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GROSS EXPORTS VERSUS VALUE ADDED EXPORTS: DETERMINANTS AND POLICY IMPLICATIONS FOR MANUFACTURING SECTORS IN SELECTED CEE COUNTRIES

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Gross Exports versus Value Added Exports: determinants and policy implications for manufacturing sectors in selected CEE countries

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ABSTRACT

The main objective of this paper is to assess the impact of selected determinants on both exports in value added and exports in gross terms for seven CEE economies, based on 13 manufacturing subsectors and for the period 1995-2011. The results of the analysis show a substantial decrease in domestic value added in a majority of the countries, especially in medium-high- and high-tech industries. For the seven CEE countries the impact of the main determinants (except vertical specialisation) are fairly similar when exports are measured in value added or in gross terms. The results indicate a greater impact of labour productivity and highly skilled employees on generating domestic value added in the manufacturing sector. CEE countries do not achieve comparative advantages of a capital-intensive nature in exports of manufactured products. Additionally, manufacturing in CEE countries does not serve a 'carrier function' for services to contribute to a country's export performance.

JEL classification codes: C23, F12, F14, F40, L60

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1. Introduction

Value chains have been rapidly evolving in the last decade. In 2011, nearly half (49 per cent) of the world trade in goods and services took place within global value chains (GVCs), up from 36 per cent in 1995 (WTO, 2015). Earlier, the use of imports to produce goods for export was much limited. Nowadays, due to widespread intra-industry specialization inputs pass through chains and cross borders many times (Hummels et al., 2001). This means that traditional trade data include substantial double-counting, so new data – new indicators to estimate and evaluate the position of countries in the new global trade – are required. A possible solution could be an analysis of "trade in value added" which takes into account the value added embodied in intermediate flows, in contrast with gross trade statistics, where this flow is skipped and which may or may not lead to a biased estimation. WTO former Director General Pascal Lamy has advocated that global trade should "trade added value" as a new trade statistics standard (Wang and Xie, 2014).

The first method of calculating trade in value added was proposed by Hummels et al. (2001) and then was developed and improved by Koopman et al. (2008). The first empirical analyses of value added trade provide some revealing facts. The differences are large between gross and value added exports, ranging from 50% for Taiwan to 90% for Russia (Johnson and Noguera, 2012a).³ According to Johnson (2014), the ratio of value added to gross trade declined from 85% in the early 1970s to 71% in 2008, which implies an increase in double counting in trade statistics. This ratio varies strongly across trade partners (e.g. for Germany from 60% to 100%, for Japanese exports to the US even 107%), but it is lower between nearby countries (Johnson and Noguera, 2012b) and countries belonging to regional trade agreements than for trade with those outside them (Johnson, 2014). Moreover, manufacturing becomes less important compared to services in value added terms than in gross terms, i.e. in 2008 in world statistics the share of manufacturing and the shares of services in gross world exports were respectively 70% and 20%, while in value added terms the percentages for both sectors were the same, around 40% (Johnson, 2014).⁴

The most recent analyses based on trade in value added have been used to estimate bilateral trade imbalances or to reveal comparative advantages in exports among selected countries (Johnson, 2014; Johnson and Noguera, 2012c). In the first type of analysis, the trade balances of the countries analysed in gross terms often differ from those measured in value added terms. For example, the USA-China imbalance in value added for 2010 was 23.5% smaller than

³ This ratio is higher, the smaller the share of manufacturing in total exports is (Johnson and Noguera, 2012a).

⁴ In gross terms, manufacturing is characterized by a higher import content of exports than services and manufacturing exports include value added from the services sector.

that measured in gross terms, whereas in relation to the rest of the world China has a 94% larger trade balance in terms of value added than in gross terms (Kuboniwa, 2014). These findings are coherent with the results of studies focused on the distribution of revealed comparative advantages (RCAs) calculated comparing gross exports and value added terms, i.e. RCAs measured using the two terms are significantly different (Brakman and Marrewijk, 2015) and RCAs based on gross exports and value added lead to different conclusions (Timmer et al., 2013; Johnson, 2014; Koopman et al., 2014).

The increasing importance of value chains in the world economy entails not only a necessity of a new approach to measuring them, but it also changes the competition landscape for single economies or groups of economies. EU countries, for example, are meeting competition in GVCs from new countries, i.e. from emerging economies such as China, Brazil and India, and increasingly for high-value products. This is why the European Commission has "refocused attention on the central importance of a strong, competitive and diversified industrial manufacturing value chain for the EU's competitiveness and job creation potential" (COM, 2010). However, among EU countries, the degree of participation in global value chains is surprisingly greater among CEE countries than in other EU countries (i.e. 62.4% for the Czech Republic, 56.6% for Hungary, 50.2% for Lithuania, 49.5% for Germany, 45.9% for France)⁵. This is why in this paper we focus on selected CEE countries and on their participation in GVCs. In particular, we aim to fill the gap existing in the empirical literature by finding the determinants of exports in value added terms (compared to exports in gross terms) for selected CEE economies. We concentrate on 13 manufacturing subsectors (NACE 1.1) for the years 1995-2011, due to the very high (often 3/4) share of manufacturing in the total exports of CEE countries.

The structure of the paper is as follows. In the first part, the theoretical background for research on export determinants in value added terms is presented. Next, both the data and the methodology of the research conducted are shown. The subsequent part provides the results of the empirical analysis. Conclusions follow.

2. Theoretical background and related literature

The pioneering research on trade in value added can be considered that of Leontief and Strout (1963), who proposed a first formalized approach to the analysis of the nature of global

⁵ The degree of participation in global value chains is the sum of the value added by trade partners included in a country's total exports and the value added by the country included in its trade partners' total exports.
https://www.ecb.europa.eu/home/pdf/research/compnet/20131212/ws_3_iossifov.pdf?12244fa23bc7a0682cd1ec77c52f6659.

production. However, real attention to 'the value added' in trade flows was paid twenty years later in two types of economic research.

First, there are analyses of the importance of intermediate goods and services in international trade. Sanyal and Jones (1982) in their models of trade in intermediate products indicated that "few items in international commerce are pure raw materials or primary factors which have not received any value added from other local inputs". Today, intermediates constitute almost 56% of world goods trade and 70% of world imports (UNCTAD, 2014), so the sum of hidden and embodied value added in intermediates is becoming larger and larger.

Second, in models of vertical specialization trade by Dixit and Grossman (1982) and Sanyal (1983) the vertical trading chain stretching across many countries is shown, where each country specializes in particular stages of the production sequence of a good and two or more countries provide value added in the production sequence (Hummels et al., 2001). The most popular measure of trade in vertical production chains is the import content of exports. This index, despite being much narrower, is very close to the concept of trade in value added, i.e. recognising and counting the domestic and foreign value added in gross exports.

The first papers strictly related to the measurement of value-added trade are by Wang (2005), Daudin et al. (2006), Johnson and Noguera (2009) and Daudin et al. (2009). All these researchers worked independently on reallocating trade flows from the Global Trade Analysis Project (GTAP) to their original input-producing industries/countries and calculating trade in value added terms. All these approaches and measures are used by Koopman et al. (2010), who propose a first full decomposition of value added trade, i.e. into domestic value, returned domestic value and foreign value added.

Koopman et al.'s (2010) conceptual framework led to an explosion of empirical research on trade in value added. As previously mentioned, these analyses concentrate on estimating bilateral trade imbalances or revealed comparative advantages in exports in valued added terms. The value-added approach to trade analysis has so far brought one important insight to trade policy, related to protectionism policy. High protectionist tariffs against intermediate inputs become self-defeating for a country, since higher costs of these imports obviously hurt a country's exports too. Certain instruments of government support for exports (like currency interventions) become useless in cases when intermediate inputs purchased from abroad are more expensive, making final domestic products non-competitive in foreign markets. Therefore, empirical trade analyses in value added terms, in contrast with gross trade data, indicate different trading results between countries and force changes in trade policies. From this, a new important

and still open question arises: whether exports in value added and in gross terms have the same determinants.

So far, few analyses related to the determinants of exports/trade in value added (TiVA) have been conducted (Choi, 2013; Yücer et al., 2014; Nakazawa et al., 2014, Guilhoto et al., 2015). These mostly use the gravity model, which often shows the impact of only three determinants on countries' exports: market size (home market effect), geographical location and gaps in resources and technology between economies. The results of these analyses are often misleading and do not give a clear answer to whether the determinants of exports in value added or in gross terms are different or which kind of data is more suitable for the creation of an appropriate export policy. In some analyses – e.g. for the exports of Brazilian states – the bilateral gravity model shows that the main determinants (GDP, distance etc.) are fairly similar when exports are estimated either way (Yücer et al., 2014, Guilhoto et al., 2015), or even the explanatory power of the gravity model based on value added (VA) data turns out to be relatively small compared to that of pooled data on trade in gross value (Choi, 2013). In other studies, gravity equations fit better with VA exports than with 'gross' exports, and capital ratios and technological differences have more significant effects on TiVA flows than on trade in gross terms (Nakazawa et al., 2014).

We find one major weakness in the existing analyses. The models applied (gravity models) take into account too few export determinants, which does not allow differences in the determinants of exports in gross and value added terms to be captured. The approach proposed by Landesmann et al. (2015) partly eliminates this gap. This is an econometric analysis of export determinants both in gross and VA terms, including in the model explanatory variables highlighted by traditional and new trade theories.

We also take our main export determinants from various trade theories, but additionally we try to focus on those determinants which well characterize the specificity of manufacturing sector. Referring to classical trade theories, e.g. Ricardo's comparative theory, we use the unit labour cost as the first determinant of export growth. According to the literature overview by Turner and Van't Dack (1993) and the literature analysis by Turner and Golub (1997), in industrialized economies unit labour costs (ULCs) in manufacturing seem to be the best single measure of cost/price advantages of countries. There are myriads of examples of studies on the negative relationship between the level of unit labour costs and the intensity of exports (Ito and Shimizu, 2013; Guerrieri and Cafferelli, 2012), but sometimes, especially in countries with low levels of ULC, exports can increase even when ULCs increase (Lewney, 2011).

Next, based on the Heckscher-Ohlin model, which says that countries will export products that use their abundant and cheap factor(s) of production and import products that use factors which for them are scarce, we use labour and capital ratios to evaluate the importance of these two production factors in export increases. Because of the Leontief paradox, we focus not on the quantity but on the quality of labour. We treat labour as a heterogeneous factor, defined by its skill composition in terms of high-, medium- and low-skilled labour shares. Landesmann et al. (2009) confirm a positive influence of a higher share of both high- and medium-skilled labour on the export growth of industries for selected EU countries. As a capital ratio, we take the share of capital stock in gross output to verify whether comparative advantages in CEE manufacturing are capital-intensive or not.

Based on new new trade theory (*New, New Trade Theory – NNTT*), and especially on Melitz's model (2003) and Melitz and Ottaviano's model (2008), we take labour productivity as a factor having a positive influence on export expansion (self-selection hypothesis). In the literature there are plenty of empirical firm-level analyses which confirm that exporters are more productive than non-exporters, and also in manufacturing sectors (Bustos, 2011, Cieřlik et al., 2012).

Nowadays, we observe two major phenomena in manufacturing which have fundamentally altered the global trade landscape in this sector. First, manufacturing activities have become increasingly intertwined with services in many ways: a fragmentation of production processes involves a demand for services such as co-ordination, administration and transportation, increasing the demand for specialized customized production, inquiry planning and product engineering services (an instrument for product differentiation). Modern manufacturing production depends strongly on software and the services it can provide. Therefore, services may impact on export performance by raising labour productivity, reducing costs and product differentiation, which may raise the income elasticity of goods. Wolfmayr's (2012) analysis confirms that service inputs to manufacturing industries contribute positively to the export performance of this sector, so we decide to use backward linkages of manufacturing industries with services as a determinant of export growth in our analysis.

Second, according to Hummels et al. (2001), there is a process of joint fragmentation of manufacturing production, where specialization has become increasingly vertical (countries use imported intermediate inputs to produce goods they later export). In the literature there are two arguments in favour of a positive effect of increased specialization on economic growth: first, following the Ricardian tradition, the exploitation of comparative advantages through specialization fosters growth; second, as advocated by the endogenous growth tradition, the

exploitation of economies of scale or knowledge and technology spillovers results in higher growth (Vogiatzoglou, 2012). Many empirical studies have confirmed a positive impact of vertical specialization on economic growth through productivity increases and income growth (employment growth), but few analyses have treated vertical specialisation as an important determinant of export performance (Guerrieri and Caffarelli, 2012; Vogiatzoglou, 2012). Leitner and Stehner (2014) also show that export growth and the degree of vertical specialization tend to reinforce each other, i.e. the effects of export growth on macroeconomic performance tend to be even higher if vertical specialization is high. Therefore, we decide to add vertical specialization to the export determinants in our models.

In our study, we also take institutional determinant of export intensity into account. It is very difficult to find one determinant, which shows the impact of the economic governance mechanisms on the export intensity. We decided to use the Government Effectiveness Index, which seems to be one of the most complex indicators measuring the quality of the government (Lee and Whitford, 2009). In literature, we can find many empirical studies which have confirmed a positive impact of government effectiveness on the export performance, the macro-competitiveness, the internationalization and the growth rate of economies (Cuckovic and Jurlin, 2009, Xuehui et al., 2014; Marinova, 2015)

As a last determinant of export growth, we take foreign demand. Traditionally, export performance is modelled as a function of the foreign demand for a country's output and indicators of a country's price and quality competitiveness. Of course, an increase in foreign demand (not the absolute value of foreign demand) fosters exports. However, at the same time the nature of the GVC phenomenon indicates that the production carried out in the framework of a global value chain should be mostly independent of foreign growth increases. We therefore also aim to verify this hypothesis in our studies.

In sum, we evaluate the impact of selected determinants on exports in value added terms (in comparison to exports in gross terms) for selected CEE economies. We then compare our results with Landesmann et al.'s (2015) estimation for 35 industries and 40 countries over the period 1995-2011.

3. Data description

The panel dataset we use in our investigation is defined by double cross-sectional dimensions – thirteen manufacturing sectors⁶ (Appendix, Table A1) and seven selected CEE

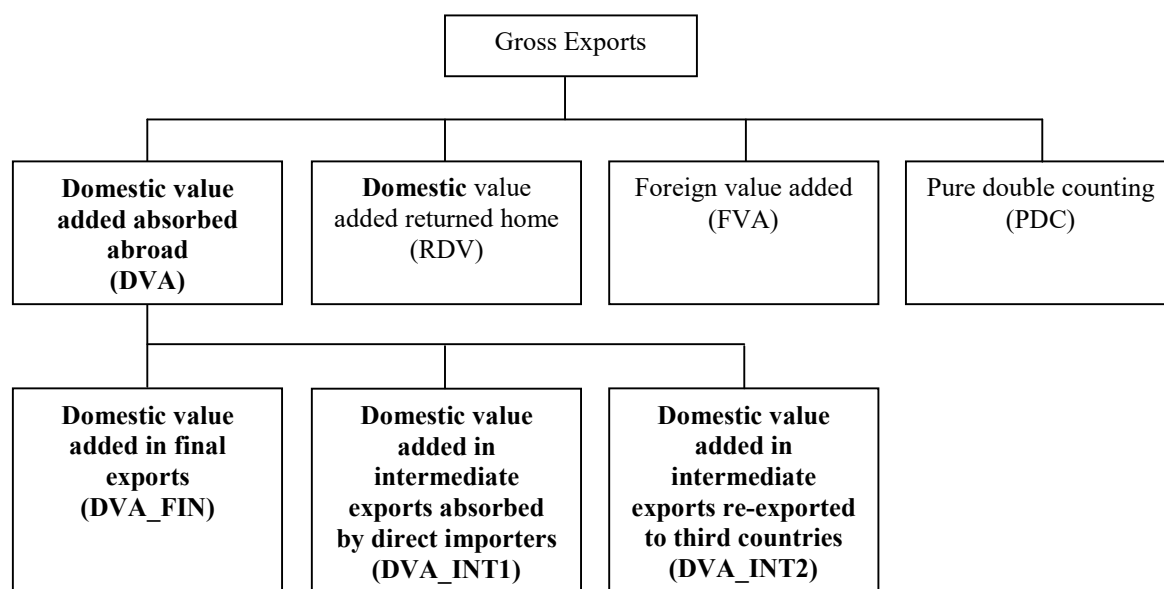
⁶ Sector 23, Coke, Refined Petroleum and Nuclear Fuel, is removed from our calculation due to a strong sensitiveness of the estimation results when this sector is included.

countries – the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland and Slovakia. Among UE Members we distinguish three different groups of CEE economies: Central East European countries (Czech Republic, Hungary, Poland, Slovakia), South East European group, comprising Bulgaria and Romania, and the Baltic countries (Estonia, Latvia, Lithuania). We observe a strong differentiation amongst these economies: Central and Baltic countries move strongly away from South East European group especially as an important location of manufacturing production within cross-border European production networks; there is also a strong effect of the recent economic crisis on the South East European position (Landesmann et al., 2015) This is why we concentrate in our analysis only on Central East European and Baltic countries. All of the cross-sections are observed over the period 1995 – 2011. The main database for the key variables used in the analysis is the World Input Output Database – WIOD (Timmer et al., 2015), the most comprehensive database for sectoral analysis. We also derive the data from Worldwide Governance Indicators database (World Bank, 2015).

As an export performance indicator (*EXIND*) we use two measures: the logarithm of gross exports (*LnTEXP*) and the logarithm of domestic value added in exports (*LnDVA*).

In order to obtain domestic value added from total exports we use the *decompr* package in R (Quast and Kummnitz, 2015), which is based on the decomposition procedure proposed by Wang et al., (2013, WWZ in further analysis).

Figure 1. Decomposition of total gross exports



Source: own elaboration based on Wang et al., (2013)

The decomposition procedure of WWZ is rooted in works of Leontief (1936). Considering three countries, r , s and t , the final equation of WWZ total exports decomposition in G-country and N-industry model mathematically is expressed in the following way⁷:

$$\begin{aligned}
E^{s*} = & \underbrace{(V^s B^{ss})^T \# \sum_{r \neq s}^G Y^{sr}}_{DVA_FIN} + \underbrace{(V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} B^{rr} Y^{rr})}_{DVA_INT1} + \underbrace{(V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} \sum_{t \neq s, r}^G B^{rt} Y^{tt})}_{DVA_INTrexI1} \\
& + \underbrace{(V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} B^{rr} \sum_{t \neq s, r}^G Y^{rt})}_{DVA_INTrexF} + \underbrace{(V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} \sum_{t \neq s}^G \sum_{ru \neq s, t}^G B^{rt} Y^{tu})}_{DVA_INTrexI2} \\
& + (V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} B^{rr} Y^{rs}) + (V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} \sum_{t \neq s, r}^G B^{rt} Y^{ts}) \\
& + (V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} B^{rs} Y^{ss}) + (V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} \sum_{t \neq s}^G B^{rs} Y^{st}) \\
& + (V^s B^{ss} - V^s L^{ss})^T \# (\sum_{r \neq s}^G A^{sr} X^r) + (\sum_{r \neq s}^G V^r B^{rs})^T \# Y^{sr} + (\sum_{t \neq s, r}^G V^t B^{ts})^T \# Y^{sr} \\
& + (\sum_{r \neq s}^G V^r B^{rs})^T \# (A^{sr} L^{rr} Y^{rr}) + (\sum_{t \neq s, r}^G V^t B^{ts})^T \# (A^{sr} L^{rr} Y^{rr}) \\
& + \sum_{r \neq s}^G (V^r B^{rs})^T \# (A^{sr} L^{rr} E^{r*}) + \sum_{t \neq s, r}^G (V^t B^{ts})^T \# (A^{sr} L^{rr} E^{r*})
\end{aligned} \tag{1}$$

where A^{sr} is an $N \times N$ block matrix of input-output coefficients, B^{rr} is an $N \times N$ block global Leontief inverse matrix, L^{rr} is an $N \times N$ local Leontief inverse matrix, V^s is a $1 \times N$ vector of direct value added coefficients of country s , X^{sr} is a $N \times 1$ vector of gross output and Y^{sr} is an $N \times 1$ vector of global use.

The procedure allows two main categories of total domestic value added to be obtained (Figure 1): domestic value added which is finally absorbed abroad (DVA) and domestic value added which returns home (RDV). In our analysis, we only focus on domestic value added absorbed abroad. This constitutes about 99% of total domestic value added for the countries analysed; the rest is RDV.

Considering DVA, both exports of final goods (FIN) and exports of intermediates (INT) are taken into account. There are two patterns in the trade of intermediates – they can be exported to direct users (DVA_INT1) or re-exporting to third countries can take place (DVA_INT2). Additionally (Equation 1), domestic value added in intermediate exports that is re-exported to third countries as intermediates can be used to produce domestic final goods (DVA_INTrexI1), or to produce exports (DVA_INTrexI2). It can also be re-exported as final goods (DVA_INTrexF).

Figure 2 reports the domestic value added absorbed abroad, discrepancies between total gross exports and DVA, and the VAX ratio for the seven economies in the period 1995 – 2011. The VAX ratio is the DVA share of gross exports (Johnson and Noguera, 2012c). The sectoral data is aggregated to country data.

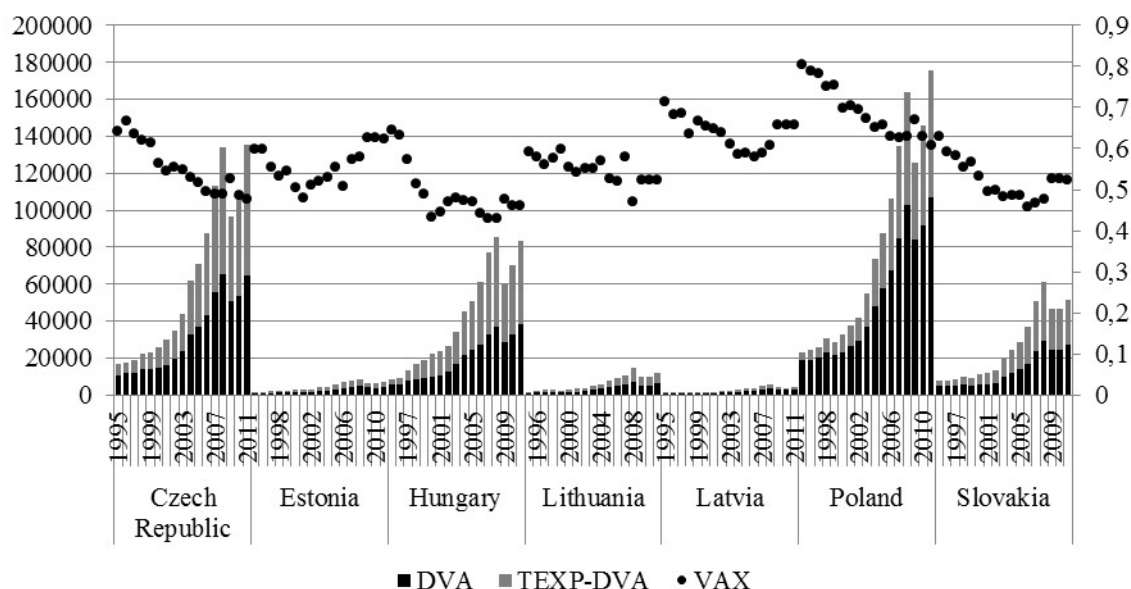
⁷ Due to a space limitation we refer to readers who are interested in the decomposition details to the base paper by Wang et al. (2013), Appendix J.

For all the countries analysed except Estonia the share of DVA in gross exports for manufacturing declined over the period analysed. The deepest drops are observed for Poland and Hungary and amount to 19 and 18 percentage points respectively. This change in shares indicates that Poland and Hungary lost their domestic content in favour of a foreign content of their gross exports, but it also means that both countries started being involved in global value chains more than the rest of the countries in the group analysed.

When we take the technological involvement of industries into consideration (Appendix Table A2), we can observe a decreasing role of domestic value added mainly in medium-high- and high-tech sectors in four of the seven economies (Poland, Hungary, the Czech Republic and Slovakia). The only country which enlarges its DVA in relation to gross exports regardless of the group of industries is again Estonia.

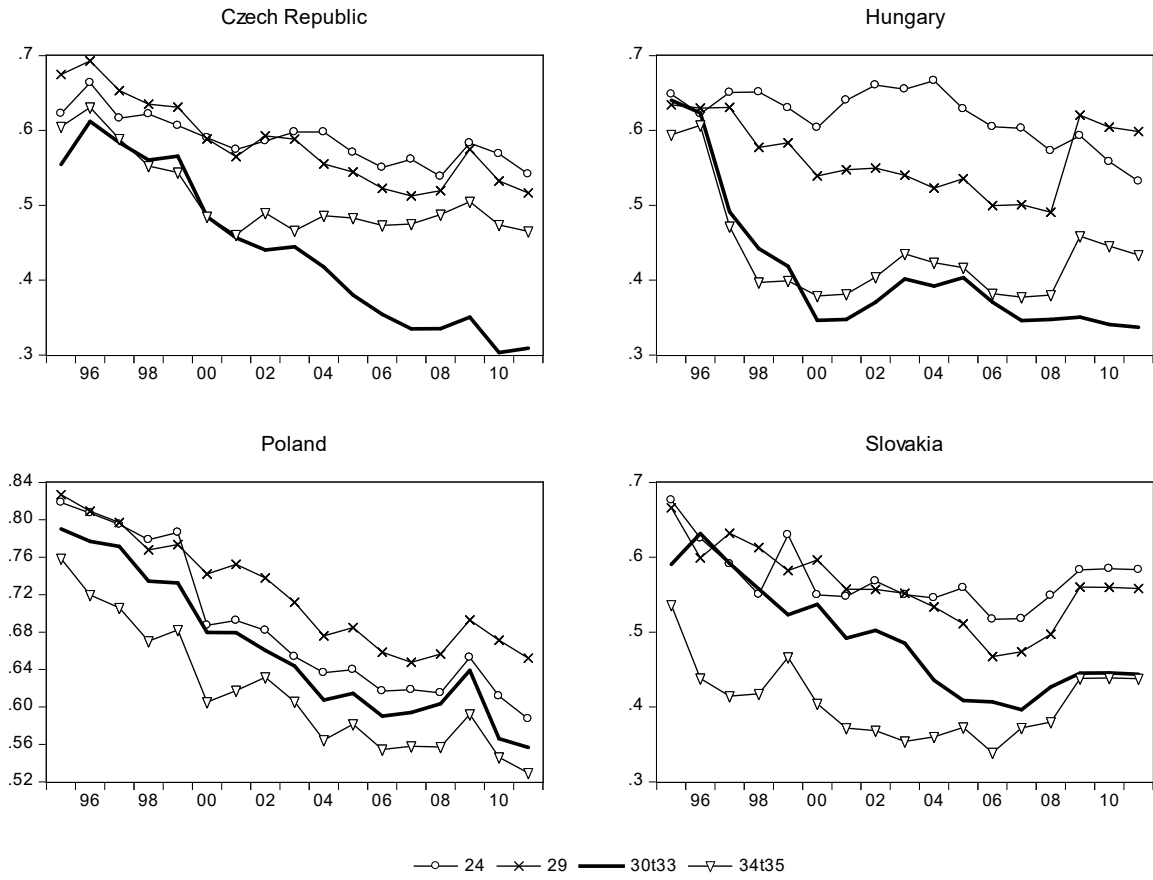
Looking more closely at the individual sectors of the medium-high- and high-tech group for all four of the economies mentioned above, we see that the sector which reduces its VAX ratio the most over the period analysed is identical for all the countries (Figure 3). This is sector 30t33, producing electrical and optical equipment. This indicates the growing role of foreign value added embodied in gross exports of particular sector which can be a synonym of

Figure 2. Domestic value added in exports and the VAX ratio



Source: own elaboration based on WIOD and Wang et al.'s (2013) decomposition

Figure 3. VAX ratio for individual sectors of medium-high- and high-tech



Source: own elaboration based on WIOD and Wang et al.'s (2013) decomposition

production fragmentation of the industry. In the case of Poland, we can also observe the similar decrease of VAX ratio in case of production of chemicals, chemical products (sector 24) and transport equipment (sector 34t35). The details of VAX ratio for 1995 and 2011 are reported in Appendix Table A3.

The relationship between the export performance indicator and its determinants for 13 manufacturing sectors i and for 7 selected CEE countries j observed over the period 1995 – 2011 is as follows:

$$\begin{aligned} \ln EXIND_{ijt} = & \alpha_1 \ln LPro_{ijt} + \alpha_2 HS_{ijt} + \alpha_3 MS_{ijt} + \alpha_4 VS_{ijt} + \alpha_5 CapCoeff_{ijt} + \alpha_6 BL_{ijt} \\ & + \alpha_7 GE_{ijt} + \alpha_8 X_{ijt} + \mu_i + \nu_t + \varepsilon_{ijt} \end{aligned} \quad (2)$$

As a measure of unit labour costs (ULC), two components of the phenomenon are taken into consideration. $\ln LPro$ is the logarithm of labour productivity, which is obtained as the relation between value added based in 1995 prices corrected by the current exchange rate and the total hours worked by persons engaged. The second component of ULC is the logarithm of the share of labour compensation in hours worked by persons engaged ($\ln CompEmp$). The labour

compensation is corrected by the current exchange rate and is based on the PPP. In our investigation we treat labour compensation per hours worked as a control variable.

From the perspective of export growth, an increase in high-skilled labour is an indication of labour productivity growth. Thus, the structure of employment is taken into account. HS and MS denote the respective shares of hours worked by high-skilled and medium-skilled workers in the total hours worked.

VS describes vertical specialization, which according to Hummels et al. (2001) is defined as the use of imported inputs in producing goods that are exported. In our case, VS is measured as the share of foreign content in total exports. Foreign content consists of the sum of foreign value added embodied both in final and in intermediate exported goods (FVA) and is increased by pure double counting from foreign sources.

$CapCoeff$ refers to the relation between capital stock and gross output. Both of these are based in 1995 prices.

Leontief's decomposition of input-output tables allows linkages between the sectors in the analysis to be shown. Due to the growing role of service sectors, and mainly those which are treated as tradable, we decide to include in our analysis indicators which show the direct and indirect impacts of business services (financial intermediation – J, and renting of machines and equipment and other business activities – 71t74) on manufacturing sectors. The variable which reflects backward linkages between services and manufacturing is BL and is obtained as the gross output multiplier.

GE represents one out of the six World Bank Governance Indicators and describes the “perceptions of quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies” (World Bank, 2015).⁸

As an additional variable, we use $LnFD$, which reflects the logarithm of external demand faced by the exporting country.

$$FD_{ijt} = \sum_{j=1}^{40} (C_{ijt}^H + C_{ijt}^{NPSH} + C_{ijt}^G + GFCE_{ijt} + IV_{ijt}). \quad (3)$$

Foreign demand is combined with the sum of the consumption expenditure of households (C^H), non-profit institutions serving households (C^{NPSH}) and government (C^G), gross fixed capital formation ($GFCE$) and changes in inventories and valuables (IV). The sum of these for 39

⁸ As indicators of the economic governance mechanisms, we also used Economic Freedom Summary Index, Index of Government Size (both from The Heritage Foundation database), as well as Political Stability Indicator (from The Worldwide Governance Indicators database). All mentioned indicators were statistically insignificant in our model, so finally we take into consideration only the Government effectiveness index (from The Worldwide Governance Indicators database).

countries and the rest of the world provides the measure of external demand for a particular economy.

4. Estimation results

Our estimation procedure consists of two steps. First, the regression (2) is estimated on the basis of information which comes from all manufacturing sectors taken together in order to evaluate the influence of the determinants both on total exports and domestic value added. This model is called the joint model. The next step is an estimation of regression (2) for 3 independent groups of sectors divided according to their technological involvement.

The estimation results for all manufacturing sectors, both for total exports and domestic value added are reported in Table 1. Comparison of the results for regressions which do not contain control variables (columns 1 and 4) and where the control variables are included (columns 2, 3, 5 and 6) leads to the conclusion that the additional variables only significantly influence the coefficients for labour productivity. Regardless of the way of measuring export flows (total exports, DVA), the direction and the strength of the impact of particular variables on the phenomenon are very similar. Only in the case of vertical specialisation and DVA as an indicator of export performance is a decrease in the coefficients observed.

In line with our expectations, the most important and statistically significant factor which influences the exports indicator is labour productivity. Depending on the regression, a growth in labour productivity leads to an increase in exports/domestic value added from 0.44% to 0.76%.

Considering the structure of employment in terms of skills, we can confirm that high-skilled employees have a positive and statistically significant influence on exports. The strength of the impact does not depend either on the specification of the model or on the exports measure. The influence of high-skilled workers is also stronger than the influence of medium-skilled employees.

Vertical specialisation, which is described by the foreign component of gross exports, influences export performance in a positive way. This means that involvement in global value chains brings benefits to the economies in the form of export growth. Comparing the results for gross exports and DVA, the discrepancies between the coefficients are noticeable. The impact of VS on gross exports is twice or more stronger than on DVA. This is due to the structure of gross exports (Figure 1), which contain foreign value added. In the case of the VS variable, the correct value of the coefficient comes from regressions 4 – 6 and means that an increase in the foreign content of total exports of one percentage point will boost DVA by 1.6% – 1.8%.

Table 1. The impact of selected determinants on total exports and domestic value added

	total exports			domestic value added		
	1	2	3	4	5	6
<i>lnLPro</i>	0.760*** [0.054]	0.496*** [0.139]	0.443*** [0.150]	0.759*** [0.054]	0.501*** [0.139]	0.447*** [0.149]
<i>HS</i>	0.099*** [0.015]	0.091*** [0.015]	0.090*** [0.014]	0.100*** [0.015]	0.092*** [0.015]	0.091*** [0.014]
<i>MS</i>	0.021* [0.011]	0.020* [0.011]	0.017 [0.011]	0.022* [0.011]	0.020* [0.011]	0.018* [0.011]
<i>VS</i>	0.036*** [0.005]	0.034*** [0.005]	0.034*** [0.005]	0.018*** [0.005]	0.017*** [0.005]	0.016*** [0.005]
<i>CapCoeff</i>	-0.488*** [0.140]	-0.559*** [0.153]	-0.490*** [0.147]	-0.495*** [0.141]	-0.564*** [0.153]	-0.496*** [0.148]
<i>BL</i>	0.484 [0.489]	0.470 [0.487]	0.379 [0.495]	0.537 [0.464]	0.524 [0.463]	0.431 [0.469]
<i>GE</i>	0.251** [0.120]	0.208* [0.118]	0.205* [0.117]	0.242** [0.119]	0.200* [0.118]	0.196* [0.117]
<i>lnCompEmp</i>		0.277** [0.118]	0.309** [0.126]		0.271** [0.118]	0.304** [0.126]
<i>ΔlnFd</i>			0.140 [0.114]			0.140 [0.112]
R2	0.800	0.804	0.824	0.785	0.789	0.811
N	907	907	904	907	907	904

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Panel specified by country-industry pairs. In all specifications, country-industry FE is included.

Source: own calculations

The capital coefficient has a negative impact on the phenomenon analysed for all the models. This suggests that manufacturing sectors in CEE countries do not achieve comparative advantages which have a capital-intensive character. However, potential analyses conducted for individual sectors could indicate that particular industries have such a nature.

Contrary to the findings of Landesmann et al. (2015), backward linkages between business sectors and manufacturing sectors in the CEE countries analysed appear to be statistically insignificant.

Considering the influence of the governance quality measured by World Bank government effectiveness index, we can confirm its positive impact on trade flows. Each growth

of the indicator leads to the strengthening of both total exports and DVA at more or less the same rate.

When we add the second component of unit labour costs to our model (*lnCompEmp*), the direct influence of labour productivity on export indicators substantially declines. However, if we sum the two parameters their common impact is more or less identical as in models 1 and 4. The same can be observed analysing the influence of both *lnLPro* and *lnCompEmp* in models 3 and 6.

A growth in foreign demand, in line with our expectations, causes a growth in export performance, but the significance of the relationship is not observed.

Table 2. The impact of selected determinants on total exports and domestic value added for low-tech industries

	total exports			domestic value added		
	7	8	9	10	11	12
<i>lnLPro</i>	0.744***	0.427***	0.447***	0.743***	0.433***	0.451***
	[0.068]	[0.137]	[0.142]	[0.067]	[0.136]	[0.141]
<i>HS</i>	0.080***	0.077***	0.075***	0.081***	0.078***	0.075***
	[0.019]	[0.019]	[0.020]	[0.019]	[0.019]	[0.020]
<i>MS</i>	0.009	0.010	0.006	0.009	0.010	0.006
	[0.014]	[0.014]	[0.016]	[0.014]	[0.014]	[0.016]
<i>VS</i>	0.023***	0.020***	0.019***	0.007	0.004	0.003
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
<i>CapCoeff</i>	-0.815***	-0.958***	-0.903***	-0.817***	-0.957***	-0.904***
	[0.120]	[0.111]	[0.119]	[0.121]	[0.112]	[0.120]
<i>BL</i>	0.879	0.614	0.257	0.905	0.645	0.285
	[0.601]	[0.649]	[0.545]	[0.601]	[0.653]	[0.545]
<i>GE</i>	0.237	0.200	0.164	0.236	0.199	0.164
	[0.169]	[0.163]	[0.169]	[0.168]	[0.163]	[0.168]
<i>lnCompEmp</i>		0.308**	0.309**		0.302**	0.305**
		[0.115]	[0.120]		[0.116]	[0.120]
<i>ΔlnFd</i>			0.302			0.302
			[0.226]			[0.225]
R2	0.746	0.753	0.773	0.734	0.741	0.761
N	419	419	418	419	419	418

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Panel specified by country-industry pairs. In all specifications, country-industry FE is included.

Source: own calculations

In our second step, the manufacturing sectors are divided into 3 groups according to the level of their technological involvement (Appendix Table A1) and regression (1) is used to explain how the determinants identified influence both gross exports and domestic value added in the particular groups of sectors. Tables 2, 3 and 4 contain the results of the estimations for low-tech industries, medium-low-tech industries and medium-high- and high-tech industries respectively.

Analysing the relationship between labour productivity and the measure of export performance, we notice its sensitivity to the control variables included, especially to the inclusion of share of labour compensation in hours worked. In spite of this, labour productivity is still one the most important determinants of export flows, especially in medium-low-tech sectors and low-tech sectors.

A growth in the hours worked by high-skilled employees influences growth in the export indicators in each group in a statistically significant way. However, the strongest impact is observed in medium-high- and high-tech industries. As in the case of the joint model (1 - 6) the impact of medium-skilled employment is clearly lower and moreover in models for groups of industries its significant impact is limited to medium-high- and high-tech industries only.

Comparing both types of model – the joint model and the models for individual groups of sectors – we again see that the reaction of total exports is much stronger than the reaction of domestic value added in the case of vertical specialisation growth. The impact is more noticeable especially for medium-low-tech, medium-high- and high-tech sectors. As previously mentioned, we should stress that the correct results should be derived from the DVA models due to the construction of the VS variable.

Splitting all the manufacturing sectors into groups described by their differing levels of technological involvement does not allow recognition of the group which achieves comparative advantages of a capital-intensive nature due to the negative sign of the *CapCoeff* coefficient. The higher the level of *CapCoeff* the lower the levels of both total exports and DVA for all the groups analysed. Furthermore, the relationship is not statistically significant for medium-low-tech sectors.

As in the case of the joint model, the influence of business services linkages is not crucial in explaining export performance.

Table 3. The impact of selected determinants on total exports and domestic value added for medium-low-tech industries

	total exports			domestic value added		
	13	14	15	16	17	18
<i>lnLPro</i>	0.755***	0.537	0.533	0.754***	0.545	0.541
	[0.110]	[0.320]	[0.331]	[0.110]	[0.320]	[0.330]
<i>HS</i>	0.126***	0.112***	0.116***	0.127***	0.114***	0.118***
	[0.028]	[0.024]	[0.021]	[0.028]	[0.023]	[0.021]
<i>MS</i>	0.023	0.017	0.018	0.023	0.018	0.018
	[0.021]	[0.018]	[0.018]	[0.021]	[0.017]	[0.018]
<i>VS</i>	0.044***	0.044***	0.043***	0.027**	0.027**	0.026**
	[0.012]	[0.012]	[0.011]	[0.011]	[0.012]	[0.010]
<i>CapCoeff</i>	-0.173	-0.194	-0.171	-0.177	-0.197	-0.175
	[0.137]	[0.146]	[0.159]	[0.135]	[0.145]	[0.158]
<i>BL</i>	1.345	1.350	1.370	1.398	1.402	1.422
	[0.839]	[0.880]	[0.900]	[0.839]	[0.880]	[0.899]
<i>GE</i>	0.563**	0.535**	0.559**	0.549**	0.522**	0.546**
	[0.254]	[0.244]	[0.250]	[0.252]	[0.242]	[0.248]
<i>lnCompEmp</i>		0.244	0.235		0.234	0.225
		[0.259]	[0.262]		[0.259]	[0.262]
<i>ΔlnFd</i>			0.079			
			[0.156]			
R2	0.858	0.862	0.863	0.853	0.856	0.857
N	210	210	210	210	210	210

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Panel specified by country-industry pairs. In all specifications, country-industry FE is included.

Source: own calculations

The strength of impact of governance quality on export indicator depends on group of industries. The only group which reacts positively and significantly is a medium-low-tech group of industries.

Adding control variables only has a material impact on the strength of the relationship between the measures of exports and labour productivity. The remaining coefficients are stable. The share of labour compensation in hours worked explains exports in a significant way in the low-tech and high-tech sectors, and what is crucial in the high-tech sectors is that the impact of *CompEmp* is stronger than the impact of labour productivity. Exports, both in value added terms and gross terms, are not sensitive to a growth in foreign demand.

Table 4. The impact of selected determinants on total exports and domestic value added for medium-high- and high-tech industries

	total exports			domestic value added		
	19	20	21	22	23	24
<i>lnLPro</i>	0.734***	0.295*	0.164	0.735***	0.300*	0.169
	[0.089]	[0.170]	[0.157]	[0.089]	[0.168]	[0.152]
<i>HS</i>	0.134***	0.122***	0.114***	0.135***	0.124***	0.115***
	[0.029]	[0.028]	[0.023]	[0.028]	[0.028]	[0.023]
<i>MS</i>	0.062**	0.065**	0.055***	0.062**	0.066***	0.055***
	[0.025]	[0.024]	[0.018]	[0.025]	[0.024]	[0.018]
<i>VS</i>	0.039***	0.037***	0.039***	0.020***	0.018***	0.019***
	[0.006]	[0.005]	[0.005]	[0.006]	[0.005]	[0.005]
<i>CapCoeff</i>	-0.506*	-0.629**	-0.495**	-0.519*	-0.641***	-0.506**
	[0.252]	[0.228]	[0.192]	[0.254]	[0.229]	[0.194]
<i>BL</i>	0.002	0.200	0.098	0.040	0.236	0.135
	[0.810]	[0.757]	[0.796]	[0.766]	[0.715]	[0.754]
<i>GE</i>	0.090	-0.003	-0.029	0.080	-0.012	-0.039
	[0.157]	[0.151]	[0.152]	[0.157]	[0.153]	[0.155]
<i>lnCompEmp</i>		0.482***	0.578***		0.477***	0.574***
		[0.155]	[0.144]		[0.153]	[0.140]
$\Delta \ln Fd$			0.041			0.042
			[0.043]			[0.044]
R2	0.838	0.846	0.897	0.817	0.826	0.882
N	278	278	276	278	278	276

Note: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Panel specified by country-industry pairs. In all specifications, country-industry FE is included.

Source: own calculations

5. Conclusions

Participation by companies in international production sharing and thus the growing role of global value chains forces researchers to look for new indicators of countries' export flows which can adequately describe the phenomenon in the present conditions. The solution can be found in the possibility of deriving domestic value added from gross exports.

In this paper, we have evaluated the influence of selected determinants on both exports in value added terms and exports in gross terms. The analysis has been conducted for seven CEE economies – the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland and Slovakia – and

has focused on 13 manufacturing subsectors for the years 1995-2011. The results of the analysis show a substantial decrease in the domestic value added in gross exports in the majority of countries, especially in medium-high- and high-tech industries. The sector which loses the most is that producing electrical and optical equipment. For the seven CEE countries the main determinants (apart from vertical specialisation) are fairly similar when exports are estimated in the two ways. The results indicate a greater impact of labour productivity and highly skilled employees on generating domestic value added in manufacturing sectors. CEE countries do not achieve comparative advantages of a capital-intensive nature in exporting manufactured products. Additionally, we have found that manufacturing in CEE countries does not serve a 'carrier function' for services to contribute to a country's export performance.

The results have some policy implications for CEE countries. In many CEE countries (Hungary, Poland, Bulgaria) a heated discussion is taking place about reindustrialization as the only way to eliminate the development gap between them and the leading European economy – Germany. Although business services are an especially fast-growing area of international trade, for CEE countries it is very difficult to gain strong competitive positions in this trade (they are already occupied by very advanced high-income economies with long historical traditions in such activities (such as the UK, the US and Hong Kong). This is why the development of industries, especially manufacturing, has become a priority in the growth strategies of some CEE countries. Our results show that this development path is more demanding than it might have seemed.

Over the period analysed, in all the CEE countries studied (except Estonia) the share of domestic value added in gross exports for manufacturing has declined. It can be concluded that the CEE countries do not occupy a favourable position in global value chains. Probably, they are in the middle part of GVCs (low domestic value added) and during 1995-2011 were not able to go up into the higher stages of GVCs in which more value is generated.

Additionally, a major problem in some CEE economies is a lack of useful linkages between the manufacturing sector and services, i.e. manufacturing does not serve a 'carrier function' for services to contribute to the country's export performance. Once again, it would seem that this is due to CEE countries occupying the middle stages of GVCs. In the early stages of GVCs there is a high demand for services such as research, conception and product design; while the finishing stages require sales, coordination, marketing and distribution services. The industrial policies of CEE countries will have to be modified in a more effective manner to tackle this problem. The biggest challenge is to improve the CEE positions in GVCs, especially in high-tech industries.

The results of this study should be regarded as preliminary and requiring verification. It is hoped, however, that they will play an important role in the discussion on the problematic position of CEE manufacturing exports i.e. the position of those economies which neither develop a strong position in manufacturing (a decreasing share of DVA in gross export) nor move towards a strong position in advanced tradable services. Further analyses are needed. From the methodological point of view, it would be worthwhile to conduct a more in-depth analysis of the relationship between the manufacturing (leading CEE export sector) and services sector (the CEE sector generating highest employment). The questions which are still open: why the manufacturing does not serve a 'carrier function' for services, which contribute to the country's export performance, how sensitive the manufacturing to the quality and efficiency of services is, what determinants of these linkages are, what the instruments for supporting this relationship between manufacturing and services sectors are.

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Appendix

Table A1. Manufacturing sectors, NACE 1.1

codes	description	groups of industries
15t16	Food, Beverages and Tobacco	low-tech
17t18	Textiles and Textile Products	low-tech
19	Leather, Leather Goods and Footwear	low-tech
20	Wood and Products of Wood and Cork	low-tech
21t22	Pulp, Paper, Printing and Publishing	low-tech
24	Chemicals and Chemical Products	medium-high and high-tech
25	Rubber and Plastics	medium-low-tech
26	Other Non-Metallic Minerals	medium-low-tech
27t28	Basic Metals and Fabricated Metal	medium-low-tech
29	Machinery, Nec	medium-high and high-tech
30t33	Electrical and Optical Equipment	medium-high and high-tech
34t35	Transport Equipment	medium-high and high-tech
36t37	Manufacturing, Nec; Recycling	low-tech

Table A2. Total VAX ratio and VAX ratio by industry group

		VAX	VAX_LT	VAX_MT	VAX_HT
Czech Republic	1995	64%	70%	62%	61%
	2011	48%	64%	53%	42%
Estonia	1995	60%	61%	58%	57%
	2011	62%	67%	61%	58%
Hungary	1995	64%	71%	59%	63%
	2011	46%	61%	47%	44%
Lithuania	1995	59%	66%	43%	57%
	2011	52%	70%	32%	54%
Latvia	1995	71%	74%	63%	68%
	2011	66%	72%	52%	65%
Poland	1995	80%	85%	75%	80%
	2011	61%	72%	57%	56%
Slovakia	1995	63%	72%	59%	62%
	2011	52%	67%	56%	47%

Notes: LT – low-tech industries, MT – medium-low-tech industries, HT – medium-high- and high-tech industries

Source: own calculations based on WIOD and Wang et al., (2013) decomposition

Table A3. VAX ratio for individual medium-high- and high-tech sectors

		Chemicals and Chemical Products	Machinery, Nec	Electrical and Optical Equipment	Transport Equipment
Czech Republic	1995	62%	67%	55%	60%
	2011	54%	52%	31%	47%
Hungary	1995	65%	63%	64%	59%
	2011	53%	60%	34%	43%
Poland	1995	82%	83%	79%	76%
	2011	59%	65%	56%	53%
Slovakia	1995	68%	67%	59%	54%
	2011	58%	56%	44%	44%

Source: own calculations based on WIOD and Wang et al., (2013) decomposition

Table A4. Correlation matrix for regressors

	<i>lnLPro</i>	<i>HS</i>	<i>MS</i>	<i>VS</i>	<i>CapCoeff</i>	<i>BL</i>	<i>lnCompEmp</i>	$\Delta \ln Fd$
<i>lnLPro</i>	1.0000							
<i>HS</i>	0.1965	1.0000						
<i>MS</i>	0.1038	-0.7698	1.0000					
<i>VS</i>	0.2472	0.0539	-0.0613	1.0000				
<i>CapCoeff</i>	0.2445	0.0780	-0.2036	-0.1292	1.0000			
<i>BL</i>	-0.1801	-0.0470	0.0124	-0.3300	-0.1264	1.0000		
<i>lnCompEmp</i>	0.3143	-0.3594	0.0578	0.1103	0.1701	-0.0186	1.0000	
$\Delta \ln Fd$	0.1091	0.0027	0.0268	0.0941	-0.0872	0.0455	0.0456	1.0000

Source: own calculations

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