Kraje Europy Środkowo-Wschodniej w globalnych powiązaniach produkcyjnych: analiza na poziomie krajów i sektorów

Streszczenie

Artykuł koncentruje się na wskazaniu miejsca krajów Europy Środkowo-Wschodniej w globalnych łańcuchach wartości (GVCs). Chcąc zlokalizować pozycję każdego kraju w GVCs (segment *upstream* lub *downstream*), zastosowano specjalną metodykę roli kraju w powiązaniach produkcyjnych. Z badania można wywnioskować, że (a) kraje EŚW różnią się poziomem uczestnictwa w powiązaniach produkcyjnych. Państwa, które mają silniejsze więzi z Europą Zachodnią, zwłaszcza z Niemcami są bardziej zintegrowane z GVCs; (b) duży udział eksportu brutto krajów EŚW przechodzi przez łańcuchy dostaw krajów Europy Zachodniej; (c) większość eksporterów z EŚW plasują się w dalszych segmentach produkcji, a nie na rynkach *upstream*.

Słowa kluczowe: *handel zagraniczny, globalne łańcuchy wartości, Europa Środkowo-Wschodnia*

Abstract

The paper evaluates Central and Eastern European countries' (CEEs) location in global vertical specialization (global value chains, GVCs). To locate each country in global value chains (upstream or downstream segment/market) and to compare them with the selected countries, a very selective methodology was adopted. We concluded that (a) CEE countries differ in the levels of their participation in production linkages. Countries that have stronger links with Western European countries, especially with Germany, are more integrated; (b) a large share of the CEE countries' gross exports passes through Western European GVCs; (c) most exporters in Central and Eastern Europe are positioned in the downstream segments of production rather than in the upstream markets. **JEL classification**: F14, F15.

Keywords: *foreign trade, global value chains, Central and Eastern Europe*

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Central and Eastern European states in global production linkages: country-level and sector-level analysis[1]

Introduction

Since the early 1990s, CEE countries have achieved similar development goals. Democratization, integration with the European Union (EU), the development of bilateral and multilateral relations, and the economic and political transformation of financial systems, particularly banking were the most popular achievements of long-term development strategies of the analysed countries. One of the transformation priorities was the reorientation of foreign trade to Western Europe (Cieślik et al. 2016a: p. 35-48; Cieślik et al. 2015: p. 72-75).

This article[2] presents the transformation of foreign trade in the CEE countries that have become new members of the EU[3] with special focus on the role of these countries in global value chains (GVCs) as a result of the liberalisation process and integration with the EU. The article evaluates the position of these countries in global vertical specialisation. The paper adopts a highly selective methodology to locate each country in global value chains (upstream or downstream segment/market) and to compare them to the selected countries. The analysis covers the period from 2000 to 2011. In some cases (sector-level analysis) we have to shorten the period of the analysis to 2009 due to lack

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[2] The article is an extended version of: Cieślik 2014: s. 25-38; Cieślik et al. 2016b: s. 467-489.

[3] Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

of complete data. In order to ensure uniformity of results, the study was based on data compiled by international organisations. Trade in value added statistics are collected by OECD-WTO tables and the World Input-Output *Database.* Both databases provide information till 2011.

The article consists of three sections, an introduction and conclusions. Firstly, it discusses the methodology. Then role of CEE states in GVCs using country-level approach in order to place each country in global vertical specialisation. The third section analyses these countries in terms of selected sectors. The paper concludes with several remarks on foreign economic policy implications for the future.

Methodology

With contemporary international production chains, value added has its origins in many locations. While precising these sources and trying to measure their contribution to exports are crucial for a number of research and policy questions, measures existing so far are unsatisfactory. HIY proposed by Hummels et al. (Hummels et al. 2001: p. 75–96), provided the first empirical measures of participation in vertically specialised trade[4].

If we want to reflect foreign contents in exports, we need two main assumptions for the HIY's measure: (a) first, all imported intermediate inputs must contain 100 percent foreign value added and no more than one country can export intermediates; (b) second, the intensity in the use of imported inputs is assumed to be the same whether goods are produced for export or for domestic final demand. Hence, HIY's measures do not hold generally with the multi-country, back-and-forth nature of current global production networks.

Two-country case

We assume that we have a two-country (home and foreign) world, in which each country produces goods in N differentiated tradable sectors. Goods in each sector can be consumed directly or used as intermediate inputs. Moreover, each country exports both intermediate and final goods to the other.

[4] However, their measure of foreign value in exports is valid only in a special case; they did not mathematically define their measure of indirect value-added exports through third countries; and these two measures do not capture all sources of value added in gross exports (Koopman et al. 2010).

Entire gross output produced by country *r* must be used as an intermediate good or a final good at home or abroad, or

$$X_r = A_{rr}X_r + A_{rs}X_s + Y_{rr} + Y_{rs}, \qquad r, s = 1,2 \qquad (1)$$

where

X_r is the N×1 gross output vector of country *r,*

Y_{rs} is the N×1 final demand vector that gives demand in country *s* for final goods produced in *r*,

A_rs is the N×N IO coefficient matrix, giving intermediate use in *s* of goods produced in *r*.

The two-country production and trade system can be written as an ICIO model in block matrix notation as follows:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} A_{11}A_{12} \\ A_{21}A_{22} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} Y_{11} + Y_{12} \\ Y_{21} + Y_{22} \end{bmatrix} \qquad (2)$$

and rearranging,

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} I - A_{11} - A_{12} \\ -A_{21}I - A_{22} \end{bmatrix}^{-1} \begin{bmatrix} Y_{11} + Y_{12} \\ Y_{21} + Y_{22} \end{bmatrix} = \begin{bmatrix} B_{11} + B_{12} \\ B_{21} + B_{22} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} \qquad (3)$$

where

B_{sr} denotes the N×N block Leontief inverse matrix, which is the total requirement matrix that gives the amount of gross output in producing country *s* required for a one-unit increase in final demand in country r.

Y_r is a 2N×1 vector that gives the global use of *r's* final goods.

This can be expressed succinctly as:

$$X = (I - A)^{-1}Y = BY \qquad (4)$$

Where X and Y are 2N×1 vectors, and *A* and *B* are 2N×2N matrices.

Having defined the Leontief inverse matrix, we turn to measures of domestic and foreign contents (first for production, and then applied to trade).

We agree that:

V_s will be the 1×N direct value-added coefficient vector and each element of V_s gives the share of direct domestic value added in total output. This amounts to one minus the intermediate input share from all countries:

$$V_r \equiv u(I - \sum_s A_{sr}) \tag{5}$$

where u is a 1×N unity vector. To be consistent with the multiple-country discussion below, we should also define V, the 2×2N matrix of direct domestic value added for both countries,

$$V = \begin{bmatrix} V_1 & 0 \\ 0 & V_2 \end{bmatrix} \tag{6}$$

Combining these direct value-added shares with the Leontief inverse matrices produces the 2×2N value-added share (VAS) matrix, our main measure of value-added shares by source.

$$VAS \equiv VB = \begin{bmatrix} V_1 B_{11} & V_1 B_{12} \\ V_2 B_{21} & V_2 B_{22} \end{bmatrix} \tag{7}$$

Within VAS, each column of $V_1 B_{11}$ denotes domestic value-added share of domestically produced products in a particular sector at home. Similarly, the columns of $V_2 B_{21}$ denote the share of country 2's value-added in these same goods. Each of the first N columns in the VAS matrix includes all value added, domestic and foreign, required to produce one additional unit of domestic products at home. The second N columns present value--added shares for production in country 2. All value added must be either domestic or foreign, hence the sum along each column is unity:

$$V_1 B_{11} + V_2 B_{21} = V_1 B_{12} + V_2 B_{22} = u \tag{8}$$

The VAS matrix contains all the necessary information to separate domestic and imported content shares in the production and trade of particular country at the sector level. Either final goods exports or total exports could be used as weights to assess these shares when aggregation is necessary. In order to compare with other measures of vertical specialisation and to link our measures with official trade statistics, we use gross exports. Let E_{rs} be the N×1 vector of gross exports from r to s. For consistency with the multi-country analysis below, we will define

$$E_{r*} = \sum_{s \neq r} E_{rs} = \sum_s (A_{rs} X_s + Y_{rs}), \quad r, s = 1,2 \tag{9}$$

$$E = \begin{bmatrix} E_{1\bullet} & 0 \\ 0 & E_{2\bullet} \end{bmatrix} \tag{10}$$

and

$$\hat{E} = \begin{bmatrix} [diag\,(E]_{1*}) & O \\ O & [diag\,(E]_{2*}) \end{bmatrix} \tag{11}$$

where E is a 2N×2 matrix and $\hat{E}$ is a 2N×2N diagonal matrix.

The combination of the value-added share matrix and an export matrix as weights produces a 2×2N matrix VAS_Ê, our sectoral measure of value-added share by source country:

$$\text{VAS\_}\hat{\text{E}} \equiv VB\hat{\text{E}} = \begin{bmatrix} V_1B_{11}\widehat{E_1} & V_1B_{12}\widehat{E_1} \\ V_2B_{21}\widehat{E_1} & V_2B_{22}\widehat{E_2} \end{bmatrix} \tag{12}$$

The elements of this matrix provide disaggregated value added by source in gross exports for each sector. It is important to add that this measure captures all upstream sectors' contributions to value added in a specific sector's exports.

Domestic/foreign content of exports and value-added exports, if we consider them as related, are different concepts. However, both concepts measure the value generated by factors used in the producing country, domestic content of exports is independent of where that value is employed. By contrast, value-added trade depends on how a country's exports are used by importers. It is the value-added produced by a country but absorbed by another country. Therefore, equation (12) shows related measures of domestic/foreign contents in sector level gross exports, not sector level value-added exports. Because the later depends on where the value-added is absorbed, it has to be defined in the context of final demand, as the following matrix (after zeroing its diagonal):

$$\text{VÂT} \equiv \hat{V}BY = \begin{bmatrix} \widehat{V_1} & O \\ O & \widehat{V_2} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix} \tag{13}$$

where

Y_{sr} is an N by 1 vector,

Y is 2N by 2 final demand matrix,

$\widehat{V_r}$ is a N by N diagonal matrix with direct value-added coefficients along the diagonal and has different dimension with V matrix defined earlier.

The resulting VÂT is a 2N by 2 value-added production matrix, its diagonal elements give each country's production of value-added absorbed by itself while its off diagonal elements constitute the 2N by 2 bilateral value-added trade matrix. The value-

-added trade matrix is the off-diagonal elements of VÂT, therefore, it excludes value--added produced in the home country that returns home after processing abroad.

To illustrate these two major concepts and their relations in the simplest possible way, we will aggregate the version throughout the rest of this section. The aggregate (2×2) measure of value-added by source in gross exports is given by

$$\text{VAS\_E} \equiv VBE = \begin{bmatrix} V_1 B_{11} E_{1*} & V_1 B_{12} E_{2*} \\ V_2 B_{21} E_{1*} & V_2 B_{22} E_{2*} \end{bmatrix} \tag{14}$$

Although rather elementary with only two countries, VAS_E shows the major concepts of new value-added by source measure. Additionally, diagonal elements of VA-S_E define the domestic value-added in each country's exports and off-diagonal elements give the foreign value-added embodied in each country's exports.

In the two-country case, explicit solutions for the four B_{rs} block matrices are not too burdensome, and enable us to demonstrate why HIY's vertical specialisation measures are a special case of new general measures. Applying the algebra of the partitioned matrix inverse, we have (15)

$$\begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} = \begin{bmatrix} (I - A_{11} - A_{12}(I - A_{22})^{-1} A_{21})^{-1} & B_{11} A_{12} (I - A_{22})^{-1} \\ (I_2 - A_{22})^{-1} A_{21} B_{11} & (I - A_{22} - A_{21}(I - A_{11})^{-1} A_{12})^{-1} \end{bmatrix}$$

Therefore, gross exports can be decomposed into foreign value-added (or VS, following the HIY notation) and domestic value-added (DV) in the following way:

$$DV = \begin{bmatrix} V_1 B_{11} E_{1*} \\ V_2 B_{22} E_{2*} \end{bmatrix} = \begin{bmatrix} V_1 (I - A_{11} - A_{12}(I - A_{22})^{-1} A_{21})^{-1} E_{1*} \\ V_2 (I - A_{22} - A_{21}(I - A_{11})^{-1} A_{12})^{-1} E_{2*} \end{bmatrix} \tag{16}$$

$$FV = \begin{bmatrix} V_2 B_{21} E_{1*} \\ V_1 B_{12} E_{2*} \end{bmatrix} = \begin{bmatrix} u(A_{21} - A_{12}(I - A_{22})^{-1} A_{21})(I - A_{11} - A_{12}(I - A_{22})^{-1} A_{21})^{-1} E_{1*} \\ u(A_{12} - A_{21}(I - A_{11})^{-1} A_{12})(I - A_{22} - A_{21}(I - A_{11})^{-1} A_{12})^{-1} E_{2*} \end{bmatrix} \tag{17}$$

They are both 2×1matrices.

Using the same notation, the HIY measure of foreign value added can be shown as another 2×1matrix:

$$VS = \begin{bmatrix} uA_{21}(I - A_{11})^{-1} E_{1*} \\ uA_{12}(I - A_{22})^{-1} E_{2*} \end{bmatrix} \quad (18)$$

Comparing equations (17) and (18), we can note that the HIY measure only captures foreign value added in gross exports when either A_{12}=0 or A_{21}=0; i.e., in the case when only one country's intermediate goods are used abroad. The new measure captures an important element omitted from the HIY's formula. For the home country, both domestic and foreign value added vary from their true values by the term $A_{12}(I\text{-}A_{22})^{-1}A^{21}E^{21}$. Thus the new measure can account for a country importing its own value added which has been exported but return home after being processed abroad. In a general context, VAS_E will attribute foreign and domestic contents to multiple countries in the proper way when intermediate products cross borders in even more complicated patterns.

The second HIY measure of vertical specialisation (labelled as VS1 by HIY) details domestic value-added in inputs exported indirectly to third countries. In a two-country world, the home country's IV (indirectly exported value-added) is identical to foreign country's FV:

$$\mathrm{IV}_1 = V_1 B_{12} E_{21} \quad (19)$$

However, this will not be true in the multi-country model that we explain below.

Three or more countries case

The analysis can be generalised to any arbitrary number of countries. Production, value-added shares, and sources of value-added in gross exports are given succinctly by:

$$X = (I - A)^{-1} Y = BY$$
$$VAS = VB$$
$$VAS\_E = VBE \quad (20)$$

with G countries and N sectors,
X and Y are GN×1 vectors;
A and *B* are GN×GN matrices;
V and VAS are G×GN matrices;

E is a GN×G matrix;

VAS_E is a G×G matrix.

While we analyse the aggregate measures, all results continue to hold with full dimensionality and can be shown simply by replacing the relevant weighting matrix.

In the multiple-country case, properly calculating value added by source needs adjustments for intermediate inputs that cross multiple borders. Examining a three-country case in some details is useful for two reasons:

- it exhibits nearly all the richness of the fully general multi-country analysis,
- analytical solutions remain tractable and have intuitive explanations.

$$B_{11} = \begin{Bmatrix} I - A_{11} - A_{12}\left[I - A_{22} - A_{23}(I - A_{33})^{-1} A_{32}\right]^{-1}\left[A_{21} + A_{23}(I - A_{33})^{-1} A_{31}\right] \\ - A_{13}\left[I - A_{33} - A_{32}(I - A_{22})^{-1} A_{23}\right]^{-1}\left[A_{31} + A_{32}(I - A_{22})^{-1} A_{21}\right] \end{Bmatrix} \quad (21)$$

Comparing equation (21) with the equivalent term in equation (15), the three-country case contains more adjustments than the two-country case, all involving intermediate exports via third countries. Hence, to measure domestic value-added share in country 1's total exports, the value-added embodied in its intermediate exports to country 2 and country 3 has to be calculated. These intermediate goods can be used by the importing country (country 2 or country 3) to produce final goods and export back to the home country; or they can be used to produce intermediate goods exports to a third country (country 3 or country 2) that are then used to produce exports to the home country. Thus, adjustments have to be done for each of these intermediate flows. Similar adjustments are made to all measures of value-added by source to capture value added in production chains stretching across multiple borders.

As above, the value-added shares can be applied to gross exports to produce VAS_E.

With three countries, VAS_E is a 3x3 matrix:

$$VAS_E = VBE = \begin{bmatrix} V_1 B_{11} E_{1\bullet} & V_1 B_{12} E_{2\bullet} & V_1 B_{13} E_{3\bullet} \\ V_2 B_{21} E_{1\bullet} & V_2 B_{22} E_{2\bullet} & V_2 B_{23} E_{3\bullet} \\ V_3 B_{31} E_{1\bullet} & V_3 B_{32} E_{2\bullet} & V_3 B_{33} E_{3\bullet} \end{bmatrix} \quad (22)$$

The difference between value-added from direct and indirect sources in gross exports is much clearer with three countries than with two. The sum of off-diagonal elements along a column is the real measure of value-added from foreign sources embodied in a particular country's gross exports:

$$FV_r = \sum_{s \neq r} V_s B_{sr} E_{r*}$$

(23)

The sum of off-diagonal elements along a row gives information on a country's value-added embodied as intermediate inputs in third countries' gross exports:

$$IV_r = \sum_{s \neq t} V_r B_{sr} E_{st}$$

(24)

The diagonal terms measure domestic value added in gross exports:

$$DV_r = V_r B_{rr} E_{r*}$$

(25)

Equation (8) shows that columns of the VAS matrix sum to unity, so the sum of domestic and

foreign value added must account for all gross exports, ensuring that value-added from all sources sum to official trade flows and this relation is true at both aggregate and sector level:

$$DV_r + FV_r = E_{r*}$$

(26)

Position of countries within global value chains

By using the decomposition results at the country-sector level, we can construct an index that helps us to assess if a country is likely to be in the upstream or downstream of the global value chain (GVC) in any sector. We can also construct a separate index that helps us to assess the extent to which a country-sector is involved in the global production chain.

For an index to capture a country's position (i.e., upstream or downstream), it is possible to compare that country's exports of intermediates in that sector that are used by other countries, with that country's use of imported intermediates in the same sector. If a country lies upstream in the global value-chain, it produces inputs for others, either by providing raw materials (such as Russia), or by providing manufactured intermediates (such as Japan), or both. For such a country, its indirect value added exports (IV) share in gross exports will be higher than its FV share. Comparing this situation with the situation of a country which lies downstream in the global value chain, we can observe that it will use a large portion of other countries intermediates to produce final goods for exports, and its FV share will be higher than its IV share.

We define a country-sector level index for the position in the global value chain as the log ratio of a country-sector's supply of intermediates used in other countries' exports to the use of imported intermediates in its own production.

$$GVC\_Position_{ir} = Ln(1+\frac{IV_{ir}}{E_{ir}}) - Ln(1+\frac{FV_{ir}}{E_{ir}})$$

If the country-sector lies upstream in a supply chain, the numerator tends to be large. On the other hand, if it lies downstream, then the denominator tends to be large.

Of course, two countries can have the same values of the GVC position index in some sector while having very different degrees of participation in GVCs. Therefore, the position index must be used in conjunction with another index that summarises the significance of the global supply chain for that country-sector. Finally, we define a GVC participation index as

$$GVC\_Participation_{ir} = \frac{IV_{ir}}{E_{ir}} + \frac{FV_{ir}}{E_{ir}}$$

If a country is located in the upstream segment in the production value chains (first stages of production), it is likely that it has a high value of forward participation relative to backward. It means that the country relies more on its own production. If a country specialises in the final stages of production (downstream segment), it is likely that it imports a lot of intermediate goods from abroad and therefore it has high backward participation. The GVC position index is constructed in such a way that states with high forward relative to backward participation record a positive value. More general approach indicates that the upstream economies produce the raw materials or knowledge assets at the beginning of the production process (e.g. R&D or design tend to create more value added than assembly), while downstream economies assemble processed products or specialise in customer services.

Role of CEE countries in global value chains: country-level analysis

The analysis of the decomposition of value added includes in some cases, apart from the CEE states, also the whole EU as important link in GVCs. The results of the study show that the shares of value added from trade partners embodied in country total

exports are very diverse. The largest share of foreign value added embodied in total domestic exports in 2011 was in Hungary (48.48%), while the lowest share of this type of value added was in Lithuania (23.71%). It means that these states a considerable part of exports relies on foreign value added. These shares may be compared to the EU, Japan or the United States where the value added from trade partners embodied in country total exports is relatively low, but we should be cautious about these comparisons. Developed countries with extended domestic markets and large economies are more self-sufficient, which results in a lower share of foreign value added embodied in their exports (table 1).

A positive trend is observed in the share of domestic value added contained in exports of CEE states' trade partners. An especially high "value added from country embodied in trade partners' total exports" characterised Lithuania, Poland, and Latvia in 2011, 32.75 percent, 29.65 percent, and 28.08 percent respectively. We observe a relatively high degree of participation in GVCs in the analysed countries and great importance of participation in GVCs for national economy (table 1).

In fact, the results of the study show bidirectional links of the analysed states in vertical specialisation, although with a stronger tendency to hold lower positions in GVCs than developed countries, especially in the more technologically advanced sectors of the economy[5]. The greater prominence of downstream relations is proven by the indicator of the relative position in GVCs. The higher the value of the indicator is, the higher the country's position within GVCs (upstream segment) should be. The borderline value between segments is 1. As a result, most CEE states are positioned lower in GVCs than the EU average (e.g. Czech Republic, Hungary, Slovakia, Slovenia,

[5] According to a number of international rankings, e.g. the ICT Development Index (International Telecommunication Union 2015), the Global Innovation Index (Boston Consulting Group 2016), or the Innovation Union Scoreboard (UNU-MERIT 2016), Central and Eastern European states hold lower positions than Western European countries. It means that the field of technological development still needs improvements. The study of the position of Central and Eastern European states in GVCs shows that the region is still perceived as a supplier of low- and middle-processed products rather than a high-tech manufacturer. We observe the above-mentioned phenomenon in the CEE states that have taken advantage of FDI flowing to more advanced sectors (e.g. automobile). We can attempt to explain the lower technological advancement of CEE countries by their low share of expenses on research and development. By comparison, the average for the EU in this regard was 2.04 percent of GDP in 2014, for Poland it was only 0.94 percent of GDP. The lowest level of R&D in 2014 spending was in Romania (0.38 percent of GDP) and Latvia (0.69 percent of GDB). Only Slovenia (2.38 percent of GDP) exceeded the EU average. The CEE countries rank far behind Western Europe in terms of patents, total R&D personnel, and R&D personnel per capita (Eurostat 2016).

Bulgaria). Two of CEE states exceeded EU's average, e.g. Romania and Latvia. Poland reached the same position as the EU. It is an alarming fact that in many of the CEE states' and the EU's positions in GVCs have been deteriorating in recent years. Only Estonia, Hungary, Lithuania, and Romania improved their positions slightly. This indicates that the whole region's as well as the EU role as a link in the chain of production of the global economy is decreasing. It is worth mentioning to that in 2000 Latvia was the only country that crossed the borderline and entered upstream markets. However, Poland was placed exactly at the borderline that year (table 1, figure 1).

On the one hand, we observe a great share of CEE states in downstream segments in relation to well-developed countries. It means that the region of Central and Eastern Europe is an importer of foreign value added. On the other hand, moving toward the EU average of domestic value added embodied in trade partners exports testifies to the fact that the region is entering the upstream in the cross-border production process. A particularly pronounced vertical integration between the CEE countries and Germany can be observed in more advanced products. These strong relations between the countries are the consequence of differences in labour costs and workforce qualifications, as well as of sectoral and cultural similarity and geographical proximity (IMF 2013).

Table 1. The degree of participation of selected countries in GVCs in 2000 and 2011

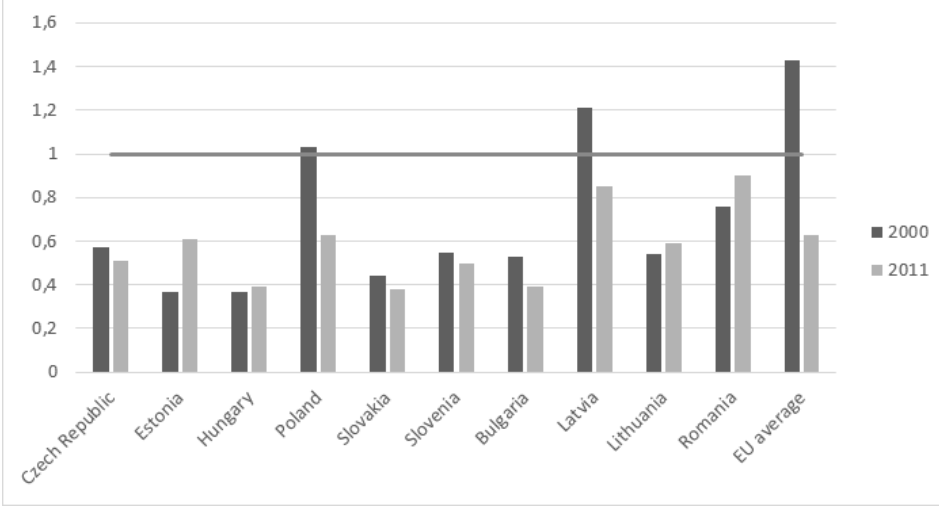
	Value added from trade partners embodied in country total exports (in % of country total exports)		Value added from country embodied in trade partners total exports (in % of country total exports)		Degree of participation in GVCs (in % of country total exports)		Importance of participation in GVCs for the national economy (in % of country GDP)
	2000	2011	2000	2011	2000	2011	2011
Czech Republic	39.18	45.09	22.2	23.35	61.38	68.09	38.53
Estonia	50.06	35.12	18.7	25.45	68.76	56.42	29.87
Hungary	46.19	48.48	17.2	19.07	63.39	67.18	35.06
Poland	23.33	32.29	24.1	29.65	47.43	52.79	15.58

Slovakia	48.26	46.73	21.2	21.49	69.46	64.63	36.81
Slovenia	37.52	36.11	20.6	24.62	58.12	54.31	27.98
Bulgaria	38.13	39.82	20.2	23.84	58.33	55.52	26.98
Latvia	24.62	28.61	29.8	28.08	54.42	52.91	13.70
Lithuania	32.56	23.71	17.7	32.75	50.26	37.81	18.37
Romania	27.39	24.40	20.8	29.57	48.19	46.30	16.43
EU	12.63	28.03	18.0	65.65	30.63	45.83	7.78

Degree of participation in GVCs – to what extent are countries participating in GVCs; the GVC participation index adds the foreign value-added in exports and the share of domestic value-added in exports of intermediate inputs used for exports in third-countries.

Source: author's own calculations on the basis of (OECD 2016).

Figure 1. Relative position of CEE states in GVCs in 2000 and 2011



Relative position in GVCs was calculated on the basis of the relation between value added from a country embodied in trade partners' total exports and value added from trade partners embodied in a country's total exports.
The higher the value of the index, the more upstream the country exporters are situated in GVCs.

Source: author's own calculations on the basis of (OECD 2016).

When we examine the share of foreign value added included in the products exported by CEE states, we can see that the dominating element is the value added from high-

ly developed countries, especially from EU-15. It means that a large part of Eastern and Central European countries' export is integrated into EU's value chains. This phenomenon can be observed especially in Slovakia, the Czech Republic, and Hungary. In those three nations more than 40 percent of foreign value added embodied in total export originates from countries of EU-15. In the case of the Baltic States, especially Lithuania, the links in the European chains are not as strong as in other countries. Lithuania's export is more connected to the Russian Federation and Asian markets (OECD 2016).

When we want to indicate five most influent countries in building foreign value added of analysed CEE nations we should mention Germany with an average share in foreign value added of gross export in analysed nations amounted to 15.95% in 2011, the Russian Federation with this share amounted to 7.12%, Italy: almost 7%, and France: 4.81%. Germany was the most important provider of intermediate goods to the Czech Republic, Hungary and Slovakia, what derived mainly from the linkages in their automotive sector. The Russian Federation seems to be an important partner to its closest neighbours (Lithuania, Latvia, Estonia) and Poland. These countries cooperated mainly through trade of chemicals and non-metallic mineral products. Italy and France had the stable share in gross exports of all CEE countries. The Czech Republic, Estonia, Hungary, Slovakia, Bulgaria, and Romania relied round the half of their gross exports on the EU-15. These quite high indicators of share of Western Europe in gross exports in CEE nations indicate that CEE nations relayed a considerable part of their exports on the Western European markets value added in 2011 (table 2).

Table 2. Participation of selected countries in foreign value added of gross exports of CEE states in 2011

	Czech Republic	Estonia	Hungary	Poland	Slovakia	Slovenia	Bulgaria	Latvia	Lithuania	Romania
Austria	4.37%	0.62%	5.67%	1.19%	1.89%	5.66%	8.4%	1.88%	0.93%	2.48%
Belgium	1.37%	0.63%	0.96%	0.85%	1.24%	0.53%	0.93%	1.7%	0.97%	1.31%
Denmark	0.8%	1.81%	0.89%	3.12%	1.5%	0.42%	0.53%	1.03%	2.18%	0.19%
Finland	0.58%	23.38%	0.3%	4.15%	0.94%	0.29%	0.23%	0.15%	2.08%	0.2%
France	5.28%	1.52%	4.13%	1.64%	6.05%	5.41%	4.72%	4.47%	6.57%	8.34%
Germany	28.03%	4.3%	20.66%	7.94%	24.53%	17.2%	19.63%	11.05%	10.85%	15.29%
Ireland	0.47%	1.21%	0.55%	1.26%	0.63%	0.26%	0.44%	0.34%	0.58%	0.6%

Italy	5.04%	1.4%	6.56%	1.71%	6.02%	5.94%	17.28%	9.63%	2.71%	13.58%
Japan	0.48%	0.71%	1.97%	0.68%	0.41%	0.21%	0.19%	0.31%	0.23%	0.8%
Mexico	0.41%	0.09%	0.38%	0.23%	0.31%	0.21%	0.38%	0.19%	0.11%	0.22%
Netherlands	0.93%	1.69%	0.98%	1.17%	1.66%	0.3%	0.93%	0.41%	2.45%	1.5%
Norway	0.67%	4.26%	0.46%	3.99%	1.56%	0.53%	0.38%	0.78%	3.93%	0.51%
Portugal	0.26%	0.05%	0.23%	0.03%	0.3%	0.18%	0.15%	0.35%	0.23%	0.26%
Spain	2.7%	0.85%	3.48%	0.83%	2.6%	2.45%	1.22%	2.54%	2.02%	2.53%
Sweden	1.4%	11.69%	1.12%	8.12%	2.68%	1.43%	0.86%	0.43%	4.08%	0.63%
Switzerland	2.0%	0.6%	1.23%	1.66%	1.69%	1.18%	1.49%	0.73%	0.4%	0.91%
United Kingdom	5.07%	2.75%	5.07%	5.08%	6.95%	3.53%	2.26%	2.89%	4.7%	4.08%
United States	3.44%	5.12%	4.55%	4.49%	3.6%	3.08%	2.99%	4.23%	5.69%	2.94%
China	2.37%	1.3%	2.94%	1.18%	1.35%	4.53%	1.11%	2.16%	0.77%	1.68%
Russian Federation	5.56%	9.24%	4.27%	11.23%	5.37%	6.97%	4.4%	9.29%	11.73%	3.19%
EU-15	56.96%	52.42%	51.43%	37.42%	57.73%	44.04%	58.34%	44.33%	40.55%	52.28%

Source: author's own calculations on the basis of (OECD 2016).

In turn, when we analyse the role of CEE countries in exports of their main foreign partners it seems that there is no such a great interdependence. Eastern and Central Europe relayed noticeable on the value added (intermediate goods) from the Western European nations in 2011. In contrast, the opposite flow of value added (from the CEE countries to the Western Europe) was not so visible. It indicates that the CEE states' role in GVCs of Western Europe is not so strong and presumably concentrated on lower market segments. The strongest production linkages in terms of value added flows can be observed in trade between the CEE states and Germany, China, the Russian Federation, France, the United Kingdom, and the United States (table 3). German market was concentrated especially on the Czech Republic's and Hungarian value added, but still these indicators of value added from these states embodied in German exports were not impressive. German imports of value added from these countries focused on transport equipment, basic metals, fabricated metal products and chemicals. The Czech Republic provided to the German markets mainly transport equipment. China cooperated primarily with the Czech Republic and imported from this country value added connected to the sector of machinery, basic metals and fabricated metal production. The Russian Federation was mostly linked to Slovakia and Lithuania. It imported from Lithuania and Slovakia markets basic metals, fabricated metal products and chemicals.

France imported from Hungary and Slovakia mainly transport equipment, electrical and optical equipment, and chemicals. The United Kingdom's export of foreign value added from CEE states was concentrated on Hungarian transport equipment, electrical and optical equipment. The United States cooperated with the Czech Republic in terms of machinery and equipment (OECD 2016).

Table 3. Participation of CEE countries in foreign value added of gross exports of selected states from Western Europe and world in 2011

	Czech Republic	Estonia	Hungary	Latvia	Poland	Slovakia	Slovenia	Bulgaria	Lithuania	Romania
Austria	1.19%	0.30%	1.85%	0.41%	0.57%	0.87%	2.24%	0.79%	0.18%	0.70%
Belgium	0.61%	0.54%	0.66%	0.41%	0.51%	0.48%	0.45%	0.39%	0.28%	0.29%
Denmark	0.30%	0.53%	0.31%	0.49%	0.34%	0.17%	0.17%	0.18%	0.34%	0.15%
Finland	0.19%	3.52%	0.23%	0.97%	0.32%	0.13%	0.13%	0.09%	0.61%	0.08%
France	1.73%	0.96%	1.90%	0.85%	1.56%	1.82%	1.52%	0.99%	0.48%	1.16%
Germany	9.50%	3.53%	9.76%	3.06%	6.00%	6.43%	5.77%	3.01%	2.05%	3.29%
Ireland	0.32%	0.25%	0.49%	0.25%	0.20%	0.16%	0.33%	0.28%	0.11%	0.13%
Japan	1.32%	0.74%	1.34%	0.22%	0.78%	1.20%	0.43%	0.28%	0.20%	0.24%
Korea	0.85%	0.28%	0.95%	0.16%	0.51%	1.68%	0.31%	0.19%	0.11%	0.20%
Norway	0.32%	0.84%	0.24%	0.55%	0.73%	0.19%	0.25%	0.13%	0.29%	0.14%
Portugal	0.15%	0.06%	0.11%	0.04%	0.10%	0.10%	0.08%	0.09%	0.04%	0.08%
Spain	1.01%	0.49%	0.86%	0.64%	0.76%	0.69%	0.72%	1.77%	0.50%	0.57%
Switzerland	0.69%	0.39%	0.65%	0.60%	0.48%	0.44%	0.57%	0.39%	0.17%	0.38%
United Kingdom	1.35%	1.36%	1.63%	0.79%	1.26%	1.10%	1.02%	0.83%	0.71%	0.81%
United States	2.01%	1.14%	3.04%	0.71%	1.48%	1.23%	1.53%	0.75%	0.54%	1.02%
China	3.76%	1.97%	2.77%	0.89%	2.05%	2.14%	1.46%	0.91%	0.69%	0.84%
Russian Federation	4.16%	3.93%	5.70%	3.72%	4.13%	9.20%	2.92%	13.27%	7.00%	2.51%

Source: author's own calculations on the basis of (OECD 2016).

From these two tables presented above arise following issues. Firstly, the inflows of value added from Western Europe to the CEE nations exceeds significantly the opposite direction: the outflows of value added from Central and Eastern Europe to the countries of Western Europe. Secondly, such network of value added flows indicates that the Western Europe countries occupied higher positions in GVCs than the CEE countries in 2011. Thirdly, the high shares of value added from Western Europe in gross exports of CEE states might be a testimony to a strong export linkages of the CEE markets with the Western production chains. Meanwhile, the countries of Western Europe base their exports on components imported from Central and Eastern Europe to a much lesser extent (Cieślik 2014: p. 25–38).

Role of CEE countries in global value chains: sector-level analysis

We could also try to identify the position of CEE states depending on the place they occupy in each sector. The sample of countries selected to analyse the decomposition of value added includes the CEE countries as well as other members of the EU, the United States, Japan, and China as important links in GVCs (Cieślik 2012). Two most internationalised branches have been selected for this analysis: transport equipment and electrical and optical equipment. Theoretically, according to OECD classification these sectors belong to medium and high-technology industries. Besides these two advanced sectors we analysed mining and quarrying sector as well as basic metals and fabricated metal products, because their share in industrial production of CEE countries remains high. We also took into account food products and beverages which are still important in Polish and Romanian economies. The analysis ends in 2009 because lack of complete data for 2011 (table 4).

Development of transport equipment as well as electrical optical equipment may indicate that the production is advanced. The labour productivity has increased most dynamically in these sectors. In recent years, automotive industry has become the driving force behind exports and has attracted considerable foreign investments to these countries. However, it should be noted that in practice these branches in the analysed nations focus more on assembling imported parts than on manufacturing from the scratch. In the production of transport equipment five of ten CEE countries ranked in upstream production chain (Czech Republic, Romania,

Hungary, Slovakia, and Poland). The automotive industry is the domain of the states of Central and Eastern Europe, which are in the lead of the supply network. The transport industry in the Baltic States, Slovenia, and Bulgaria does not have such a long tradition, as a result of which these countries are positioned low in GVCs (table 4) (Cieślik 2014: p. 25–38).

The commodity group of „electrical and optical equipment", in turn, has traditionally been the domain of the "Asian Tigers" and many years will pass before the CEE states' economy achieves a comparable level of technological advancement. Hungary and the Czech Republic held the highest positions in this industry in 2009, unfortunately far behind the developed Asian countries. In terms of mining and quarrying, all CEE states can be found in upmarket segment, though this sector is not predominant in most of CEE states[6]. Obviously, these countries are situated in GVCs far behind the mining-tycoons as Saudi Arabia, Russia or Chile. The interesting case is Hungary, where the mining sector's share in GDP is relative high, but this production locates the country in downstream market. This can be explained by the relative high share of foreign value added content of gross exports, which was one of the least expanded among Eastern and Central European countries. High level of foreign value added is the result of the significant inflows of FDI to this sector in relation to other analysed countries[7]. Basic metals and fabricated metal products manufacturing have the long tradition in CEEs states and derives from resource-rich areas. In many nations exists the special clusters of this production. Food products and beverages, in turn, may be important link in GVCs in the case of Poland and Romania. These two nations are geographically well placed to become strong competitors in food processing and become (especially Poland) the regional "food hub". McKinsey estimated that for almost all types of food, savings in labour, materials, and other costs of importing food products from CEE countries to Western Europe outweigh higher transportation costs (McKinsey 2013) (table 4).

[6] Lithuania is excluded from this type of GVC, because this country does not export any mining and quarrying products.

[7] Hungarian mining sector attracted the largest FDI among all CEE countries in 2009. Second was Slovenia which low position in GVCs can also explain this phenomenon.

Table 4. CEE states and selected countries in GVCs regarding the production of selected sectors (data of 2009)

	Transport equipment	Electrical and optical equipment	Mining and quarrying	Basic metals and fabricated metal products	Food products and beverages
↑ *Upstream*	Japan (14) United States (5.9) **Czech Republic (5.6)** **Romania (3.9)** **Hungary (3.8)** Germany (3.7) South Korea (3.4) **Slovakia (3.1)** **Poland (2.8)** Italy (2.7) ..... Mexico (1.2)	Taiwan (21.3) ..... Singapore (19.9) South Korea (12.7) ..... Japan (5.8) ..... China (4.7) **Hungary (4.1)** **Czech Republic (3.7)** ..... **Romania (3.4)** **Estonia (3.0)** ..... Germany (1.9) ..... Mexico (1.8) ..... **Slovenia (1.7)** ..... **Poland (1.2)** ..... **Slovakia (1.1)**	Saudi Arabia (5914) Russia Federation (369) Chile (366) Norway (345) ..... Australia (148) Canada (80) South Africa (76) Mexico (69) ..... India (31) ..... **Poland (8.1)** ..... **Bulgaria (7.5)** ..... **Latvia (3.7)** ..... **Czech Republic (3.1)** **Romania (2.9)** **Estonia (2.6)** ..... **Slovakia (1.3)** ..... Germany (1.2)	Russia Federation (47.0) Brazil (29.8) Japan (20.2) Australia (13.2) USA (13.0) ..... South Africa (9.6) **Slovakia (9.0)** **Romania (8.7)** ..... **Slovenia (7.5)** **Poland (7.4)** ..... Germany (6.9) **Czech Republic 6.9)** **Bulgaria (6.4)** Mexico (6.2) ..... China (4.1) ..... **Latvia (3.7)** ..... **Hungary (3.5)** **Estonia (3.4)** ..... **Lithuania (2.0)**	Australia (18.0) ..... **Romania (2.1)** ..... **Poland (1.3)** United States (1.3) ..... France (1.1)

↓ Downstream	China (0.9) ..... Slovenia (0.6) ..... Estonia (0.3) ..... Latvia (0.2) ..... Lithunania (0.06) ..... Bulgaria (0.01)	Bulgaria (0.7) ..... Lithuania (0.5) ..... Latvia (0.4) ..... Argentina (0.3)	South Korea (0.88) France (0.73) ..... **Slovenia (0.6)** ..... **Hungary (0.2)**	*Philippines* (0.8) Singapore (0.7) ..... Saudi Arabia (0.2)	**Lithuania (0.9)** **Latvia (0.8)** ..... **Slovakia (0.6)** **Estonia (0.6)** **Slovenia (0.5)** ..... **Czech Republic (0.5)** *Germany (0.5)* ..... **Bulgaria (0.4)** Mexico (0.4) ..... **Hungary (0.3)** .....

Arrow up – upstream segment/market
Arrow down – downstream segment/market
Research covers the countries available in OECD Statistics database. The bases for creation of GVCs were the relative positions of chosen states in the industry

Source: author's own calculations on the basis of (OECD 2016).

Conclusions

CEE states have completely transformed their economies as well as foreign trade structures. The trade policy of the analysed countries favours greater integration with global economies, especially the EU markets. The synchronisation of economic activity between countries in Central and Eastern Europe and the EU-15 has resulted in more correlated business cycles (Iossifov 2014). Due to close integration of EU markets, CEE countries have become important links in cross-border production process. We also observe stronger connections in terms of trade and capital flows in advanced sectors, and consequently growing interdependence among these markets. A large share of exports from the CEE region passes through EU-15 production chains. However, this is some type of the hub-and-spoke model, where the 'hub' are the EU-15 states and the

'spokes' are CEE countries. To decrease this dependence, the CEE region should not only concentrate on euro area market, but shift its interests in emerging markets in Asia, Africa, or Latin America (Liberska 2013: p. 191–212).

The study leads to following conclusions. First, the degree of CEE nations' participation in GVCs is diverse. More integrated are countries with grater connections to Western European countries, especially Germany. Second, a large share of exported goods from the CEE states passes through GVCs in Western Europe. Third, exporters from Central and Eastern Europe are usually located more in downstream segments of production than in upstream markets. Four, the presented study has some limitations deriving from data accessibility. Attempting to examine changes in value added of international trade the author referred to the available data. Since 2009 trade trends have been unfavorable for most of the EU countries so this analysis should be broadened by this period. Applying these years to the study might change the results of sector-level analysis.

To sum up, despite this negative aspect of the dependency and the exposure to shocks from EU-15 markets, the analysed countries are expected to continue the model of integration with the EU economy in the future, especially in terms of GVCs. However, the processes of integration in foreign trade and cross-border production process will likely proceed with varying intensity.

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