Supply-Chain Trade and Labor Market Outcomes: The Case of the EU 2004 Enlargement*

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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 10 Central and Eastern European Countries (CEECs) accession to the European Union (EU) affected European supply-chain trade. We find that accession primarily fostered CEECs' integration in value chains of other entrants, not incumbents. Upgrading dynamics in terms of more skill-intensive production are also driven by intra-CEEC integration. Smaller integration benefits stem for East-West trade in services for low-skill activities. These increases in value added exports translate into job creation.

Keywords: Economic integration, international fragmentation, gravity equation, input-output, labor markets, European Union (*JEL* F13, F14, F15, F16).

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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 et al., 2010). Several novel datasets on trade in value added have recently been made available, enabling research in international trade policy to move beyond conventional gross trade statistics (see, e.g., Johnson and Noguera, 2012*a*; Koopman et al., 2014; Timmer et al., 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 et al., 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, i.e., 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.

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 global value chains (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.[1]

[1] 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).

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 analyse how these dynamics translate into employment effects.

Our paper is related to Noguera (2012), 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.[2] The case of the Central and Eastern European Countries' (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 (2007)'s version of the gravity equation—which accounts for both endogenous trade policy and phase-in effects over a 5-year period—to the World Input-Output Dataset (WIOD)'s time-series data on trade in value added for 40 countries in the 1995-2009 period (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 manufactur-

[2]Throughout this paper, the Central and Eastern European Countries (CEECs) will interchangeably be referred to 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, i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, the Netherlands, Spain, Sweden, United Kingdom.

ing, 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. Surprisingly, skill-upgrading in entrants' service industries is driven by demand from other Central and Eastern European states.

The remainder of this paper is structured as follows. Section 2 reviews the literatures 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

Widespread industrialization and declining trade costs have given rise to an increase of trade in intermediate goods (Jones and Kierzkowski, 1990; Krugman and 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 10-15 percentage points in the last four decades (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 factoral 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 and 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 factoral specialization patterns due to trade integration. While specialization may arise due 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 et al., 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 US-technology) masked specialization patterns in previous studies (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, i.e., 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 et al. (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. It is in this context that our paper focuses on the specific example of the 10 new member states, which acceded to the EU 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.

The accession of CEECs was gradually phased-in and preferential liberalization already took place partly within the framework of the Europe Agreements during the 1990s. Moreover, 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. Although pre-2004 liberalization lowers additional benefits of full membership as of 2004, the EU entry was expected to give further impetus to the CEECs' growth for the following reasons: Full EU membership increased financial inflows due to political stabilization (Baldwin et al., 1997) and a further reduction of trade frictions in terms of abolished border controls and product standard harmonization facilitated integration into value chains of the EU15 (Martinez-Zarzoso et al., 2015).

3 Data & Methodology

This section describes the underlying data and outlines the empirical methodology used to answer the main questions.

3.1 Data

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% of world GDP, and provides annual time-series data for the 1995-2009 period for 14 manufacturing and 20 services industries (see Timmer et al., 2015). The Appendix provides details about descriptive statistics (**Table A.1**), country coverage (**Table A.7**) and industry coverage (**Table A.8**).

Our dependent variable of interest, VAX, is a measure of a country's "domestic value added embodied in final expenditures abroad" (Timmer et al., 2015, p. 580). While Johnson and Noguera (2012*a*) and Koopman et al. (2014) provide similar measures, there are differences in how these data are constructed. Johnson and Noguera (2012*a*)'s Value Added measure builds on the seminal contribution of Leontief (1936), who introduced a framework to describe the international Input-Output structure and follow up intermediate production steps to the nth tier via the so-called Leontief inverse L. This is appealing in a fragmented world economy as it reveals the VA contribution from domestic production steps in final products, e.g., in terms of VAX from country a to b:

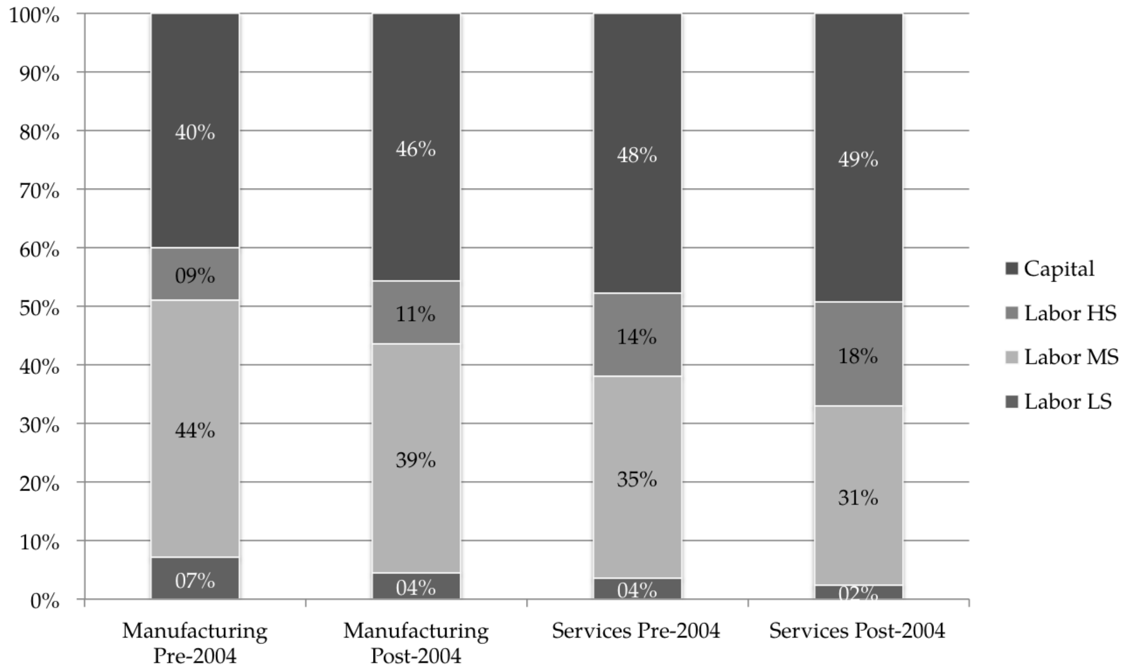
$$VAX_{ab} = v_a * L * d_b, \tag{1}$$

where VAX is calculated by multiplying a vector of value added inputs of domestic sectors v_a from country a with the international production structure exhibited by the Leontief inverse L. The product is then post-multiplied via the final demand vector in foreign country b, d_b.

A major advantage of the data obtained from WIOD is that it provides a factoral decomposition of VAX in terms of its capital and labor components. 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 factoral weights, F_a, which describes the input share of the respective factor.

When using these data, one has to consider that comprehensive databases like WIOD have to build on partly 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 do their products (Helpman et al., 2008; Altomonte et al., 2011).

Figure 1 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.

Figure 1 displays the factoral decomposition of VAX from entrants to the EU 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. 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%), while the share of high-skilled labor has grown stronger in service exports to the EU27 (4%).

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[3]

[3]For surveys, see Head and Mayer (2014) and Kohl (2014).

we employ a theoretically based log-linear gravity model that according to Anderson and Wincoop (2003) should be estimated as:

$$ln(E_{ijt}) = \beta_1 ln(Y_{it}) + \beta_2 ln(Y_{jt}) + \beta_3 ln(D_{ij}) + \beta_4 EU_{ijt} - lnP_{it}^{1-\sigma} - lnP_{jt}^{1-\sigma} + \epsilon_{ijt}, \quad (2)$$

where E_{ijt} 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 EU and 0 otherwise, and ϵ is the error term. As suggested by Anderson and Wincoop (2003) multilateral resistance—e.g., to account for the relative trade costs vis-à-vis the rest of the world—is considered by the terms $-lnP_{it}^{1-\sigma}$ and $-lnP_{jt}^{1-\sigma}$.

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, i.e., 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, i.e., geographic distance (D_{ij}), common language or colonial history.[4,5] This yields:

$$ln(E_{ijt}) = \beta_1 EU_{ijt} + \gamma_{it} F_{it} + \delta_{jt} F_{jt} + \phi_{ij} F_{ij} + \epsilon_{ijt}, \quad (3)$$

or, in first-differences:

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

assuming that $\upsilon_{ij,t-(t-1)} = \epsilon_{ijt} - \epsilon_{ij,t-1}$ is white noise. Wooldridge's (2002) test for serial correlation, reported in **Table A.2**, 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 and Bergstrand, 2007). In all cases, parameter estimates are obtained with country-pair clustered robust standard errors to mitigate potential bias due 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 and Bergstrand, 2007, p. 89-91). At the very least, our

[4]For the period of observation the unobservables of interest --e.g., cultural differences or complementary resource endowments—are assumed to be time-invariant or slow-moving.

[5]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.

results provide lower bound estimates of EU accession effects on (value-added) exports. Altogether, this yields:

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

In addition to distinguishing between gross and VA exports, we are also interested in the accession impacts at a factoral 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 factoral contributions are based on scaling the underlying VAX measure, it can be assumed that the errors of the models with the dependent variables (3)-(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 non-zero 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 ~~and unbiased~~ 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**.[6] 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.

Table 1 Total Average Treatment Effects (ATEs)

	(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
Manufacturing	0.109	0.1179**	0.0921*	0.1213*	0.1294**	0.1316**
	(0.2515)	(0.0077)	(0.0364)	(0.0156)	(0.0079)	(0.0057)
Services	-0.288**	0.0939*	0.0730*	0.1062	0.0905*	0.0903*
	(0.0818)	(0.0263)	(0.0281)	(0.0628)	(0.0127)	(0.0168)

Notes: Estimates for **Equation 5**. The full version of this table is **Table A.4** in the Appendix. Dependent variables are reported in the second row. To save space, country-time fixed effects are not reported. p-values of joint-significance of the coefficients in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

For the manufacturing sector, column (1) indicates that the accession led to an average increase of gross exports among members by about 11.5%, which is however not statistically significant.[7] In contrast, VAX (column 2) shows a positive effect of EU enlargement of 12.5%. This effect can be decomposed by factoral contributions (column 3-6). We find that the effect of EU enlargement for capital and high-skilled labor in VAX is lowest (9.6% and 12.9%), and highest for medium- and low-skilled labor (13.81% and 14.1%).

For value-added trade in services, EU enlargement induced a significant and positive

[6]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 et al., 2012).

[7]Estimates of percentage changes are for all estimations referring to the summation of baseline and phase-in effects following $(exp(baseline + phaseins) - 1) * 100\%$.

ATE of 9.8% that can be attributed to capital (7.6%), medium-skilled labor (9.5%) and low-skilled labor (9.5%). In contrast, VAX by high-skilled labor is not significantly affected and, thus, a decline in the labor-skill ratio is suggested. Based on the results from the seemingly unrelated regressions and the corresponding tests on equality of coefficients across equations reported in **Table A.3** this decline would be statistically significant.[8]

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, i.e., from entrants (CEECs) to incumbents (EU15), from entrants to other entrants (intra-CEEC), and from incumbents to entrants.[9]

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 (2-6). This is in contrast to our expectation that the CEECs would become integrated in Western-European countries' value chains once they accede to the EU. 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.[10]

Interesting is our finding that EU accession brought about stronger regional integration *among* CEECs in terms of gross exports (43.6%).[11] The estimated ATE for VAX is slightly higher at 47.4% and driven by VAX of capital (32.8%) as well as low-skilled (32%), medium-skilled (23.3%) and high-skilled labor (20.6%). Although coefficient sizes differ

[8]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).

[9]Results with a full set of (lagged) trade agreement terms are provided in **Tables A.5-A.6**.

[10]However, looking more closely at the results in **Table A.5**, significant lags for the year 2009 suggest that five years might be a timeframe too short to capture the full accession impact on CEEC-EU15 trade.

[11]While the strong intra-CEEC effect of manufacturer's gross exports is confirmed in Hornok (2010), note that our studies are not comparable due to her usage of bi-annual data for 1999-2007 and exclusion of Cyprus, Malta and Greece from the sample.

Table 2 Total ATEs: Differential Accession Impacts

	(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
Manufacturing						
CEEC→EU15	0.0000	0.0732	0.0772	0.0169	0.0197	0.0213
	(0.6625)	(0.2318)	(0.9445)	(0.9328)	(0.9776)	(0.9004
Intra-CEEC	0.362**	0.388***	0.2839**	0.1869*	0.2093*	0.278*
	(0.0088)	(0.0000)	(0.0049)	(0.0420)	(0.0260)	(0.0235)
EU15→CEEC	0.269***	0.0922***	0.159*	0.173	0.179*	0.180*
	(0.0002)	(0.0000)	(0.0417)	(0.0530)	(0.0336)	(0.0336)
Services						
CEEC→EU15	-0.461*	0.1195*	0.0003	-0.0201	0.0622*	0.1218*
	(0.0171)	(0.0255)	(0.1490)	(0.3304)	(0.0309)	(0.0269)
Intra-CEEC	-0.340	0.1340**	0.253***	0.2169***	0.2259***	0.2287***
	(0.4060)	(0.0075)	(0.0005)	(0.0005)	(0.0001)	(0.0004)
EU15→CEEC	0.0000	0.1064	0.1220	0.0572	0.0976	0.0598
	(0.4335)	(0.1787)	(0.0845)	(0.2590)	(0.1495)	(0.2176)

Notes: Estimates for **Equation 5**. The full version of this table is **Table A.5-A.6** in the Appendix. Dependent variables are reported in the second row. p-values of joint-significance of the coefficients in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

markedly, the SUR results suggest that only those of high- and medium-skilled labor are significantly different (see **Table A.3**).

Turning to the trade effects for incumbents, we find positive effects for gross (30.9%) and value added exports (9.7%) to new member states. VAX by capital increases by 17.2%. Among the labor-skill types, the effects on medium- and low-skilled labor were 19.6% and 19.7% respectively.

For *gross* exports in services (lower part of **Table 2**), we do not find evidence of meaningful accession effects for either incumbents or entrants.[12] However, the CEECs' contribution to *value added* exports with the EU15 increased by 12.7%. This effect is attributed

[12]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.

largely to low-skilled labor (13%), whereas medium-skilled labor is affected to a smaller extent (6.4%). The results from the seemingly unrelated regressions support the notion that enlargement fostered specifically low-skilled services exports to incumbents, 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%) between entrants. Here, the gains range between 24.2% for high-skilled labor and 28.8% 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.

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. 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.

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 increases in jobs across European member states by estimating:

$$\Delta J_{ij} = j_{is} \times L_{ijs2004} \times ATE_{ij} \tag{v}$$

Based on the input-output accounting framework, we can pre-multiply the sectoral

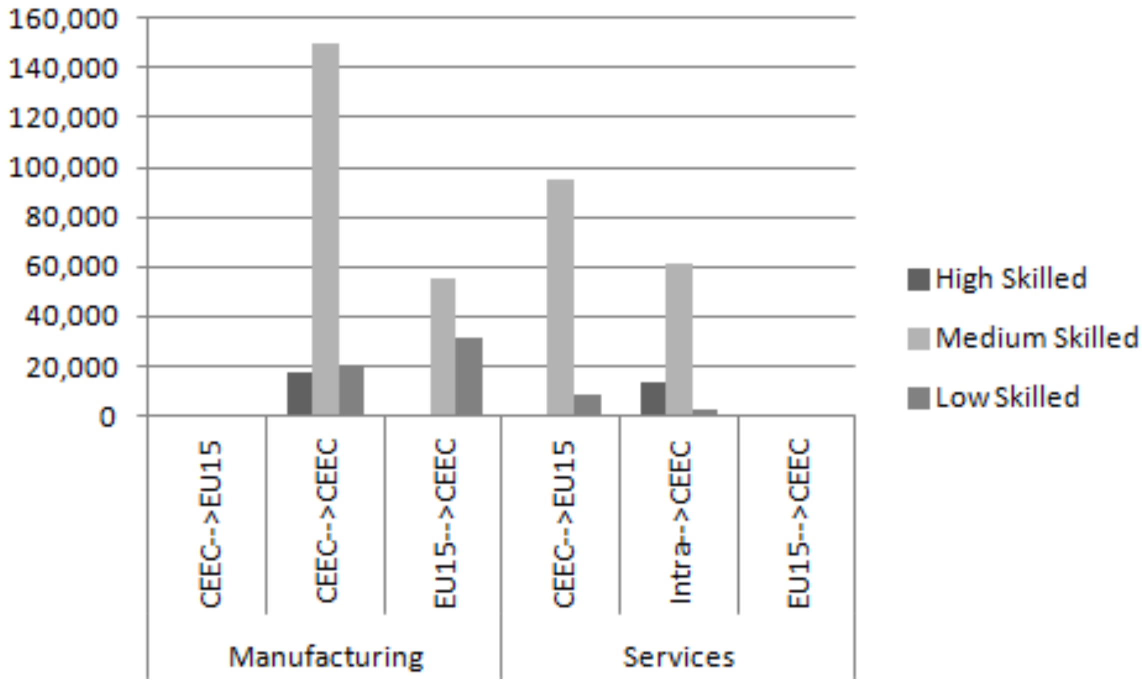
Input-Output for trade between partner i and j with a sectoral job vector j_s in order to obtain the jobs, which are implicitly contained in sectoral exports.[13] These are then post-multiplied with the treatment effects ATE_{ij} obtained in Table 2.

Figure 2 Job Market Effects by Country

The implied job gains per EU member state are depicted as a fraction of total employment in **Figure 2**. While the incumbent economies experienced minor gains from EU enlargement ranging to a maximum of 0.12% for Germany, the entrants benefit markedly. Major gains of 3.65% job growth are found in Slovakia, whereby also the other Eastern European nations exhibit markable increases of more than 1%. The smallest gains are found for Cyprus, which may be explained by its remoteness from other Central European states.

[13]In order to calculate jobs, the Leontief inverse is pre-multiplied with a vector indicating the jobs per unit of production in each sector. The underlying procedure is described in more detail in the Appendix.

Figure 3 Job Market Effects by Country



Analogously to the main results, **Figure 3** presents the implied labor market effects of 2004s EU accession by trade direction. Interestingly, although relative increases in VA 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 et al., 2013; Andersson et al., 2016). Substantial increases are found for intra-CEEC trade, where the accession leads to an implied creation of 190,000 jobs in manufacturing and 80,000 jobs in services. Interestingly, service exports of the new member states to incumbents contribute to the creation of additional 100,000 jobs, while—in contrast to pre-enlargement expectations—the manufacturing sector remains unaffected. Note that we only take into account demand effects of other EU25 member states, while not accounting for further potential gains associated to the integration in global value chains of partner countries producing for African, American or Asian consumers.[14]

[14]These aspects are covered by other complementing studies. See, e.g., Timmer et al. (2013).

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," i.e., changes in trade flows prior to the *de jure* enforcement of the trade agreement. A significant 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%). 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 and 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, i.e., the Baltic Free Trade Area (BAFTA) and the Central European Free Trade Agreement (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.

Table 3 Anticipation and Phase-In Effects

	(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
Manufacturing						
$EU_{ij,t+5}$	-0.0320	-0.0151*	-0.0115	-0.0126	-0.0127	-0.0121
	(0.065)	(0.015)	(0.1883)	(0.1260)	(0.1240)	(0.1430)
Total ATE	0.109	0.133**	0.115	0.1307*	0.1391*	0.14*
	(0.2190)	(0.0045)	(0.0575)	(0.0455)	(0.0310)	(0.0309)
Services						
$EU_{ij,t+5}$	0.00507	-0.00663	-0.00387	-0.00652	-0.0103	-0.0134
	(0.731)	(0.257)	(0.521)	(0.440)	(0.202)	(0.104)
Total ATE	-0.293	0.1398*	0.0768	0.0875	0.1407**	0.1574**
	(0.2190)	(0.0377)	(0.0502)	(0.1068)	(0.0063)	(0.0039)

Notes: Estimates for **Equation 5** including lead term in levels (5 years). Dependent variables are reported in the second row. *p*-values of joint-significance 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.

In order to test whether it is not the de jure accession impact which 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.[15] 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.

[15]For instance, the fifth lag of a 2000 placebo accession is in 2005, one year after the true EU accession.

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

Notes: Estimates for **Equation 5** for different "placebo" years of entry. Dependent variables are reported in the second row. p-values of joint-significance 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.

6 Discussion & 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 at a sectoral and factoral level. Our results indicate that while gross exports of manufacturers grew thanks 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 et al., 2013): Czech financial services do not "cross the border," but are implicitly embedded in Czech car parts destined for export markets. Another explanation may be that the European internal market for goods was already more liberalized than the market for services.[16]

Nevertheless, positive accession effects can be observed for both sectors when value added exports (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 it is mainly the old member states' demand that fosters gross and VAX growth (Baldwin et al., 1997). In contrast, our paper's results indicate that it is the demand from new entrants that exerts a strong impulse. Our interpretation is that EU15 demand was already close to its natural level due to 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% vs. 1.1% annually) (IMF, 2014). Thus, entrants seem to participate less than expected in Western European value chains and there is no evidence for the es-

[16]For a draft of the EU directive on services in the internal market 2006/123/EG, European Commissioner Bolkenstein 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.

tablishment of a hub-and-spoke structure between core and periphery (De Benedictis et al., 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 2004s accession. While the enlargement promoted manufacturing value added exports from incumbents to entrants, there is no increase in the reversed 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.[17]

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 lower-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 low skill intensity are disproportionately favored by the reduction of trade impediments. Referring to Johnson and Noguera (2012*b*), 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 attributable to production steps involving low value adding activities associated with lower-skilled labor. If trade is liberalized and

[17]The small and mostly insignificant placebo effects in **Table 4** suggest that strong dynamics before the *de iure* accession are unlikely.

barriers are reduced, traded tasks do not have to be that profitable anymore in order to justify the trade costs—trade in low-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 to global trade integration. Therefore, in intra-EU trade relations, low value adding activities would be favored vis-á-vis trade of EU members with other parts of the world. The result would be the previously found over-proportional increase in low-skill value added exports from the CEECs to the EU. 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 EU 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, recently announced 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 and Bergstrand (2007). Second, more comprehensive data for larger country samples and more detailed factoral 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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Appendix

A 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 A.1**. 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 importers). The highest share of non-positive values was detected in gross exports of services (55 out of 23,400 observations, or 0.24%). Such values may be attributed to negative changes in importing countries' inventories. Overall, zero 'trade' flows are not prevalent in the data.

Table A.1 Descriptive Statistics (in Millions of US$)

Variable	Mean	Median	Max.	Min.	Std. Dev.
Manufacturing					
(1) Gross Exports	2919.7	288.1	292331.7	0.00	11018.78
(2) VAX	1217.1	133.43	149851.3	-0.22	4733.7
(3) VAX by Capital	481.4	54.58	100421.1	-17.22	2211.7
(4) VAX by Labor HS	193.5	13.20	17567.9	-0.01	812.7
(5) VAX by Labor MS	378.4	33.56	36487.3	-0.01	1562.1
(6) VAX by Labor LS	163.8	16.16	24348.8	-.08	603.2
Services					
(7) Gross Exports	837.2	86.7	90597.9	0.00	2781.3
(8) VAX	1405.4	179.7	128842.2	0.18	4717.0
(9) VAX by Capital	621.1	80.9	70668.5	0.04	2327.8
(10) VAX by Labor HS	282.0	28.4	20872.4	0.03	1008.0
(11) VAX by Labor MS	381.7	41.6	39208.0	0.03	1343.18
(12) VAX by Labor LS	120.6	14.8	8373.4	0.01	349.91

Source: Authors' calculations based on WIOD.

B Additional Results

Table A.2 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
Manufacturing						
FE	196.113	324.653	436.405	300.29	246.392	282.519
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
FD	0.654	2.408	0.048	9.485	11.753	7.938
	(0.4187)	(0.1209)	(0.8273)	(0.0021)	(0.0006)	(0.0049)
Services						
FE	547.768	1792.998	1380.092	1756.719	1693.634	1804.236
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
FD	100.428	10.446	7.638	22.110	12.173	8.572
	(0.0000)	(0.1209)	(0.0002)	(0.0000)	(0.0000)	(0.0000)

Note: F-values, with p-values in parentheses.

Table A.3 Test for Coefficient Equality Based on Seemingly Unrelated Regressions

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

Note: p-values in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.4 Full Lag Structure: Total Average Treatment Effects

	(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
Manufacturing						
$\text{Accession}_{ij,t-(t-1)}$	0.109**	0.0671***	0.0455**	0.0741***	0.0777***	0.0785***
	(0.012)	(0.000)	(0.025)	(0.001)	(0.000)	(0.000)
$\text{Accession}_{ij,(t-1)-(t-2)}$	-0.0380	-0.00897	0.0202	-0.0236	-0.0238	-0.0240
	(0.280)	(0.566)	(0.288)	(0.205)	(0.202)	(0.196)
$\text{Accession}_{ij,(t-2)-(t-3)}$	-0.0209	-0.00674	-0.0138	-0.00185	0.00141	0.000273
	(0.548)	(0.694)	(0.421)	(0.923)	(0.941)	(0.989)
$\text{Accession}_{ij,(t-3)-(t-4)}$	0.00464	-0.0111	-0.0199	-0.00372	-0.00685	-0.00855
	(0.912)	(0.582)	(0.326)	(0.858)	(0.742)	(0.683)
$\text{Accession}_{ij,(t-4)-(t-5)}$	-0.0281	-0.0150	-0.0127	-0.0177	-0.0160	-0.0121
	(0.433)	(0.421)	(0.523)	(0.341)	(0.396)	(0.523)
$\text{Accession}_{ij,(t-5)-(t-6)}$	0.0161	0.0508**	0.0466**	0.0472**	0.0518**	0.0532**
	(0.677)	(0.015)	(0.033)	(0.029)	(0.017)	(0.013)
ATE: Accession Manufacturing	0.109	0.1179**	0.0921*	0.1213*	0.1294**	0.1316**
	(0.2515)	(0.0077)	(0.0364)	(0.0156)	(0.0079)	(0.0057)
Services						
$\text{Accession}_{ij,t-(t-1)}$	0.0184	0.0353*	0.0316	0.0350*	0.0401*	0.0390*
	(0.744)	(0.082)	(0.119)	(0.089)	(0.054)	(0.070)
$\text{Accession}_{ij,(t-1)-(t-2)}$	-0.00826	-0.00500	-0.00787	0.00395	0.00639	0.00414
	(0.896)	(0.817)	(0.719)	(0.867)	(0.765)	(0.850)
$\text{Accession}_{ij,(t-2)-(t-3)}$	0.0147	0.0261	0.0253	0.0317*	0.0296	0.0269
	(0.774)	(0.146)	(0.167)	(0.099)	(0.106)	(0.162)
$\text{Accession}_{ij,(t-3)-(t-4)}$	0.0541	0.00611	0.00514	0.00501	0.00424	0.000661
	(0.316)	(0.742)	(0.784)	(0.812)	(0.824)	(0.972)
$\text{Accession}_{ij,(t-4)-(t-5)}$	-0.288***	-0.0242	-0.0249	-0.0468	-0.0189	-0.0126
	(0.001)	(0.407)	(0.398)	(0.144)	(0.509)	(0.668)
$\text{Accession}_{ij,(t-5)-(t-6)}$	-0.00662	0.0586***	0.0730***	0.0395*	0.0504**	0.0513**
	(0.904)	(0.005)	(0.001)	(0.055)	(0.013)	(0.027)
ATE: Accession Services	-0.288	0.0939*	0.0730*	0.1062	0.0905*	0.0903*
	(0.0818)	(0.0263)	(0.0281)	(0.0628)	(0.0127)	(0.0168)
N	21832	21838	21775	21838	21838	21838
R^2	0.203	0.492	0.579	0.523	0.494	0.521

Notes: 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 A.5 Full Lag Structure: Differential Accession Impacts for Manufacturing

	(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
Manufacturing						
CEEC→EU15$_{ij,t-(t-1)}$	-0.0505	-0.0341	-0.0687*	-0.0576*	-0.0562*	-0.0557*
	(0.430)	(0.2480)	(0.013)	(0.0026)	(0.031)	(0.032)
CEEC→EU15$_{ij,(t-1)-(t-2)}$	-0.00579	0.0181	0.0772**	0.0304	0.0295	0.0296
	(0.927)	(0.4790)	(0.005)	(0.240)	(0.256)	(0.254)
CEEC→EU15$_{ij,(t-2)-(t-3)}$	-0.0988	-0.0342	-0.0531	-0.0476	-0.0452	-0.0467
	(0.098)	(0.2380)	(0.0054)	(0.065)	(0.082)	(0.071)
CEEC→EU15$_{ij,(t-3)-(t-4)}$	0.0602	0.0176	0.00578	0.0783	0.00798	0.0836
	(0.422)	(0.6190)	(0.833)	(0.761)	(0.758)	(0.746)
CEEC→EU15$_{ij,(t-4)-(t-5)}$	-0.0420	-0.0144	-0.0140	-0.0128	-0.0103	-0.00464
	(0.478)	(0.6520)	(0.61)	(0.617)	(0.691)	(0.857)
CEEC→EU15$_{ij,(t-5)-(t-6)}$	0.0434	0.0732**	0.0482	0.0745***	0.0759***	0.0770***
	(0.490)	(0.0270)	(0.078)	(0.0004)	(0.003)	(0.003)
ATE: CEEC→EU15	0.0000	0.0732	0.0772	0.0169	0.0197	0.0213
	(0.6625)	(0.2318)	(0.9445)	(0.9328)	(0.9776)	(0.9004)
Intra-CEEC$_{ij,t-(t-1)}$	0.362***	0.263***	0.219***	0.239***	0.246***	0.247***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Intra-CEEC$_{ij,(t-1)-(t-2)}$	-0.124	-0.0454	0.0438	-0.0192	-0.0190	-0.0196
	(0.132)	(0.256)	(0.205)	(0.553)	(0.559)	(0.547)
Intra-CEEC$_{ij,(t-2)-(t-3)}$	-0.116	-0.0625	-0.0495	-0.0938***	-0.0886**	-0.0900**
	(0.118)	(0.110)	(0.149)	(0.0004)	(0.006)	(0.005)
Intra-CEEC$_{ij,(t-3)-(t-4)}$	-0.0253	-0.0146	-0.0435	-0.00830	-0.0147	-0.0183
	(0.765)	(0.719)	(0.204)	(0.796)	(0.0649)	(0.570)
Intra-CEEC$_{ij,(t-4)-(t-5)}$	-0.101	-0.0759	-0.0821*	-0.0693*	-0.0671*	-0.0623
	(0.208)	(0.0770)	(0.016)	(0.031)	(0.037)	(0.053)
Intra-CEEC$_{ij,(t-5)-(t-6)}$	0.0551	0.125**	0.147***	0.111***	0.119***	0.121***
	(0.476)	(0.003)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
ATE: Intra-CEEC	0.362**	0.388***	0.2839**	0.1869*	0.2093*	0.278*
	(0.0088)	(0.0000)	(0.0049)	(0.0420)	(0.0260)	(0.0235)
EU15→CEEC$_{ij,t-(t-1)}$	0.269***	0.168***	0.159***	0.173***	0.179***	0.180***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
EU15→CEEC$_{ij,(t-1)-(t-2)}$	-0.0702	-0.0361*	-0.0360	-0.0388	-0.0383	-0.0389
	(0.0860)	(0.0500)	(0.188)	(0.130)	(0.138)	(0.131)
EU15→CEEC$_{ij,(t-2)-(t-3)}$	0.0569	0.0208	0.0249	0.0158	0.0199	0.0193
	(0.1240)	(0.2540)	(0.363)	(0.537)	(0.440)	(0.455)
EU15→CEEC$_{ij,(t-3)-(t-4)}$	-0.0509	-0.0397*	-0.0456	-0.0267	-0.0332	-0.0369
	(0.1750)	(0.0360)	(0.096)	(0.298)	(0.199)	(0.152)
EU15→CEEC$_{ij,(t-4)-(t-5)}$	-0.0143	-0.0157	-0.0115	-0.0226	-0.0217	-0.0196
	(0.733)	(0.423)	(0.676)	(0.379)	(0.401)	(0.447)
EU15→CEEC$_{ij,(t-5)-(t-6)}$	-0.0111	0.0285	0.0449	0.0198	0.0276	0.0293
	(0.808)	(0.263)	(0.101)	(0.441)	(0.284)	(0.255)
ATE: EU15→CEEC	0.269***	0.0922***	0.159*	0.173	0.179*	0.180*
	(0.0002)	(0.0000)	(0.0417)	(0.0530)	(0.0336)	(0.0336)
N	21832	21838	21775	21838	21838	21838
R^2	0.203	0.492	0.579	0.523	0.494	0.521

Notes: 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 A.6 Full Lag Structure: Differential Accession Impacts for Services

	(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
Services						
CEEC→EU15$_{ij,t-(t-1)}$	0.134	0.0182	0.0131	0.0128	0.0282	0.0182
	(0.097)	(0.525)	(0.618)	(0.630)	(0.266)	(0.483)
CEEC→EU15$_{ij,(t-1)-(t-2)}$	0.0743	0.00714	0.00332	0.0120	0.0170	0.0264
	(0.461)	(0.829)	(0.899)	(0.651)	(0.503)	(0.309)
CEEC→EU15$_{ij,(t-2)-(t-3)}$	-0.0275	0.0565*	0.0433	0.0684*	0.0647*	0.0607*
	(0.720)	(0.0350)	(0.100)	(0.010)	(0.011)	(0.019)
CEEC→EU15$_{ij,(t-3)-(t-4)}$	0.0786	0.0255	0.0329	0.0152	0.0267	0.0148
	(0.317)	(0.372)	(0.211)	(0.567)	(0.293)	(0.568)
CEEC→EU15$_{ij,(t-4)-(t-5)}$	-0.461***	-0.0702	-0.0736*	-0.0885**	-0.0577*	-0.0406
	(0.0000)	(0.130)	(0.005)	(0.001)	(0.0230)	(0.118)
CEEC→EU15$_{ij,(t-5)-(t-6)}$	0.000877	0.0630*	0.0739**	0.0434	0.0552*	0.0611*
	(0.9910)	(0.034)	(0.005)	(0.102)	(0.030)	(0.019)
ATE: CEEC→EU15	-0.461*	0.1195*	0.0003	-0.0201	0.0622*	0.1218*
	(0.0171)	(0.0255)	(0.1490)	(0.3304)	(0.0309)	(0.0269)
Intra-CEEC$_{ij,t-(t-1)}$	0.0250	0.105	0.0910**	0.117***	0.113***	0.0947**
	(0.831)	(0.057)	(0.006)	(0.0000)	(0.000)	(0.0030)
Intra-CEEC$_{ij,(t-1)-(t-2)}$	-0.0459	0.0115	0.0137	0.0106	0.0298	0.0489
	(0.695)	(0.789)	(0.676)	(0.750)	(0.348)	(0.131)
Intra-CEEC$_{ij,(t-2)-(t-3)}$	0.0981	0.0385	0.0177	0.0629	0.0531	0.0470
	(0.301)	(0.334)	(0.589)	(0.058)	(0.094)	(0.147)
Intra-CEEC$_{ij,(t-3)-(t-4)}$	-0.0322	-0.0142	-0.0219	-0.00439	-0.0210	-0.0351
	(0.742)	(0.721)	(0.505)	(0.895)	(0.507)	(0.279)
Intra-CEEC$_{ij,(t-4)-(t-5)}$	-0.340*	0.0116	0.0160	-0.00401	0.000870	-0.00970
	(0.045)	(0.860)	(0.627)	(0.904)	(0.9780)	(0.764)
Intra-CEEC$_{ij,(t-5)-(t-6)}$	-0.0147	0.134**	0.162***	0.0999**	0.119***	0.134***
	(0.880)	(0.003)	(0.0000)	(0.003)	(0.0000)	(0.0000)
ATE: Intra-CEEC	-0.340	0.1340***	0.253***	0.2169***	0.2259***	0.2287***
	(0.4060)	(0.0075)	(0.0005)	(0.0005)	(0.0001)	(0.0004)
EU15→CEEC$_{ij,t-(t-1)}$	-0.0979	0.0523*	0.0500*	0.0572*	0.0520*	0.0598**
	(0.202)	(0.067)	(0.057)	(0.031)	(0.040)	(0.021)
EU15→CEEC$_{ij,(t-1)-(t-2)}$	-0.0911	-0.0171	-0.0191	-0.00413	-0.00422	-0.0181
	(0.225)	(0.525)	(0.469)	(0.876)	(0.868)	(0.4850)
EU15→CEEC$_{ij,(t-2)-(t-3)}$	0.0570	-0.00434	0.00719	-0.00494	-0.00551	-0.00689
	(0.353)	(0.852)	(0.785)	(0.852)	(0.828)	(0.7910)
EU15→CEEC$_{ij,(t-3)-(t-4)}$	0.0293	-0.0133	-0.0227	-0.00518	-0.0182	-0.0135
	(0.6620)	(0.550)	(0.389)	(0.845)	(0.473)	(0.603)
EU15→CEEC$_{ij,(t-4)-(t-5)}$	-0.115	0.0218	0.0237	-0.00503	0.0199	0.0154
	(0.3530)	(0.540)	(0.368)	(0.850)	(0.4320)	(0.553)
EU15→CEEC$_{ij,(t-5)-(t-6)}$	-0.0142	0.0541*	0.0720***	0.0355	0.0456*	0.0416
	(0.8530)	(0.0630)	(0.006)	(0.181)	(0.0720)	(0.1080)
ATE: EU15→CEEC	0.0000	0.1064	0.1220*	0.0572	0.0976	0.0598
	(0.4335)	(0.1787)	(0.0845)	(0.2590)	(0.1495)	(0.2176)
N	21772	21840	21840	21840	21840	21840
R^2	0.228	0.486	0.510	0.504	0.490	0.556

Notes: 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. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

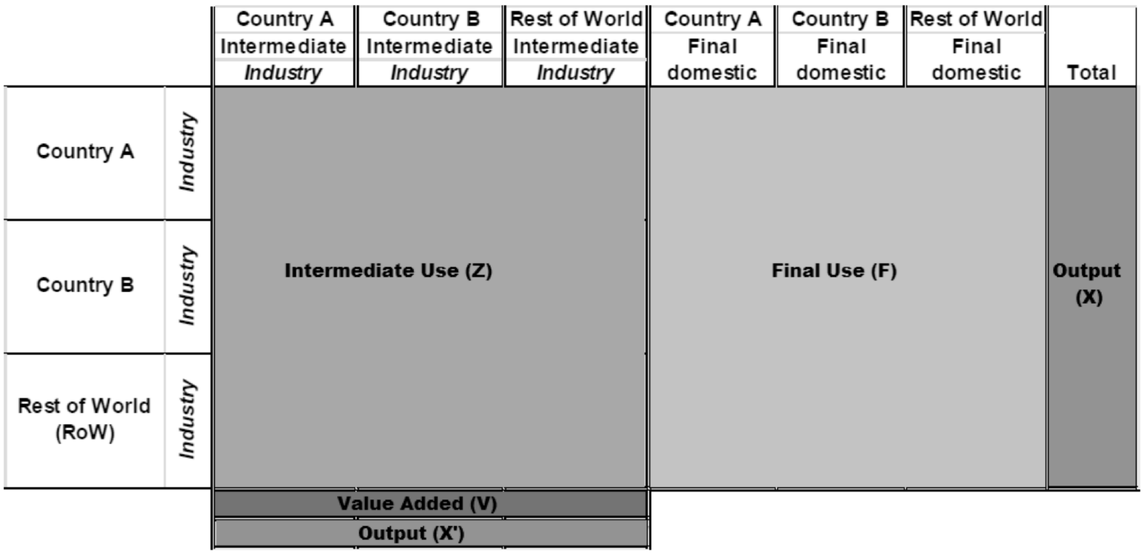
C Estimating Value Added measures based on the World Input Output Database

Leontief's accounting framework is increasingly used in order to account for the fragmentation of trade. Based on the so called Leontief inverse, it becomes possible to follow up the n-th intermediate production step of a product and, hence, to trace back VA contributions from different countries via an Input Output Table.

Figure A.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 Ouptut X or X' respectively. If we divide the 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 involve usually 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 Finish Pulp and Paper products as well as British Real Estate activities. Leontief (1936) showed that it is possible to describe these input-structure until the n-th tier via the inverse $L = (I - A)^{-1} = I + A + A^2 + ... + A^n$. The Leontief approach makes it thus possible not only to account for direct inputs, but for the indirect input structure of an economy.[18]

[18]Leontief already revealed in 1936 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 US' capital-intensity in imports occupied economists for several decades (Leontief, 1953).

Figure A.1 Schematic World Input Output Table



An actual WIOT involves not only three regions, but 40 countries (plus the Rest of World) with each 35 sectors, yielding 1435 world output sectors X(1435x1). The Intermediate Input matrix Z therefore has the structure of 1435 intermediate input sectors for 1435 intermediate goods (1435x1435). As WIOD distinguishes domestic final demands in five different use categories per region (5* 41), the Final Use matrix' dimension is 1435x205.

We now turn back to the initially described measure of VA from Lithuania (Country A) embodied in exports to Finland (Country B). In this context we would like to 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 $VAX_{ab} = v_a * L * f_b$, where v_a is the Value Added vector of the dimension (1x1435), consisting of zeros, except from the 841th until 875th digit $v_a(1, 841 : 875)$, describing Country A's VA-coefficients in the WIOD. The f_b vector is a summation of the five columns of the 1435 rows describing country B's use of worldwide outputs F(1:1435,66:70). The same framework is used to calculate the VA contribution of capital and labor inputs, by accounting for the shares of capital and different labor skill levels in the sectoral VA.

Table A.7 Country Coverage of WIOD

Australia	Brazil	Canada	China	EU27
India	Indonesia	Japan	Mexico	South Korea
Russia	Taiwan	Turkey	USA	

Table A.8 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 non-metallic 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
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