Communities, 1994). Thus, potentially larger effects from tariff reductions could be hypothesized for West–East trade.

Second, before acceding to the European Union, entrants liberalized economic exchange among themselves asymmetrically in either the Central European Free Trade Agreement (CEFTA) or the Baltic Free Trade Agreement (BAFTA) with different subsets of CEECs in either agreement. When the new member states joined the EU in 2004, they all became part of a common agreement. On the one hand, this set tariffs to zero among all members. On the other hand, it partly led to an increase of external tariffs (e.g., for the Baltic states) vis-à-vis third countries in the framework of the European Union's common external tariffs. This might have further fostered trade between new members to the detriment of external trade partners.

Third, a large body of research suggests that despite the pre-accession integration in the framework of the Europe agreements, large border effects persisted before joining the EU (Nitsch, 2000; Head & Mayer, 2000; Hornok, 2010). Full membership in the political union could therefore be expected to bring about further gains for trade, going beyond a free trade agreement (FTA) by reducing trade frictions in terms of behind-the-border barriers—most prominently, product standards and the reduction of administrative barriers. This harmonization process should be both an important facilitator for trade between incumbents and entrants, as well as for intra-CEEC trade (Hornok, 2010; Martinez-Zarzoso, Vidovic, & Voicu, 2015).

Finally, it was expected that the Eastern enlargement would lead to increased financial inflows as a result of political stabilization (Baldwin, Francois, & Portes, 1997). While before 2004 firm agglomerations would have been more focussed on intra-country trade, the EU accession could in this way also lead to a set-up of production networks covering several CEECs (Martinez-Zarzoso et al., 2015). In line with Javorcik (2004), these investments could create complex backward linkages to suppliers, boosting technological upgrading and ultimately productivity.

### 3 | DATA AND METHODOLOGY

We now proceed to describe the underlying data and outline our empirical strategy to answer the main questions.

#### 3.1 | Data

Our dependent variable of interest, value-added exports (VAX) is a measure of a country's "domestic value added embodied in final expenditures abroad" (Timmer et al., 2015, p. 580). Similar to Johnson and Noguera's (2012a) value-added measure, we rely on the seminal contribution of Leontief (1936), who introduced a framework to describe the international input–output structure and follow up intermediate production steps via the so-called Leontief inverse  $L$ .<sup>3</sup> This is appealing in a fragmented world economy as it reveals the value-added (VA) contribution from domestic production steps in final products, for example, in terms of VAX from country  $a$  to  $b$ . Based on the Leontief framework, it becomes possible to trace back VA contributions from different countries via an input–output table.

Figure 1 shows a basic input output table. Like this table, a world input–output table (WIOT) contains a matrix  $Z$  of direct intermediate inputs for the production of goods for final use  $F$ . While the columns of the intermediate use matrix  $Z$  describe the inputs for one final demand unit of the respective sector, the rows describe the intermediate exports and the use of domestic intermediate products of the respective countries. As production processes usually not only involve intermediate inputs, but also the use of capital and labor, further value is added. The latter is depicted by the vector of value added  $V$ . The columns of the final use table  $F$  describe the domestic final demand for products worldwide, whereas the rows describe worldwide final demand for domestic products. Summing up  $Z$  and  $F$  row-wise or  $Z$  and  $V$  column-wise, yields the vector of world output  $X$  or  $X'$  respectively. If we divide the

		Country A Intermediate Industry	Country B Intermediate Industry	Rest of World Intermediate Industry	Country A Final domestic	Country B Final domestic	Rest of World Final domestic	Total
Country A	Industry	Intermediate Use (Z)			Final Use (F)			Output (X)
Country B	Industry							
Rest of World (RoW)	Industry							
		Value Added (V)						
		Output (X')						

**FIGURE 1** Schematic world input–output table

Source. Authors' illustration based on Timmer (2012).

intermediate use matrix  $Z$  and the VA matrix  $V$  by the output matrix  $X$ , we derive the matrix of direct inputs  $A$  and the matrix of VA coefficients, thus, VA embodied  $v$  in one output unit of vector  $X$ .

However, the direct inputs for one output unit usually involve further intermediate inputs. For instance, one unit of French transport equipment might need 0.3 units of British financial intermediation as an input. The latter might embody Finnish pulp and paper products. Leontief (1936) showed that it is possible to describe these input structures until the  $n$ th tier via the inverse  $L = (I - A)^{-1} = I + A + A^2 + \dots + A^n$ . The Leontief approach makes it, thus, possible not only to account for direct inputs, but for the indirect input structure of an economy.<sup>4</sup>

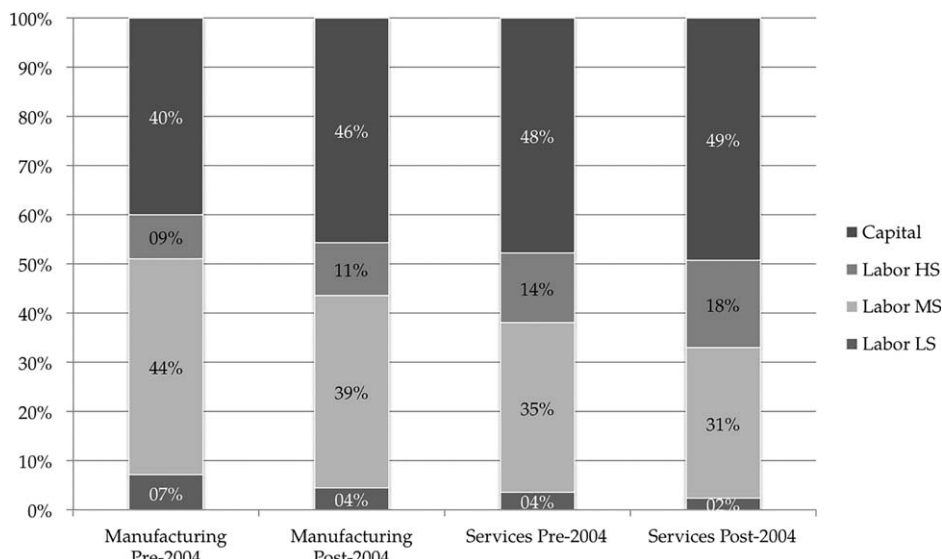
An actual WIOT involves not only three regions, but 40 countries (plus the rest of world) with each 35 sectors, yielding 1,435 world output sectors in vector  $X$  ( $1,435 \times 1$ ). The intermediate use matrix  $Z$ , therefore, has the structure of 1,435 intermediate input sectors for 1,435 intermediate goods ( $1,435 \times 1,435$ ). As WIOD distinguishes domestic final demands in five different use categories per region ( $5 \times 41$ ), the final use matrix's dimension is  $1,435 \times 205$ .

In this framework we can calculate country A's VA of products that are used directly and indirectly for the production of country A's exports for country B's final demand. Describing country A by the subscript  $a$  and country B by the subscript  $b$ , the desired measure is now simply computed as:

$$VAX_{ab} = v_a \times L \times f_b, \tag{1}$$

where  $v_a$  is the value-added vector of the dimension ( $1 \times 1,435$ ), consisting of zeros, except for (1, 841:875), describing country A's VA coefficients in the WIOD. Finally,  $f_b$  is the final demand vector in country B. The same framework can be used to calculate the VA contribution of capital and labor inputs based on the WIOD, by accounting for the shares of capital and different labor-skill levels in the sectoral VA. Moreover, the latter is measured in terms of educational attainment, which makes it possible to identify specialization patterns in terms of low-, medium-, and high-skilled labor. For this purpose the value-added vector  $v_a$  is pre-multiplied with a matrix of factorial weights,  $F_a$ , which describes the input share of the respective factor.

Data on the factor content of trade in value added are from the World Input–Output Database (WIOD, November 2013 release). The database covers 40 advanced and emerging countries, which is equivalent to approximately 85 percent of world GDP, and provides annual time-series data for the 1995 to 2009 period for 14 manufacturing and 20 services industries (see Timmer et al., 2015). The Appendix provides details about descriptive statistics (Table A1), country coverage (Table A7) and industry coverage (Table A8).



**FIGURE 2** Composition of CEECs' VAX to EU27

Note. Labor HS, MS and LS refer to high-skilled, medium-skilled, and low-skilled labor, respectively.

Source. Authors' calculations based on WIOD

When using these data, one has to consider that comprehensive databases like WIOD have to build partly on strong assumptions. One of them is that the average production structure in an industry is assumed to be constant for all products and all firms (for details, see Timmer et al., 2015). Firms that produce for the domestic market, however, differ significantly from firms following internationalization patterns, as the latter are on average more productive (Helpman, Melitz, & Rubinstein, 2008; Altomonte, Aquilante, & Ottaviano, 2011).

Figure 2 displays the factoral decomposition of VAX from entrants to the European Union in the pre- and post-accession period for manufacturing and services. Service sectors' VAX build to a larger extent on capital and high-skilled labor. It is striking that the VAX from services to the EU27 have a higher capital share than manufacturing products. A closer look at the data offers an explanation, in that the most intensively exported services from the CEECs to the EU27 are from technology-intensive sectors such as telecommunication and finance. In contrast, CEECs' manufacturers exporting to the EU27 have a higher medium-skilled labor intensity. Although capital and high-skilled labor intensity in the post-accession period have increased in both sectors, the changes differ in magnitude. The shift to a higher capital intensity is more marked for manufacturing firms (6 percent), while the share of high-skilled labor has grown stronger in service exports to the EU27 (4 percent).

### 3.2 | Model specification

We now proceed to determine, empirically, how European integration affects international fragmentation. Drawing on the rich literature on the gravity equation of international trade<sup>5</sup> we employ a theoretically based log-linear gravity model that according to Anderson and Van Wincoop (2003) should be estimated as:

$$\ln(E_{ij,t}) = \beta_0 + \beta_1 \ln(Y_{i,t}) + \beta_2 \ln(Y_{j,t}) + \beta_3 \ln(D_{i,j}) + \beta_4 EU_{ij,t} - \ln P_{i,t}^{1-\sigma} - \ln P_{j,t}^{1-\sigma} + \varepsilon_{ij,t} \quad (2)$$

where  $E_{ij,t}$  is country  $i$ 's exports to country  $j$  in year  $t$ ,  $Y$  is GDP,  $D$  is geographic distance,  $EU$  a binary variable equal to 1 if the country-pair is in the European Union and 0 otherwise, and  $\varepsilon$  is the error

term. As suggested by Anderson and Van Wincoop (2003), multilateral resistance—for example, to account for the relative trade costs vis-à-vis the rest of the world—is considered by the terms  $\ln P_{it}^{1-\sigma}$  and  $\ln P_{jt}^{1-\sigma}$ .

Building on Baier and Bergstrand (2007), we control for time-varying multilateral resistance terms by using exporter-year ( $F_{it}$ ) and importer-year ( $F_{jt}$ ) fixed effects. As is well known in the empirical trade literature, these fixed effects essentially capture all variables that vary by country-year, that is, GDP, and time-varying multilateral resistance terms.

A further concern when assessing the effectiveness of trade agreements relates to the potential endogeneity of these agreements. Trade policy might not be strictly exogenous as well-informed policy makers take factors into account that influence trade already before the conclusion of the agreement. In the case of the Eastern EU enlargement, cultural similarities between the accession states might have contributed both to the selection into the agreement and increased trade levels *ex ante* by facilitating transactions. In a classical cross-sectional gravity model point estimates would be biased (an issue discussed at length in Baier and Bergstrand, 2007).

One strategy to account for the biased estimate of endogenous trade agreements is by adopting instrumental variables. Previous studies, however, obtained fragile results (Baier and Bergstrand, 2002; Magee, 2003). For this reason, we will focus on a panel data model in first differences (Magee, 2008) or alternatively with dyadic fixed effects (Baier and Bergstrand, 2007). Both are different ways to address time-invariant dyadic unobservables, that is, geographic distance  $D_{ij}$ , common language or colonial history.<sup>6</sup> This yields:

$$\ln(E_{ij,t}) = \beta_0 + \beta_1 EU_{ij,t} + \gamma_{i,t} F_{i,t} + \delta_{j,t} F_{j,t} + \phi_{ij} F_{ij} + \varepsilon_{ij,t}, \quad (3)$$

or, in first differences:

$$\begin{aligned} d\ln(E_{ij,t-(t-1)}) = & \beta_1 dEU_{ij,t-(t-1)} + \gamma_{i,t-(t-1)} dF_{i,t-(t-1)} \\ & + \delta_{j,t-(t-1)} dF_{j,t-(t-1)} + v_{ij,t-(t-1)}, \end{aligned} \quad (4)$$

assuming that  $v_{ij,t-(t-1)} = \varepsilon_{ij,t} - \varepsilon_{ij,t-1}$  is white noise. Wooldridge's (2002) test for serial correlation, reported in Table A2, rejects the null hypothesis of no autocorrelation in all instances in which the fixed effects (Equation 3) are used. This is less of a concern for the first-differences variant (Equation 4), which is the more efficient and our preferred alternative. A further advantage of first differencing is that stationarity of the data is induced, which is especially important as trade flows can be assumed to follow a unit-root process. Fixed effects by differencing around the mean would not account for this properly, thus, potentially causing spurious regressions (Baier & Bergstrand, 2007). In all cases, parameter estimates are obtained with country-pair clustered robust standard errors to mitigate potential bias owing to serial correlation and heteroskedasticity (Wooldridge, 2002, p. 283).

Following the literature, we include lagged trade agreement terms to allow for “phase-in effects” that capture integration effects materializing in the period following the *de jure* accession in the concurrent year (i.e., 2004). Recall that WIOD provides data up to 2009, so that our phase-in period is 5 years. Even though the literature by now suggests a phase-in period of 10 years, the most significant part of the phase-in effects seems to be in the first 5 years post-enforcement (see Baier & Bergstrand, 2007, pp. 89–91). At the very least, our results provide lower-bound estimates of EU accession effects on (value-added) exports. Altogether, this yields:

$$\begin{aligned} d\ln(E_{ij,t-(t-1)}) = & \beta_1 dEU_{ij,t-(t-1)} + \beta_2 dEU_{ij,(t-1)-(t-2)} + \beta_3 dEU_{ij,(t-2)-(t-3)} \\ & + \beta_4 dEU_{ij,(t-3)-(t-4)} + \beta_5 dEU_{ij,(t-4)-(t-5)} + \beta_6 dEU_{ij,(t-5)-(t-6)} \\ & + \gamma_{i,t-(t-1)} dF_{i,t-(t-1)} + \delta_{j,t-(t-1)} dF_{j,t-(t-1)} + v_{ij,t-(t-1)}. \end{aligned} \quad (5)$$



**TABLE 1** Total average treatment effects (ATEs)

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>	0.109 (0.2515)	0.1179** (0.0077)	0.0921* (0.0364)	0.1213* (0.0156)	0.1294** (0.0079)	0.1316** (0.0057)
<i>N</i>	21,838	21,838	21,775	21,838	21,838	21,838
<b>Services</b>	-0.288 (0.0818)	0.0939* (0.0263)	0.0730** (0.0093)	0.1062 (0.0628)	0.0905* (0.0197)	0.0903 (0.0670)
<i>N</i>	21,772	21,840	21,840	21,840	21,840	21,840

Note. Estimates for Equation 5. The full version of this table is Table A4 in the Appendix. Dependent variables are reported in the top row. To save space, country-time fixed effects are not reported. *p* values of joint-significance tests of all (lagged) coefficients in parentheses. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

In addition to distinguishing between gross and VA exports, we are also interested in the accession impacts at a factorial level. Therefore, Equation 5 is estimated in six models with different dependent variables: (1) gross exports, (2) VA exports (VAX), (3) VAX attributable to capital, (4) to high-skilled labor, (5) medium-skilled labor, and (6) low-skilled labor.

As the latter factorial contributions are based on scaling the underlying VAX measure, it can be assumed that the errors of the models with the dependent variables (3) to (6) are correlated. For this reason, we will make use of the seemingly unrelated regression (SUR) model introduced by Zellner (1962), which allows for a nonzero covariance matrix between residuals. The model builds on a two step approach, in which the covariance matrix of the stacked error terms of the related regressions is estimated in a first step. This covariance matrix is then used in a subsequent step to obtain a consistent estimator via feasible generalized least squares (FGLS). Allowing for the correlation of residuals across models, we are able to compare coefficients of different regression models and interpret changes in capital–labor and labor–skill ratios.

## 4 | RESULTS

### 4.1 | Value-added exports

Table 1 presents our estimates for Equation 5.<sup>7</sup> Multicollinearity is not a concern because all correlation coefficients are  $\leq 0.2$  (not reported). To save space, we do not report the individual parameter estimates for each and every lagged trade agreement term. Instead, we calculate the total average treatment effect (ATE) as the sum of the significant coefficients of the (lagged) trade agreement terms and report values from joint-significance tests for the corresponding variables.

For the manufacturing sector, column (1) indicates that the accession led to an average increase of gross exports among members by about 11.5 percent, which is however not statistically significant.<sup>8</sup> In contrast, VAX (column 2) shows a positive effect of EU enlargement of 12.5 percent. This effect can be decomposed by factorial contributions (columns 3 to 6). We find that the effect of EU enlargement for capital and high-skilled labor in VAX is lowest (9.6 percent and 12.9 percent, respectively), and highest for medium- and low-skilled labor (13.8 percent and 14.1 percent, respectively). This finding is in line with the literature, suggesting that GVCs can especially affect trade in goods that build on low-skilled activities (Krugman, 2008).

**TABLE 2** Total ATEs: Differential accession impacts

	<u>(1)</u>	<u>(2)</u>	<u>(3)</u>	<u>(4)</u>	<u>(5)</u>	<u>(6)</u>
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>						
CEEC→EU15	0.0000 (0.6625)	0.0732 (0.2318)	0.0772 (0.0747)	0.0169 (0.3768)	0.0197 (0.3465)	0.0213 (0.2976)
Intra-CEEC	0.362** (0.0088)	0.388*** (0.0000)	0.2839*** (0.0000)	0.1869*** (0.0000)	0.2093*** (0.0000)	0.278*** (0.0000)
EU15→CEEC	0.269*** (0.0002)	0.0922*** (0.0000)	0.159*** (0.0000)	0.173*** (0.0000)	0.179*** (0.0000)	0.180*** (0.0000)
<i>N</i>	22,392	22,398	22,335	22,398	22,398	22,398
<b>Services</b>						
CEEC→EU15	-0.461* (0.0171)	0.1195* (0.0255)	0.0003* (0.0254)	-0.0201* (0.0423)	0.0622* (0.0132)	0.1218 (0.0643)
Intra-CEEC	-0.340 (0.4060)	0.1340** (0.0075)	0.253** (0.0044)	0.2169* (0.0113)	0.2259** (0.0058)	0.2287* (0.0137)
EU15→CEEC	0.0000 (0.4335)	0.1064 (0.1787)	0.1220 (0.0616)	0.0572 (0.4627)	0.0976 (0.2677)	0.0598 (0.2648)
<i>N</i>	21,772	21,840	21,840	21,840	21,840	21,840

Note. Estimates for Equation 5. The full version of this table is in Tables A5 and A6 in the Appendix. Dependent variables are reported in the top row. *p* values of joint-significance tests of all (lagged) coefficients in parentheses. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001.

For value-added trade in services, EU enlargement induced a significant and positive ATE of 9.8 percent that can be attributed to capital (7.6 percent) and medium-skilled labor (9.5 percent). In contrast, VAX by high- and low-skilled labor is not significantly affected. Thus, a decline in the labor-skill ratio is suggested, which would be statistically significant, based on the results from the seemingly unrelated regressions and the corresponding tests on equality of coefficients across equations reported in Table A3.<sup>9</sup>

Our findings may be driven by economic and policy asymmetries between entrants and incumbents, such as changes in entrants' export structures. In order to examine these changes in more detail, we add binary variables to Equation 5 so as to account for the direction of trade, that is, from entrants (CEECs) to incumbents (EU15), from entrants to other entrants (intra-CEEC), and from incumbents to entrants.<sup>10</sup>

For manufacturing, the upper part of Table 2 shows that EU enlargement did not have any significant effect on entrants' gross exports to the EU15. Surprisingly, we also do not find that accession generally affected value-added exports when we account for global fragmentation in columns (2) to (6). This is in contrast to our expectation that the CEECs would become integrated in Western European countries' value chains once they accede to the European Union. This could be attributed to the asymmetric process of EU enlargement, which already led in the 1990s to preferential liberalization of exports from aspirant entrants to incumbents in the framework of the Europe Agreements. However, looking more closely at the results in Table A5, significant lags for the year 2009 suggest that 5 years might be too short a timeframe to capture the full accession impact on CEEC–EU15 trade.

Interesting is our finding that EU accession brought about stronger regional integration among CEECs in terms of gross exports (43.6 percent).<sup>11</sup> The estimated ATE for VAX is slightly higher at

47.4 percent and driven by VAX of capital (32.8 percent) as well as low-skilled (32 percent), medium-skilled (23.3 percent) and high-skilled labor (20.6 percent). Although coefficient sizes differ markedly, the SUR results suggest that only those of high- and medium-skilled labor are significantly different (see Table A3). Hence, intra-CEEC exports are focusing on a factor combination of capital and low-skilled labor. While the strong low-skill contribution is not surprising in terms of factor abundance, the increasing specialization in capital-intensive manufacturing is an interesting point. As value added by capital is much harder to attribute to specific countries than labor inputs, it can be conjectured that part of these value-added exports can be ascribed to foreign investment, which took place in the context of the stabilizing forces of EU enlargement (Baldwin et al., 1997).

Turning to the trade effects for incumbents, we find positive effects for gross (30.9 percent) and value-added exports (9.7 percent) to new member states. VAX by capital increases by 17.2 percent. Among the labor-skill types, the effects on high-, medium- and low-skilled labor were 18.6 percent, 19.6 percent and 19.7 percent respectively. These effects point at the asymmetric liberalization and gradual phase-out of tariffs in entrants' sensitive sectors discussed earlier.

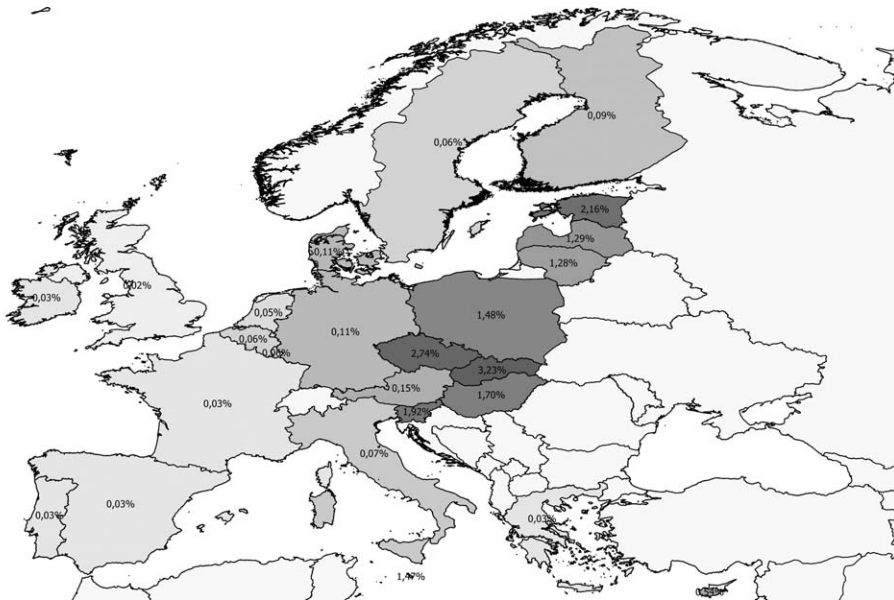
For gross exports in services (lower part of Table 2), we do not find evidence of meaningful accession effects for either incumbents or entrants.<sup>12</sup> However, the CEECs' contribution to value-added exports with the EU15 increased by 12.7 percent. This effect is attributed mainly to medium-skilled labor (6.4 percent), whereas there is only a slight increase in capital associated to EU accession (0.03 percent) and high-skilled labor even experiences a decrease of circa 2 percent. The results from the seemingly unrelated regressions support the notion that enlargement significantly negatively affected the skill ratio, which contrasts pre-enlargement expectations of an increase of high-skilled exports in services (Marin, 2004). Hence, accession had a depressing effect on the skill structure of East–West services exports.

As with manufacturing, EU enlargement had a positive effect on value-added trade in services (14.3 percent) between entrants. Here, the gains range between 24.2 percent for high-skilled labor and 28.8 percent for capital. However, the factoral ATEs are not significantly different. Therefore, unlike for services exports among entrants and incumbents, no low-skill bias is induced for East–East trade. Finally, the EU15's (value-added) exports in services to the new member states were not significantly affected by the EU enlargement.

All of the estimated effects are substantially smaller than the integration effects for gross exports as reported by Baier and Bergstrand (2007) and Bergstrand, Larch, and Yotov (2015), which range between 60 percent and 100 percent. This might seem counterintuitive, given the substantial EU membership treatment for tariff and nontariff barriers described previously. However, it needs to be noted that our study focuses mainly on the behind-the-border barrier effects, which took place with *de iure* accession, while many tariff barriers were already reduced before 2004. Furthermore, Baier and Bergstrand (2007) use a longer panel, which captures longer phase-in effects of membership in trade agreements and Bergstrand et al. (2015) employ a Poisson-quasi-maximum-likelihood estimator, which usually yields higher point estimates (Silva and Tenreyro, 2006).

Taken together, we find that EU enlargement has mainly promoted the CEECs' integration in regional value chains with other CEECs in both manufacturing and services, but not with incumbent EU15 countries. Part of this could be explained by the fact that entrants were involved in different FTAs before accession and EU membership implied the complete removal of (behind-the-border) trade barriers. In contrast to pre-enlargement expectations (Sinn, 2007), accession did not increase entrants' manufacturing (value-added) exports to the incumbent members. Yet, the CEECs exported more lower-skilled services to the incumbents after 2004. The enlargement has also increased the EU15's (value-added) exports of manufactured goods to the CEECs, but not for services.

Our results have to be interpreted in the context of tariff barriers that had already been substantially, but asymmetrically, reduced pre-2004. Hence, the main effects can be attributed mainly to behind-the-



**FIGURE 3** Job market effects by country

border barriers as well as those country-pairs, where tariffs still existed until 2004—for example, among a subset of CEECs and exports in sensitive sectors. As the results contrast in several dimensions to previous predictions of the effects of EU enlargement, they stress the importance to account for the input–output structure of value-added exports, which take the role of suppliers into account. This also motivates our subsequent analysis of labor market effects, as pre-accession discourse was largely influenced by public expectations about job security.

## 4.2 | Labor market outcomes

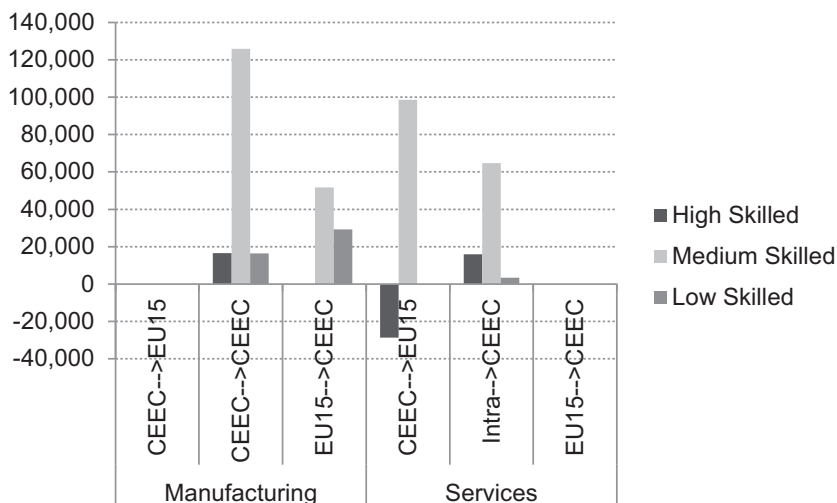
In order to illustrate the implied labor market effects, we use the coefficients from Table 2 to derive the implied changes in jobs across European member states by estimating:

$$\Delta J_{ij} = j_{is,t} \times L_{ijs,t} \times FD_{js,t} \times ATE_{ij,t}, \quad (6)$$

where  $j_{is,t}$  is a sectoral job vector, representing the jobs per VA produced in each country  $i$  and sector  $s$  in the year  $t$ .  $L_{ijs,t}$  is the Leontief inverse based on the yearly world input–output table and  $FD_{js,t}$  is the final demand in the respective partner country and sector in each year. The multiplication of these vectors and matrix gives us the jobs in country  $i$ , which stem from final demand in country  $j$ .

The underlying procedure is analogous to the procedure to estimate VA measures described earlier. Instead of weighting the Leontief inverse with a vector of monetary VA, we use a vector quantifying the jobs per output. We subsequently post-multiply this product with the treatment effects of EU accession for the different trade directions obtained in Tables A1 and A6. Based on the WIOD, we account for changes in labor productivity over time, which can be partly ascribed to EU accession. Doing so reduces the scaling of jobs per unit of VA, which means that our results should be regarded as lower-bound estimates.

The implied job gains per EU member state are depicted as a fraction of total employment in Figure 3. Although pre-accession expectations suggested stronger competition for jobs (Sinn, 2007), we find across-the-board positive labor market effects.<sup>13</sup>



**FIGURE 4** Job market effects by sector and direction

While the incumbent economies experienced minor gains from EU enlargement ranging to a maximum of 0.11 percent for Germany and Denmark, the entrants benefited markedly. Major gains of 3.23 percent job growth were found in Slovakia, while other Eastern European nations also exhibit increases of more than 1 percent. The smallest gains are found for Cyprus, which could be explained by its remoteness from other CEECs.

Analogously to the main results, Figure 4 presents the implied labor market effects of 2004's EU accession by trade direction. Interestingly, although relative increases in value-added exports by labor types were of comparable magnitude in Table 2, we find that absolute job gains differ significantly. We find that medium-skilled jobs are increasingly offshored, where the largest gains are across trade directions and sectors (see also Foster-McGregor, Stehrer, & De Vries, 2013; Andersson, Karpaty, & Savsin, 2016). Substantial increases are found for intra-CEEC trade, where the accession leads to an implied creation of 180,000 jobs in manufacturing and 80,000 jobs in services.

Interestingly, service exports of the new member states to incumbents contribute to the creation of an additional 100,000 medium-skilled jobs, while in turn around 30,000 high-skilled jobs are lost in this sector.<sup>14</sup> Again, in contrast to pre-enlargement expectations, East–West trade did not contribute to job creation in the manufacturing sector. These changes most likely already took place in the framework of the preferential pre-accession liberalization in the Europe agreements. Furthermore, it should be noted that we only take into account demand effects of other EU member states, while not accounting for further potential gains associated with the integration in global value chains of partner countries producing for African, American, or Asian consumers.<sup>15</sup>

## 5 | SENSITIVITY ANALYSES

### 5.1 | Endogeneity and anticipation effects

While our panel data approach already controls for endogeneity bias, an additional test for strict exogeneity can be performed to ensure that our findings are not still somehow subject to this bias. A lead term (in levels) is included in Equation 5 to ensure that the assumption of strict exogeneity is not violated (see Wooldridge, 2002, p. 283). This term could also indicate possible “anticipation effects,” that is, changes in trade flows prior to the *de jure* enforcement of the trade agreement. A significant

**TABLE 3** Anticipation and phase-in effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>						
EU <sub>ij,t+5</sub>	-0.0320 (0.065)	-0.0151* (0.015)	-0.0115 (0.1883)	-0.0126 (0.1260)	-0.0127 (0.1240)	-0.0121 (0.1430)
Total ATE	0.109 (0.2190)	0.133** (0.0045)	0.115 (0.0575)	0.1307* (0.0455)	0.1391* (0.0310)	0.14* (0.0309)
<b>Services</b>						
EU <sub>ij,t+5</sub>	0.00507 (0.731)	-0.00663 (0.257)	-0.00387 (0.521)	-0.00652 (0.440)	-0.0103 (0.202)	-0.0134 (0.104)
Total ATE	-0.293 (0.2190)	0.1398* (0.0377)	0.0768 (0.0502)	0.0875 (0.1068)	0.1407** (0.0063)	0.1574** (0.0039)

Note. Estimates for Equation 5 including lead term in levels (5 years). Dependent variables are reported in the top row. *p* values of joint-significance tests of the coefficients in parentheses. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001. The full version of this table is available from the authors upon request.

parameter estimate of the lead trade agreement term indicates that it is correlated with the concurrent trade flow, so that the model may still be subject to endogeneity bias.

Indeed, Table 3 shows one negative and statistically significant lead terms for VAX-related exports in manufacturing. However, this tends to be very small (-1.5 percent). Moreover, including these anticipation effects does not dramatically alter the size of the total ATEs. The coefficients are negative except for one case, suggesting a “delay” of trade integration until *de jure* accession (a similar interpretation is given in Baier & Bergstrand, 2007, p. 90).

## 5.2 | Prior membership in BAFTA and CEFTA

Another potential concern is that the CEECs had formerly been integrated in regional integration initiatives, that is, the BAFTA and CEFTA. Although the CEECs left these agreements upon their EU accession, our EU accession variables may actually capture lagged effects of former involvement in BAFTA and/or CEFTA.

In order to test whether it is not the *de jure* accession impact that is driving our results, but rather pre-2004 liberalization in BAFTA/CEFTA, we re-estimate our model with placebo accession effects. In doing so, we recode the EU dummy to indicate that EU enlargement occurred in 2000, 2001, 2002, or 2003. Table 4 shows that the total ATEs are mostly insignificant if the accession is assumed to have started in 2000, 2001, 2002, or 2003. Additionally, the parameter estimates are dwarfed by the *de jure* accession effects of 2004 and can be mostly attributed to lags occurring in the actual accession period.<sup>16</sup> Therefore, we argue that the ATEs from Table 1 and Table 2 can be specifically ascribed to the 2004 enlargement rather than to pre-accession liberalization under BAFTA/CEFTA.

## 6 | DISCUSSION AND CONCLUSION

This paper’s main objective is to assess the nature of the Eastern European enlargement distinguishing between (i) gross and value-added exports and (ii) putting a specific focus on the factor content of trade

**TABLE 4** Total ATEs for placebos

Year	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>						
2004	0.109 (0.2515)	0.1179** (0.0077)	0.0921 (0.1654)	0.1056 (0.1897)	0.1138 (0.1275)	0.1317 (0.1113)
2003	0.109 (0.1553)	0.0157** (0.0048)	0.0008 (0.5923)	0.0265 (0.6450)	0.0277 (0.6938)	0.0294 (0.7348)
2002	0.109 (0.2012)	0.0157** (0.0059)	0.0008 (0.9030)	0.0265 (0.7634)	0.0277 (0.7122)	0.0294 (0.7709)
2001	0.109 (0.1957)	0.0157** (0.0059)	0.0008 (0.4311)	0.0265 (0.4580)	0.0277 (0.4014)	0.0294 (0.4188)
2000	-0.054 (0.0812)	-0.0206** (0.0039)	0.0008 (0.6751)	-0.0053 (0.7084)	0.0277 (0.6749)	0.0294 (0.6536)
<b>Services</b>						
2004	-0.288 (0.0818)	0.0939* (0.0263)	0.0730** (0.0093)	0.1062 (0.0628)	0.0905* (0.0197)	0.0903 (0.0670)
2003	-0.288 (0.0986)	0.0007 (0.1344)	0.0000 (0.9985)	-0.0468 (0.8988)	-0.0008 (0.6469)	-0.0053 (0.7621)
2002	0.0000 (0.8069)	0.0306 (0.0911)	0.0000 (0.1945)	0.0000 (0.1181)	-0.0008 (0.0990)	-0.0053 (0.2666)
2001	0.0000 (0.9685)	0.0306** (0.0458)	0.0000 (0.0738)	0.0403* (0.0172)	-0.0008* (0.0325)	0.0663 (0.1462)
2000	0.0000 (0.7565)	-0.0124* (0.0175)	-0.0500 (0.9403)	-0.0086 (0.5960)	-0.0397 (0.6033)	-0.0438 (0.9479)

Note. Estimates for Equation 5 for different “placebo” years of entry. Dependent variables are reported in the top row. *p* values of joint-significance tests of the coefficients in parentheses. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001. The full version of this table is available from the authors upon request.

at a sectoral and factorial level. Our results indicate that while gross exports of manufacturers grew owing to EU enlargement, it is not the case for CEECs’ service providers. However, this result can be attributed to the fact that services are used largely as inputs for manufacturing products (Timmer, Los, Stehrer, & De Vries, 2013): that is, Czech financial services do not “cross the border,” but are implicitly embedded in Czech car parts destined for export markets. Another explanation is that the European internal market for goods was already more liberalized than the market for services.<sup>17</sup>

Nevertheless, positive accession effects can be observed for both sectors when VAX are taken as a preferred measure for trade flows, rather than gross trade flows. Interestingly, the results indicate that EU enlargement has predominantly caused new member states to become more integrated in regional value chains with other Eastern entrants, rather than with the incumbent EU members. CEECs’ export focus on the EU15 prior to enlargement and the relatively higher incomes of incumbents led to the expectation that mainly the old member states’ demand that fosters gross and value-added growth (Baldwin et al., 1997). In contrast, our paper’s results indicate that it is the demand from new entrants that exerts the stronger impulse. Our interpretation is that EU15 demand was already close to its natural level as a result of pre-accession liberalization. In contrast, trade among new EU members experienced further trade barrier reductions in the course of their accession. Moreover, the CEECs’ post-enlargement demand (GDP) grew relatively faster than in the EU15 (2.9 percent vs. 1.1 percent annually) (IMF, 2014). Thus, entrants seem to participate less than expected in Western European value

chains and there is no evidence for the establishment of a hub-and-spoke structure between core and periphery (De Benedictis, De Santis, & Vicarelli, 2005).

One might assume path dependency of previous agreements that were established between the new member states prior to the EU accession. Notwithstanding, placebo tests that assume EU enlargement would have taken place prior to 2004 indicate that there are membership gains between old and new member states for CEECs that can be mainly ascribed to the 2004 accession. While the enlargement promoted manufacturing value-added exports from incumbents to entrants, there is no increase in the opposite direction. This is due to the asymmetric nature of enlargement—while CEECs gained preferential access to Western European markets before *de iure* integration in light of the Europe agreements, the tariffs of CEECs vis-à-vis incumbent exporters were only phased out gradually in the pre-enlargement period. In this regard, we do not find strong evidence for the suggested competition between incumbents' and entrants' low-skilled manufacturing workers. If such dynamics occurred, they would have mainly materialized in the pre-accession phase.<sup>18</sup>

Significant effects can be found, however, for Eastern service suppliers' value-added exports to the EU15. In contrast to pre-enlargement accounts (Marin, 2004), CEEC entrants gained most from contributing medium-skilled labor-intensive activities to EU15 members. Hence, trade with incumbents had adverse effects on entrants' labor-skill ratios rather than inducing production upgrading processes in the acceding economies. An explanation for this finding is that VAX of products with a lower skill intensity are disproportionately favored by the reduction of trade impediments. Referring to Johnson and Noguera (2012b), goods with a high domestic value-added content “travel further” than goods with lower shares. On the one hand, the goods with high domestic value-added shares are on average the goods involving high value-added activities, related to capital and high-skill labor. On the other hand, low value-added shares in gross exports are related to production steps involving low value-adding activities associated with lower-skilled labor. If trade is liberalized and barriers are reduced, traded tasks do not have to be that profitable anymore in order to justify the trade costs—trade in lower-skill tasks benefits relatively more from trade liberalization. This effect is consequently larger, the further trade liberalization proceeds.

Applying these findings to the EU enlargement of 2004, the effect of economic integration can be perceived as relatively deep compared with global trade integration. Therefore, in intra-EU trade relations, low value-adding activities would be favored vis-à-vis trade of EU members with other parts of the world. The result would be the previously found over-proportional increase in lower-skill value-added exports from the CEECs to the European Union. This is not per se unfavorable for the CEECs if they continue increasing their absolute contribution of value-added exports. Nevertheless, in the long run, new member states may need to foster industrial upgrading processes regarding intra-EU trade, in order to avoid being stuck with exclusively exporting low-skilled activities. This could also become especially relevant when new countries competing in low- and medium-skilled labor sectors join the European Union in the future.

Our findings may be used as a stepping stone for future research to gain a more nuanced understanding of the economic effects of the CEECs' accession by further decomposing data for the manufacturing and services sectors. The more general topic of economic fragmentation and its sensitivity to trade policy offers various interesting fields for new empirical work. First, future updates of WIOD would make it possible to assess the long-term impacts of accession. This is important in light of long-run phase-in effects of trade agreements on trade (Baier & Bergstrand, 2007). Second, more comprehensive data for larger country samples and more detailed factorial decompositions would be instrumental to assess the economic implications of a variety of trade agreements. This would be especially helpful to obtain a better understanding of how trade policy shapes specialization in an increasingly fragmented world economy.



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## NOTES

- <sup>1</sup> In the European Social Survey 2004, low-skilled respondents from incumbent EU members were on average rather reluctant towards further integration, whereas respondents with a higher level of education were more positively inclined (NSD, 2004).
- <sup>2</sup> Throughout this paper, the Central and Eastern European Countries (CEECs) will interchangeably be referred to as entrants, acceding countries, and Eastern countries joining the European Union in 2004: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia, and Slovakia. The incumbent/Western countries are the EU15 members, that is, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, the Netherlands, Spain, Sweden, and the United Kingdom.
- <sup>3</sup> While Johnson and Noguera (2012a) and Koopman et al. (2014) provide similar measures to WIOD, there are several differences in sample coverage (countries, years, sectors) and assumptions to construct the value-added measures. For details, see Timmer, Erumban, Los, Stehrer, and De Vries (2014).
- <sup>4</sup> Leontief (1936) had already revealed how important it is to account for the input–output structure of a country in order to assess its competitive advantage. His seminal contribution on the paradox of the United States' capital intensity in imports intrigued economists for several decades (Leontief, 1953).
- <sup>5</sup> For surveys, see Head and Mayer (2014), Yotov, Piermartini, Monteiro, and Larch (2016), and Kohl (2014).
- <sup>6</sup> For the period of observation the unobservables of interest—for example, cultural differences or complementary resource endowments—are assumed to be time-invariant or slow moving. Note that regressing VAX on GDP would give rise to endogeneity because GDP measures domestic value added. The fact that GDP is fully captured by country-time effects enables us to estimate a gravity equation of trade in value added without the need to estimate parameters for GDP.
- <sup>7</sup> All estimates were obtained using the *reg2hdfe* user-written package in Stata 11, which significantly reduces computation time with high-dimensional fixed effects (for details, see Carneiro, Guimares, & Portugal, 2012).
- <sup>8</sup> For all estimations, estimates of percentage changes refer to the summation of baseline and phase-in effects following  $(\exp(\text{baseline} + \text{phaseins}) - 1) * 100\%$ .
- <sup>9</sup> The decline in gross exports of services is not in line with our expectations and may be related to data quality issues in WIOD. For services, inconsistencies and lack of data for all countries made it necessary to take the average of use structures for all imported services across time and countries (Timmer, 2012). Hence, service data are of a lower quality than data on trade in manufacturing and should for this reason be treated with some caution. Moreover, parts of the value-added exports in services might be to some extent embodied in manufacturing gross exports (Timmer et al., 2014).
- <sup>10</sup> Results with a full set of (lagged) trade agreement terms are provided in Tables A5 and A6.
- <sup>11</sup> While the strong intra-CEEC effect of manufacturer's gross exports is confirmed in Hornok (2010), note that our studies are not comparable owing to her usage of biannual data for 1999 to 2007 and exclusion of Cyprus, Malta, and Greece from the sample.
- <sup>12</sup> The significance of the ATE for service gross exports among CEECs and incumbents is surprising, yet may be explained by the fact that “services” involve several, heterogeneous sectors.
- <sup>13</sup> This speaks to the importance of going beyond gross export statistics when analyzing the effect of trade policy on labor market outcomes.

- <sup>14</sup> This is in line with accounts suggesting that rather standardized tasks such as in the call-center industry would have prospered (Ahmed, 2013).
- <sup>15</sup> These aspects are covered by other complementing studies. See, for example, Timmer et al. (2013).
- <sup>16</sup> For instance, the fifth lag of a 2000 placebo accession is in 2005, one year after the true EU accession.
- <sup>17</sup> For a draft of the EU directive on services in the internal market 2006/123/EG, European Commissioner Bolkestein proposed that services in the EU internal market be provided according to the laws of the service provider's country of origin. This triggered public concerns of social dumping in the context of Eastern enlargement. The adopted version of the directive no longer contains this "country of origin" principle.
- <sup>18</sup> The small and mostly insignificant placebo effects in Table 4 suggest that strong dynamics before the *de iure* accession are unlikely.

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## APPENDIX

## A1 Descriptive statistics

Descriptive statistics of gross exports, value-added exports (VAX) and the factoral decomposition of VAX by capital and labor (skills) are presented in Table A1. For each of these variables of interest, a total of 23,400 observations were obtained from WIOD (15 years  $\times$  40 exporters  $\times$  39 potential

**TABLE A1** Descriptive statistics (in U.S.\$millions)

Variable	Mean	Median	Max.	Min.	SD
<b>Manufacturing</b>					
(1) Gross exports	2,919.7	288.1	292,331.7	0.00	11,018.78
(2) VAX	1,217.1	133.43	149,851.3	-0.22	4,733.7
(3) VAX by capital	481.4	54.58	100,421.1	-17.22	2,211.7
(4) VAX by labor HS	193.5	13.20	17,567.9	-0.01	812.7
(5) VAX by labor MS	378.4	33.56	36,487.3	-0.01	1,562.1
(6) VAX by labor LS	163.8	16.16	24,348.8	-0.08	603.2
<b>Services</b>					
(7) Gross exports	837.2	86.7	90,597.9	0.00	2,781.3
(8) VAX	1,405.4	179.7	128,842.2	0.18	4,717.0
(9) VAX by capital	621.1	80.9	70,668.5	0.04	2,327.8
(10) VAX by labor HS	282.0	28.4	20,872.4	0.03	1,008.0
(11) VAX by labor MS	381.7	41.6	39,208.0	0.03	1,343.18
(12) VAX by labor LS	120.6	14.8	8,373.4	0.01	349.91

Source. Authors' calculations based on WIOD.

importers). The highest share of nonpositive values was detected in gross exports of services (55 out of 23,400 observations, or 0.24 percent). Such values may be attributed to negative changes in importing countries' inventories. Overall, zero "trade" flows are not prevalent in the data.

**TABLE A2** Wooldridge (2002) test for autocorrelation

Model	(1) Gross exports	(2) Value-added exports (VAX)	(3) VAX by capital	(4) VAX by labor HS	(5) VAX by labor MS	(6) VAX by labor LS
<b>Manufacturing</b>						
FE	196.113 (0.0000)	324.653 (0.0000)	436.405 (0.0000)	300.29 (0.0000)	246.392 (0.0000)	282.519 (0.0000)
FD	0.654 (0.4187)	2.408 (0.1209)	0.048 (0.8273)	9.485 (0.0021)	11.753 (0.0006)	7.938 (0.0049)
<b>Services</b>						
FE	547.768 (0.0000)	1,792.998 (0.0000)	1,380.092 (0.0000)	1,756.719 (0.0000)	1,693.634 (0.0000)	1,804.236 (0.0000)
FD	100.428 (0.0000)	10.446 (0.1209)	7.638 (0.0002)	22.110 (0.0000)	12.173 (0.0000)	8.572 (0.0000)

Note. *F* values, with *p* values in parentheses.

**TABLE A3** Test for coefficient equality based on seemingly unrelated regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	Capital	Capital Labor MS	Capital Labor LS	Labor HS Labor MS	Labor HS Labor LS	Labor MS Labor LS
<b>Manufacturing</b>						
Overall	Equality (0.7941)	Equality (0.9266)	Equality (0.8441)	Inequality* (0.0322)	Equality (0.0881)	Equality (0.5248)
CEEC→EU15	Equality (0.9868)	Equality (0.8703)	Equality (0.7523)	Equality (0.2772)	Equality (0.2107)	Equality (0.3502)
Intra-CEEC	Equality (0.1275)	Equality (0.2288)	Equality (0.2562)	Inequality* (0.0479)	Equality (0.1516)	Equality (0.7331)
EU15→CEEC	Equality (0.7126)	Equality (0.9619)	Equality (0.9587)	Equality (0.0515)	Equality (0.2356)	Equality (0.9782)
<b>Services</b>						
Overall	Equality (0.2007)	Equality (0.6573)	Equality (0.7663)	Inequality* (0.0322)	Equality (0.0606)	Equality (0.8478)
CEEC→EU15	Equality (0.4207)	Equality (0.1865)	Equality (0.1714)	Inequality*** (0.0005)	Inequality* (0.0106)	Equality (0.7199)
Intra-CEEC	Equality (0.9555)	Equality (0.6810)	Equality (0.9743)	Equality (0.5979)	Equality (0.9752)	Equality (0.5100)
EU15→CEEC	Equality (0.3059)	Equality (0.4879)	Equality (0.3437)	Equality (0.4281)	Equality (0.8720)	Equality (0.5248)

Note. *p* values in parentheses. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001.

**TABLE A4** Full lag structure: Total average treatment effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>						
Accession <sub>ij,t-(t-1)</sub>	0.109** (0.012)	0.0671*** (0.000)	0.0455** (0.025)	0.0741*** (0.001)	0.0777*** (0.000)	0.0785*** (0.000)
Accession <sub>ij,t-(t-1)-(t-2)</sub>	-0.0380 (0.280)	-0.00897 (0.566)	0.0202 (0.288)	-0.0236 (0.205)	-0.0238 (0.202)	-0.0240 (0.196)
Accession <sub>ij,t-(t-2)-(t-3)</sub>	-0.0209 (0.548)	-0.00674 (0.694)	-0.0138 (0.421)	-0.00185 (0.923)	0.00141 (0.941)	0.000273 (0.989)
Accession <sub>ij,t-(t-3)-(t-4)</sub>	0.00464 (0.912)	-0.0111 (0.582)	-0.0199 (0.326)	-0.00372 (0.858)	-0.00685 (0.742)	-0.00855 (0.683)
Accession <sub>ij,t-(t-4)-(t-5)</sub>	-0.0281 (0.433)	-0.0150 (0.421)	-0.0127 (0.523)	-0.0177 (0.341)	-0.0160 (0.396)	-0.0121 (0.523)
Accession <sub>ij,t-(t-5)-(t-6)</sub>	0.0161 (0.677)	0.0508** (0.015)	0.0466** (0.033)	0.0472** (0.029)	0.0518** (0.017)	0.0532** (0.013)
<b>ATE: Accession manufacturing</b>						
	0.109 (0.2515)	0.1179** (0.0077)	0.0921* (0.0364)	0.1213* (0.0156)	0.1294** (0.0079)	0.1316** (0.0057)

(Continues)

TABLE A4 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Services</b>						
Accession $_{ij,t-(t-1)}$	0.0184 (0.744)	0.0353* (0.082)	0.0316 (0.119)	0.0350* (0.089)	0.0401* (0.054)	0.0390* (0.070)
Accession $_{ij,(t-1)-(t-2)}$	-0.00826 (0.896)	-0.00500 (0.817)	-0.00787 (0.719)	0.00395 (0.867)	0.00639 (0.765)	0.00414 (0.850)
Accession $_{ij,(t-2)-(t-3)}$	0.0147 (0.774)	0.0261 (0.146)	0.0253 (0.167)	0.0317* (0.099)	0.0296 (0.106)	0.0269 (0.162)
Accession $_{ij,(t-3)-(t-4)}$	0.0541 (0.316)	0.00611 (0.742)	0.00514 (0.784)	0.00501 (0.812)	0.00424 (0.824)	0.000661 (0.972)
Accession $_{ij,(t-4)-(t-5)}$	-0.288*** (0.001)	-0.0242 (0.407)	-0.0249 (0.398)	-0.0468 (0.144)	-0.0189 (0.509)	-0.0126 (0.668)
Accession $_{ij,(t-5)-(t-6)}$	-0.00662 (0.904)	0.0586*** (0.005)	0.0730*** (0.001)	0.0395* (0.055)	0.0504** (0.013)	0.0513** (0.027)
<b>ATE: Accession services</b>						
	-0.288 (0.0818)	0.0939* (0.0263)	0.0730* (0.0281)	0.1062 (0.0628)	0.0905* (0.0127)	0.0903* (0.0168)
<i>N</i>	21,832	21,838	21,775	21,838	21,838	21,838
<i>R</i> <sup>2</sup>	0.203	0.492	0.579	0.523	0.494	0.521

Note. For each trade direction the ATEs refer to the summation of significant coefficients, which are also reported in Table 1. Robust standard errors of the coefficients (clustered by country-pair) in parentheses. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

TABLE A5 Full lag structure: Differential accession impacts for manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Manufacturing</b>						
CEEC→EU15 $_{ij,t-(t-1)}$	-0.0505 (0.430)	-0.0341 (0.2480)	-0.0687* (0.013)	-0.0576* (0.0026)	-0.0562* (0.031)	-0.0557* (0.032)
CEEC→EU15 $_{ij,(t-1)-(t-2)}$	-0.00579 (0.927)	0.0181 (0.4790)	0.0772** (0.005)	0.0304 (0.240)	0.0295 (0.256)	0.0296 (0.254)
CEEC→EU15 $_{ij,(t-2)-(t-3)}$	-0.0988 (0.098)	-0.0342 (0.2380)	-0.0531 (0.0054)	-0.0476 (0.065)	-0.0452 (0.082)	-0.0467 (0.071)
CEEC→EU15 $_{ij,(t-3)-(t-4)}$	0.0602 (0.422)	0.0176 (0.6190)	0.00578 (0.833)	0.0783 (0.761)	0.00798 (0.758)	0.0836 (0.746)
CEEC→EU15 $_{ij,(t-4)-(t-5)}$	-0.0420 (0.478)	-0.0144 (0.6520)	-0.0140 (0.61)	-0.0128 (0.617)	-0.0103 (0.691)	-0.00464 (0.857)
CEEC→EU15 $_{ij,(t-5)-(t-6)}$	0.0434 (0.490)	0.0732** (0.0270)	0.0482 (0.078)	0.0745*** (0.0004)	0.0759*** (0.003)	0.0770*** (0.003)
<b>ATE: CEEC→EU15</b>	0.0000 (0.6625)	0.0732 (0.2318)	0.0772 (0.9445)	0.0169 (0.9328)	0.0197 (0.9776)	0.0213 (0.9004)

(Continues)

TABLE A5 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
Intra-CEEC $_{ij,t-(t-1)}$	0.362*** (0.0000)	0.263*** (0.0000)	0.219*** (0.0000)	0.239*** (0.0000)	0.246*** (0.0000)	0.247*** (0.0000)
Intra-CEEC $_{ij,t-(t-1)-(t-2)}$	-0.124 (0.132)	-0.0454 (0.256)	0.0438 (0.205)	-0.0192 (0.553)	-0.0190 (0.559)	-0.0196 (0.547)
Intra-CEEC $_{ij,t-(t-2)-(t-3)}$	-0.116 (0.118)	-0.0625 (0.110)	-0.0495 (0.149)	-0.0938*** (0.0004)	-0.0886** (0.006)	-0.0900** (0.005)
Intra-CEEC $_{ij,t-(t-3)-(t-4)}$	-0.0253 (0.765)	-0.0146 (0.719)	-0.0435 (0.204)	-0.00830 (0.796)	-0.0147 (0.0649)	-0.0183 (0.570)
Intra-CEEC $_{ij,t-(t-4)-(t-5)}$	-0.101 (0.208)	-0.0759 (0.0770)	-0.0821* (0.016)	-0.0693* (0.031)	-0.0671* (0.037)	-0.0623 (0.053)
Intra-CEEC $_{ij,t-(t-5)-(t-6)}$	0.0551 (0.476)	0.125** (0.003)	0.147*** (0.0000)	0.111*** (0.0001)	0.119*** (0.0000)	0.121*** (0.0000)
<b>ATE: Intra-CEEC</b>	0.362** (0.0088)	0.388*** (0.0000)	0.2839** (0.0049)	0.1869* (0.0420)	0.2093* (0.0260)	0.278* (0.0235)
EU15→CEEC $_{ij,t-(t-1)}$	0.269*** (0.0000)	0.168*** (0.0000)	0.159*** (0.0000)	0.173*** (0.0000)	0.179*** (0.0000)	0.180*** (0.0000)
EU15→CEEC $_{ij,t-(t-1)-(t-2)}$	-0.0702 (0.0860)	-0.0361* (0.0500)	-0.0360 (0.188)	-0.0388 (0.130)	-0.0383 (0.138)	-0.0389 (0.131)
EU15→CEEC $_{ij,t-(t-2)-(t-3)}$	0.0569 (0.1240)	0.0208 (0.2540)	0.0249 (0.363)	0.0158 (0.537)	0.0199 (0.440)	0.0193 (0.455)
EU15→CEEC $_{ij,t-(t-3)-(t-4)}$	-0.0509 (0.1750)	-0.0397* (0.0360)	-0.0456 (0.096)	-0.0267 (0.298)	-0.0332 (0.199)	-0.0369 (0.152)
EU15→CEEC $_{ij,t-(t-4)-(t-5)}$	-0.0143 (0.733)	-0.0157 (0.423)	-0.0115 (0.676)	-0.0226 (0.379)	-0.0217 (0.401)	-0.0196 (0.447)
EU15→CEEC $_{ij,t-(t-5)-(t-6)}$	-0.0111 (0.808)	0.0285 (0.263)	0.0449 (0.101)	0.0198 (0.441)	0.0276 (0.284)	0.0293 (0.255)
<b>ATE: EU15→CEEC</b>	0.269*** (0.0002)	0.0922*** (0.0000)	0.159* (0.0417)	0.173 (0.0530)	0.179* (0.0336)	0.180* (0.0336)
<i>N</i>	21,832	21,838	21,775	21,838	21,838	21,838
<i>R</i> <sup>2</sup>	0.203	0.492	0.579	0.523	0.494	0.521

Note. For each trade direction the ATEs refer to the summation of significant coefficients, which are also reported in Table 2. Robust standard errors of the coefficients (clustered by country-pair) in parentheses. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

TABLE A6 Full lag structure: Differential accession impacts for services

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
<b>Services</b>						
CEEC→EU15 $_{ij,t-(t-1)}$	0.134 (0.097)	0.0182 (0.525)	0.0131 (0.618)	0.0128 (0.630)	0.0282 (0.266)	0.0182 (0.483)
CEEC→EU15 $_{ij,t-(t-1)-(t-2)}$	0.0743 (0.461)	0.00714 (0.829)	0.00332 (0.899)	0.0120 (0.651)	0.0170 (0.503)	0.0264 (0.309)

(Continues)



TABLE A6 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	Gross exports	Value-added exports (VAX)	VAX by capital	VAX by labor HS	VAX by labor MS	VAX by labor LS
CEEC→EU15 <sub>ij,t(t-2)-(t-3)</sub>	-0.0275 (0.720)	0.0565* (0.0350)	0.0433 (0.100)	0.0684* (0.010)	0.0647* (0.011)	0.0607* (0.019)
CEEC→EU15 <sub>ij,t(t-3)-(t-4)</sub>	0.0786 (0.317)	0.0255 (0.372)	0.0329 (0.211)	0.0152 (0.567)	0.0267 (0.293)	0.0148 (0.568)
CEEC→EU15 <sub>ij,t(t-4)-(t-5)</sub>	-0.461*** (0.0000)	-0.0702 (0.130)	-0.0736* (0.005)	-0.0885** (0.001)	-0.0577* (0.0230)	-0.0406 (0.118)
CEEC→EU15 <sub>ij,t(t-5)-(t-6)</sub>	0.000877 (0.9910)	0.0630* (0.034)	0.0739** (0.005)	0.0434 (0.102)	0.0552* (0.030)	0.0611* (0.019)
<b>ATE: CEEC→EU15</b>	-0.461* (0.0171)	0.1195* (0.0255)	0.0003 (0.1490)	-0.0201 (0.3304)	0.0622* (0.0309)	0.1218* (0.0269)
Intra-CEEC <sub>ij,t(t-1)</sub>	0.0250 (0.831)	0.105 (0.057)	0.0910** (0.006)	0.117*** (0.0000)	0.113*** (0.000)	0.0947** (0.0030)
Intra-CEEC <sub>ij,t(t-1)-(t-2)</sub>	-0.0459 (0.695)	0.0115 (0.789)	0.0137 (0.676)	0.0106 (0.750)	0.0298 (0.348)	0.0489 (0.131)
Intra-CEEC <sub>ij,t(t-2)-(t-3)</sub>	0.0981 (0.301)	0.0385 (0.334)	0.0177 (0.589)	0.0629 (0.058)	0.0531 (0.094)	0.0470 (0.147)
Intra-CEEC <sub>ij,t(t-3)-(t-4)</sub>	-0.0322 (0.742)	-0.0142 (0.721)	-0.0219 (0.505)	-0.00439 (0.895)	-0.0210 (0.507)	-0.0351 (0.279)
Intra-CEEC <sub>ij,t(t-4)-(t-5)</sub>	-0.340* (0.045)	0.0116 (0.860)	0.0160 (0.627)	-0.00401 (0.904)	0.000870 (0.9780)	-0.00970 (0.764)
Intra-CEEC <sub>ij,t(t-5)-(t-6)</sub>	-0.0147 (0.880)	0.134** (0.003)	0.162*** (0.0000)	0.0999** (0.003)	0.119*** (0.0000)	0.134*** (0.0000)
<b>ATE: Intra-CEEC</b>	-0.340 (0.4060)	0.1340*** (0.0075)	0.253*** (0.0005)	0.2169*** (0.0005)	0.2259*** (0.0001)	0.2287*** (0.0004)
EU15→CEEC <sub>ij,t(t-1)</sub>	-0.0979 (0.202)	0.0523* (0.067)	0.0500* (0.057)	0.0572* (0.031)	0.0520* (0.040)	0.0598** (0.021)
EU15→CEEC <sub>ij,t(t-1)-(t-2)</sub>	-0.0911 (0.225)	-0.0171 (0.525)	-0.0191 (0.469)	-0.00413 (0.876)	-0.00422 (0.868)	-0.0181 (0.4850)
EU15→CEEC <sub>ij,t(t-2)-(t-3)</sub>	0.0570 (0.353)	-0.00434 (0.852)	0.00719 (0.785)	-0.00494 (0.852)	-0.00551 (0.828)	-0.00689 (0.7910)
EU15→CEEC <sub>ij,t(t-3)-(t-4)</sub>	0.0293 (0.6620)	-0.0133 (0.550)	-0.0227 (0.389)	-0.00518 (0.845)	-0.0182 (0.473)	-0.0135 (0.603)
EU15→CEEC <sub>ij,t(t-4)-(t-5)</sub>	-0.115 (0.3530)	0.0218 (0.540)	0.0237 (0.368)	-0.00503 (0.850)	0.0199 (0.4320)	0.0154 (0.553)
EU15→CEEC <sub>ij,t(t-5)-(t-6)</sub>	-0.0142 (0.8530)	0.0541* (0.0630)	0.0720*** (0.006)	0.0355 (0.181)	0.0456* (0.0720)	0.0416 (0.1080)
<b>ATE: EU15→CEEC</b>	0.0000 (0.4335)	0.1064 (0.1787)	0.1220* (0.0845)	0.0572 (0.2590)	0.0976 (0.1495)	0.0598 (0.2176)
<i>N</i>	21,772	21,840	21,840	21,840	21,840	21,840
<i>R</i> <sup>2</sup>	0.228	0.486	0.510	0.504	0.490	0.556

Note. For each trade direction the ATEs refer to the summation of significant coefficients, which are also reported in Table 2. Robust standard errors of the coefficients (clustered by country-pair) in parentheses. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

**TABLE A7** Country coverage of WIOD

Australia	Brazil	Canada	China	EU27
India	Indonesia	Japan	Mexico	South Korea
Russia	Taiwan	Turkey	United States	ROW

**TABLE A8** Industry coverage of WIOD

ISIC Rev. 3 Code	Industry
AtB	Agriculture, hunting, forestry and fishing
C	Mining and quarrying
15t16	Food, beverages and tobacco
17t18	Textiles and textile products
19	Leather, leather products and footwear
20	Wood and products of wood and cork
21t22	Pulp, paper, printing and publishing
23	Coke, refined petroleum and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics
26	Other nonmetallic minerals
27t28	Basic metals and fabricated metal
29	Machinery, not elsewhere classified
30t33	Electrical and optical equipment
34t35	Transport equipment
36t37	Manufacturing, not elsewhere classified; recycling
E	Electricity, gas and water supply
F	Construction
50	Sale and repair of motor vehicles and motorcycles; retail sale of fuel
51	Wholesale trade, except of motor vehicles and motorcycles
52	Retail trade and repair, except of motor vehicles and motorcycles
H	Hotels and restaurants
60	Inland transport
61	Water transport
62	Air transport

(Continues)

TABLE A8 (Continued)

ISIC Rev. 3 Code	Industry
63	Other supporting transport activities
64	Post and telecommunications
J	Financial intermediation
70	Real estate activities
71t74	Renting of machinery and equipment and other business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal services
P	Private households with employed persons