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PATTERNS OF STRUCTURAL CHANGES IN CEE ECONOMIES IN NEW MILLENNIUM

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Abstract. In the era of intensive globalization and frequent economic shocks, boosting the GDP growth becomes the most difficult task and main preoccupation of policymakers. This is particularly true for Central Eastern European countries or so called CEE countries, which are trying to overcome contemporary and inherited imbalances at the same time. These economies were faced with another huge challenge after 2008. They have to maintain the same pace of structural reforms during the global economic crisis and to mitigate the negative effects of the crisis on economic growth. In that sense, the aim of this paper is to provide insight into a structural change in these economies in the period 2000–2014, using Leontief input-output analysis of the key sectors. The results pointed out that most of the key sectors during the period are service related sectors and that their number is increased after the crisis, while manufacturing of basic metals and electricity, gas, steam, and air conditioning supply have lost the status of the key sector.

Keywords: structural change, input-output model, key sectors, crisis, CEE economies.

JEL Classification: C67, O11, O13, O14.

Introduction

The structural change can be defined as the "reallocation of economic activity across the three broad sectors agriculture, manufacturing and services" (Van Neuss, 2018). They are taking place in accordance with the economic, systemic and technological changes and follow the common patterns in all countries. All economies typically start with a large agricultural sector and end up with a large service sector (De Groot, 1998). So, it can be concluded that GDP structure can give some rough picture of development and welfare level in any country. In developed countries, the share of the service sector in GDP is dominant, the share of industry is modest and the share of agriculture is, as a rule, marginal. On the other hand, in mid-developed countries, the relative participation of the three sectors is somewhat more balanced.

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In CEE countries, mentioned evolutionary processes have started in the middle of the XX century. The agriculture sector was a significant catalyst of growth and employment in former command economies after WWII, during the first phase of industrialization. In order to accelerate industrialization, the government in these states has enabled transfer the accumulation from agriculture to the industry, allowing the industry to form significantly higher prices than those in agriculture. Very soon agriculture share in GDP was fairly reduced, as the industry became the main driver of economic activity and employment. There are two reasons for favoring the industry. One of them is the technological handicap, which slowed the rate of industrial productivity growth and another, even more important, preferences of central planners for industrial goods over services (Raiser, Schaffer, & Schuchhardt, 2004). But, the poorly-conceived industrialization strategy has led to an emergence of numerous limitations in the development of this sector. Over-industrialization, a large number of employees, poor management in industrial enterprises and their low competitiveness on the world market have significantly contributed to the collapse of the economic system. The change of economic system in post-communist countries became inevitable.

At the beginning of the transition, all former command economies experienced a sharp decline in industrial production and, therefore, GDP. After the initial adjustment to the market economy and the emergence of several crises during that period, some of the former command economies experienced significant recovery. Parallel with that, the share of agriculture and industrial sector has been given way to the service sector. Such developments were the result of transition schemes focusing predominantly on liberalization and privatization and FDI that mostly targeted services (Cerovic, Nojkovic, & Uvalic, 2014).

The reform processes were taking place in a relatively favorable environment during the first few years of the new millennium, having in mind that all CEE economies strived to meet conditions for EU membership. As transition reforms in a large extent coincided with prerequisites for the accession, the perspective of EU membership greatly accelerated reform processes in candidate countries and that is why Berglöf and Roland (1997) concluded that it can act as "outside anchor" for transition reforms. But, reform dynamics was slowed down with the emergence of the global economic crisis. CEE economies were particularly vulnerable during the crisis, having in mind that they were already dependent economically on funding from Western Europe and lacking the robust industrial relations institutions traditional in most Western economies. However, the impact of the crisis differed across countries and economic activities, and the strategies of key actors have significantly affected the outcomes (Soulsby, Hollinshead, & Steger, 2017).

In that sense, the motivation to perform key sector analysis in the CEE region in the period 2000–2014 is twofold. Firstly, to investigate how mentioned structural changes were taking place in CEE countries during first 15 years of the new millennium, which is predominantly characterized by intensification of the globalization process, EU enlargement, and global economic and financial crisis. Key sector analysis provides the basis for the taxonomy of economies and contributes to enriching better understanding of the growth and development processes (Cmiel & Gurgul, 2002), which is particularly important for the transition economies in such circumstances. Also, this type of analysis can provide insight into the structural change of the economy, as a quality information base for the formulation of sus-

tainable development strategy. Secondly, to investigate how the global economic and financial crisis has affected the composition of key sectors in CEE countries. The crisis stopped or slowed down the growth of some economic activities, which was fuelled by demand growth and a significant FDI inflow in transition countries before the crisis, while some of them were relatively resistant to the crisis.

The paper is organized as follows. Section 1 contains a brief overview of previous literature on structural reforms in CEE economies and the impact of the crisis on the pace of the reforms. Section 2 is dedicated to the explanation of used dataset and the applied methodology for identification and examination of key sectors. In Section 3 the main empirical results and their discussion are provided. Finally, the last Section summarizes the results of the study and direction for future research.

1. Literature review

The economic transformation and structural change have been crucial issues in the economic literature in recent decades, so there is a great diversity among authors concerning their comprehension of successful structural change (Cantore, Clara, Lavopa, & Soare, 2017; Araujo & Trigg, 2015; Van Neuss, 2018). The globalization process is emphasized as the most common factor that influences structural change.

The globalization, parallel with internationalization, shaped structural change in the CEE region and their influence become more pronounced after 2000. Namely, unlike to EU-15 whose growth was based on a mix of high and low-value-added service activities, CEE economies based their growth strategies on the attraction of manufacturing plants off-shored mostly from Western EU countries and FDI from all over the world (Belloc & Tilli, 2013). EU has an active role in the sharpening of FDI inflows to the region (Medve-Bálint, 2014). By 2009, FDI inflow was especially high in the export-oriented, capital-intensive sectors and ICT sector and it was lower only in those service sectors (transportation, retail, and construction) where the size of the domestic market limits expansion. Bohle and Greskovits (2012) argued that there are also significant differences in the sectoral structure of FDI among CEE countries. In the Visegrád 4 and Slovenia, FDI targeted manufacturing, including in automotive, electronics and chemical industries. In contrast, FDI in Bulgaria, Romania, and the Baltic states was concentrated in non-tradable sectors, such as banking and real estate.

The global financial crisis faced EU with crucial crossroads (Podkaminer, 2013). The unfinished transition of CEE economies (Dobrinsky & Havlik, 2013), on one hand, and negative effects of the crisis (Capello & Caragliu, 2014; Capello & Perucca, 2015), on the other, significantly weakened EU economy as a whole. In addition, a significant challenge for the EU is to keep the pace with the latest scientific achievements of its major competitors in the world market and their strategies for the development of knowledge and innovation (Maré, Fabling, & Stillman, 2014; Mack, 2014; Archibugi & Filippetti, 2011).

There are a lot of papers that pointed out high immunity of the service sector on the crisis in CEE region. Gál (2014) stressed out that the impact of the crisis has been less severe for the offshore services industry as it forced providers to increase both efficiency and competitiveness of their services. Chilimoniuk-Przeździecka (2011) pointed out that the business

services sector was less affected by the crisis (because it is not as sensitive as manufacturing). As it is described in Schumpeterian literature, the external restructuring in business services is more intensive during recession periods, while intensive internal restructuring accompanies expansion periods. So, it can be concluded that the growth of service offshoring projects located in CEE and Asia is in a large extent result of the global economic crisis. The process is reflected by the growth of FDI inflows to CEE and Asia from developed economies as well as the growth of business and IT services trade between the mentioned economies.

The growing importance of the service sector inclined economy structure in the CEE region towards deindustrialization. In the line of the neoclassical orthodoxy, de-industrialization was predominantly viewed as a by-product of successful economic development before the economic downturn of 2008 (Škuflić & Družić, 2016). However, after the crisis, the prevailing opinion shifted and Rodrik (2009) was one of the first to openly support industrial policies as a cure for the crisis. The policymakers in some countries gradually started shifting their focus more and more toward industrial performance and emphasized the necessity of re-industrialization. In light of these events, the EU Member States decided to begin working on a common industrial policy, in order to enhance economic growth after global turmoil. The policy measures are defined in detail in the "Communication on industrial policy" (European Commission, 2014) and it argues the necessity of modernization and re-industrialization of the industrial base in EU, focusing on highly adaptive, technologically advanced and productive industries.

Landesmann and Stöllinger (2019) also pointed out the necessity of formulation appropriate industrial policy aimed at acceleration of industrialization in potentially catching-up (PCU) countries and improvement of their position in international value chains. They emphasized the strong shift of industrial capacities towards Central Europe and their withdrawal from other EU countries. CEE-5 economies (Poland, Czech Republic, Slovakia, Hungary, and Slovenia) closed the gap in the shares of high-tech and medium-high-tech industries in total export compared to advanced West European economies. Bulgaria and Romania increased the share in both types of industries, while Baltic States increase the share of the high-tech industries but they fail to increase the medium-/high-tech industries share. Due to strong FDI inflow, CEE-5 economies upgraded their industrial capabilities, especially in tradable sectors. The Baltic States are approaching them in development of tradable sectors, while Bulgarian and Romanian economies are still more relied on non-tradable sectors.

The mentioned rise of awareness about the importance of industrial development for the growth and development motivated Stojčić and Aralica (2017) to investigate the factors behind changes in the economy structure in CEE countries. They extracted two groups of CEE economies, defined as reindustrializing (Czech Republic, Hungary, Poland, Bulgaria, Lithuania, and Romania) and those going through deindustrialization (Slovakia, Estonia, Latvia and particularly Croatia and Slovenia). The main driving force of such an outcome is the difference in their competitiveness and industrial policy. They emphasized that the lower FDI inflow into sectors other than manufacturing, together with the absence of effective sectoral policies and the continuous pressure of imports on the domestic market, have eroded the industrial base in these economies.

While manufacturing and service sector and the relationship between them were the main research topic of authors and policymakers in the new millennium, the literature on the importance and role of agriculture in the economy is not so extensive. Fertő (2016) emphasized that agriculture share in GDP and employment was declining after the beginning of the transition, but there are significant differences in structural transformation outcomes among CEE economies. Török and Jambor (2013) stressed out that CEE countries implemented several changes in the agricultural sector after the EU accession: intensity agri-food trade has increased significantly (especially with EU15 countries), agri-food trade was highly concentrated by country and by-product (the same products were traded with the same countries in most cases), the focus on the agri-food raw materials in export together with the agri-food processed products in import, decrease in their comparative advantage (except Latvia and Lithuania, but it still remained at an acceptable level in most cases). Also, a stronger market competition caused by the entrance of famous retailers (so, called "Wall Mart effect") greatly affected food prices and strategies of companies from food and agriculture sectors (Igan & Suzuki, 2012).

Since the introduction of the Euro, macroeconomic imbalances across EU economies have been widened and to a certain extent, they are the result of differences in the dynamics of the non-tradable sectors between the core and the periphery countries. Authors divided sectors into tradable and non-tradable, by calculating the openness ratio. A sector is considered as tradable if its openness ratio is greater than 10%. According to the level of openness ratio for period 1995–2014, the tradable sectors in EU are sectors A, B, C, H, I, J, K, M and N (NACE classification) and rest of the sectors are non-tradable ones. Financial integration also fosters a temporary demand increase in peripheral economies, leading to an expansion of the non-tradable sector (Piton, 2017).

There is an extensive set of literature on the concept of key sector analysis and many definitions of linkage measures have been proposed by the practitioners (ten Raa, 2005; Luptáčik, & Böhm, 2010), as well the questions on the identification of key sectors in developing countries have been raised over the past period of time (Karagiannis, & Tzouvelekas, 2010). According to the Hewings (Hewings, 1982), the most important part in identifying the key sectors is certainly determining their impact upon an economy. Moreover, he also argued that since the key sector analysis implies selection from the set of sectors, based on their backward and forward linkages, the most appropriate methodology framework, which can be used for this purpose appears to be an input-output model.

The methodology for identifying key sectors of an economy based on input-output tables has a long tradition and it can be traced back to Rasmussen (1956). It is usually used for the analysis of structural change in one national economy in a particular year (Cardente, Llanes, Lima, & Morilla, 2008; Botric, 2013; Cmiel & Gurgul, 2002). To the best of our knowledge, only Gurgul and Lach (2015) used this methodology in the case of the CEE region. They strived to identify which are the key sectors in the post-communist CEE economies over the period 1995–2011. The results indicated that in the period there are the group of sectors (especially, the food-and-agriculture-related ones), which have remained the key sectors in CEE transition economies while manufacturing sectors have been continuously losing sig-

nificance. The construction sector, as well as the services, especially the financial and travel and tourism-related sectors, have clearly increased their importance.

Although the traditional Rasmussen's Input-Output analysis consequently represents one of the most frequently used methodological frameworks (Mattioli, & Lamonica, 2013), recently new modified models of Input-Output analysis emerged in the literature. For example, authors Amores and Rueda-Cantuche (Amores, & Rueda-Cantuche, 2009) introduced and adopted the Data Envelopment Analysis (DEA) concept as a more flexible approach to identify key sectors in an economy. Since the input-output model can be formulated as an optimization problem, DEA as a non-parametric linear-programming-based technique can be effectively used in order to detect key sectors by means of a comprehensive indicator ("key value"). Moreover, how authors stressed, this methodology, therefore, can be applied for overcoming controversial issues of traditional multipliers analysis.

To summarize, previous literature on this topic is very diverse in terms of the research context and used methodology. This study is one of the rare papers which investigate structural changes by the usage of key sector analysis in all CEE countries, having in mind that most of them are focused only on one or small group of economic activities and/or one or few CEE economies. In addition, the data for 2008 was used as a breakpoint, in order to investigate the impact of the economic crisis on the economy structure in each post-communist economy and CEE region as a whole.

Having in mind the conclusions from the previous literature and research context of this study, the following research questions are raised:

- What are the key sectors in CEE economies in the new millennium?
- Which economic sectors gained and lose the status of key sectors after the crisis?
- What are the main characteristics of economy structure in each CEE country?

The research questions listed above will be answered using the data and methodology which is presented in the next section.

2. Data and research methodology

2.1. Data

The data used for performing key sector analysis are taken from the World Input-Output Database (WIOD), a project funded by the European Commission as part of the 7th Framework Programme, Theme 8: Socio-Economic Sciences and Humanities. The database covers 43 countries (28 European countries and 15 other major countries in the world). The originality of this paper is in the fact that it is the among rare research conducted on the basis of recently launched World Input-Output Database (WIOD) – Release 2016 (n.d.), which incorporate data for Croatia as a New Member State (as of July 1, 2013). This is the latest available database and covers the period from 2000 to 2014. This database has the more dispersed structure of economic activities compared to the 2013 release of WIOD, including 56 economic activities (the previous, 2013 Release of WIOD had 36 economic activities), so the more detailed results can be obtained by its usage. The considered countries are Bulgaria, Romania, Croatia, Czech Republic, Hungary, Slovak Republic, Poland, Estonia, Lithuania, Latvia

and Slovenia. The national IO tables are published by the WIOD in current prices, expressed in millions of dollars. In this paper, the focus is on interrelations between 54 sectors of each economy under study thus all the IO tables used in calculations are in aggregation of 54×54. Namely, in case of all examined CEE countries there were no inflows and outflows in case of two sectors over the period – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use and Activities of extraterritorial organizations and bodies, so they are excluded from the empirical analysis.

2.2. Research methodology

In the first phase, the Inter-Industrial Linkage Analysis was conducted considering backward and forward linkages as the key indicators, which can be used to evaluate the domestic inter-dependence among sectors in particular national economy. Namely, the measure "backward linkage" is used to indicate the interconnection of a particular sector to other sectors from which it purchases inputs (demand oriented). On the other hand, the measure "forward linkage" is used to indicate this interconnection of a particular sector to those to which it sells its output (supply oriented).

Moreover, in this study backward and forward linkages were calculated by using the well-known Rasmussen approach (Rasmussen, 1956). This approach relies on the so-called inverse Leontief matrix. Where, each element of this inverse Leontief matrix represents total requirement, both direct and indirect, of goods and services produced by the i-th industry which are necessary in order to satisfy one unit of final uses of the j-th sector (Mattioli & Lamonica, 2013).

Following the traditional form of the I-O table (Figure 1), the direct consumption coefficient or domestic technical coefficient can be calculated as:

$$a_{ij} = \frac{x_{ij}}{X_j} \quad (i, j = 1...n) \ , \tag{1}$$

where x_{ij} is a flow of a product or service in a given area of the economic sector, i.e. from the i-th to the j-th sector in I-O table. And X_j is the total production of the j-th sector.

Then, Input-Output coefficient matrix A (so-called Technology matrix) is expressed as:

$$A = \begin{bmatrix} \frac{x_{11}}{X_1} & \frac{x_{12}}{X_2} & \cdots & \frac{x_{1n}}{X_n} \\ \frac{x_{21}}{X_1} & \frac{x_{22}}{X_2} & \cdots & \frac{x_{2n}}{X_n} \\ \cdots & \cdots & \cdots & \cdots \\ \frac{x_{n1}}{X_1} & \frac{x_{n2}}{X_2} & \cdots & \frac{x_{nn}}{X_n} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & & a_{1n} \\ a_{21} & a_{22} & & a_{2n} \\ & & & \\ a_{n1} & a_{n2} & & a_{nn} \end{bmatrix}. \tag{2}$$

Next, by the system of the linear equations, connections between productions and total outputs can be established as:

$$\begin{aligned} &a_{11} \cdot X_1 + a_{12} \cdot X_2 + ... + a_{1n} \cdot X_n + Y_1 = X_1 \\ &a_{21} \cdot X_1 + a_{22} \cdot X_2 + ... + a_{2n} \cdot X_n + Y_2 = X_2 \\ &... \\ &a_{n1} \cdot X_1 + a_{n2} \cdot X_2 + ... + a_{nn} \cdot X_n + Y_n = X_n \end{aligned} \tag{3}$$

or in general condensed matrix form, equation (3) becomes:

$$AX + Y = X, \tag{4}$$

where A denotes to previously defined Input-Output coefficient matrix; X the output vector; and Y the final demand vector.

Equation (4) yield the well-known I-O static model (Cmiel & Gurgul, 2002):

$$Y = (I - A) \cdot X. \tag{5}$$

Finally,

$$X = (I - A)^{-1} \cdot Y = B \cdot Y, \tag{6}$$

where I represents the unit matrix, and $(I\text{-}A)^{-1}$ or B matrix is the inverse Leontief matrix:

$$B = \begin{bmatrix} b_{11} & b_{12} & b_{1n} \\ b_{21} & b_{22} & b_{2n} \\ \\ b_{n1} & b_{n2} & b_{nn} \end{bmatrix}. \tag{7}$$

Using the mentioned matrix the backward and forward linkages can be calculated. These measures are based on the input coefficients a_{ij}, indicating the use of domestic intermediate outputs of industry i per unit of buying industry j output, and the output coefficients b_{ij}, indicating the domestic intermediate sales to industry i per unit of selling industry j output (Temurshoev & Oosterhaven, 2014). The strengths of the backward as well forward linkages can be introduced as:

– Backward linkage: $BLj = \dfrac{\frac{1}{n}\sum_{i=1}^{n} b_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{i=j}^{n} b_{ij}}$; (8)

– Forward linkage: $FLj = \dfrac{\frac{1}{n}\sum_{i=1}^{n} b_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{i=j}^{n} b_{ij}}$, (9)

where $\sum_{i=1}^{n} bij; (i, j = 1...n)$ is the column multiplier of sector j, and $\sum_{j=1}^{n} bij; (i, j = 1...n)$ is the row multiplier of sector i.

According to Tregenna (2008), backward and forward linkages represent two crucial mechanisms through which growth in one sector affects the growth of other sectors and the economy as a whole. Backward linkages stimulate demand and production in upstream sectors which in turn lead to increased upstream investment, higher levels of capacity utilization and possible technological upgrading. These linkages represent the strength by which production of sector i depends on inter-sectoral inputs (Miller & Blair, 2009). In other words, the total backward linkages represent the change in total output of economy in case the final demand for a particular sector increases by one unit and it is calculated as the column sum of the Leontief inverse matrix (Miller & Blair, 2009). So, the sum of the j-th column of the

matrix A is a measure of the strength of the backward linkage of sector j, showing the amount by which sector j production depends on the inputs from other industries (Górska, 2015).

Forward linkages, on the other hand, accelerate growth – inducing downstream effects, leading to downstream investments, technological upgrading or increase of productivity Tregenna (2008). These linkages represent the increase in the output of sector i needed to supply the inputs required to produce a unit of the final demand output in sector j (Botric, 2013). Opposite to backward linkages, the sum of the i-th row of the matrix A is a measure of the strength of the forward linkage of sector i, showing the amount by which sector i production is used by other industries.

Generally, both this measure have important synergetic economic interpretation, as well as the pulling and sustaining effects of a particular sector can be obtained at the level of the whole national economy. These effects can be clustered into four groups:

1. Key sector, where $FL_j > 1$ and $Bl_i > 1$. This kind of sector is crucial since it has both strong pulling and sustaining effects on the national economy.
2. The backward-oriented sector, where $FL_j < 1$ and $Bl_i > 1$. This kind of sector has powerful a pulling effect but weak sustaining effect on the national economy.
3. The forward-oriented sector, where $FL_j > 1$ and $Bl_i < 1$. This kind of sector has powerful a sustaining effect but weak pulling effect on the national economy.
4. The weak-oriented sector, where $FL_j < 1$ and $Bl_i < 1$. This kind of sector has both weak pulling and sustaining effects on the national economy.

Additionally, in the second phase of the model, which was used in this study, approach proposed by authors Gurgul and Lach in 2015 has been adapted with the main purpose to investigate considered indicators in more detail manner for the whole group of selected transitional countries (Gurgul & Lach, 2015). Namely, this so-called "Weighted key sector analysis" can address the importance of the particular sector for the group of countries for defined numbers of the time period. Hence, in this analysis measures, BL_j and FL_i have been substituted with BL_j^* and FL_i^*, respectively.

Next equation can be used to calculate country and time-weighted indicators for backward and forward linkages:

$$BL_i^* = \frac{1}{t_k - t_0 + 1} \sum_{t=t_0}^{t_k} \sum_{p=1}^{N} w_{p,t} \cdot FL_i^{p,t}; \tag{10}$$

$$FL_i^* = \frac{1}{t_k - t_0 + 1} \sum_{t=t_0}^{t_k} \sum_{p=1}^{N} w_{p,t} \cdot BL_i^{p,t}, \tag{11}$$

where p ($p \in \{1 \ldots N\}$) is considered transition country identification number, t ($t \in \{t_0 \ldots t_k\}$) stands for a specific year, $BL_i^{p,t}$ and $FL_i^{p,t}$ stand for country's p individual backward and forward linkage of the sector i (i$\in${1…n}) in year t, respectively.

Also, weights of the country p in the year t, can be calculated by the following formula:

$$w_{p_0,t_s} = \frac{GDP_{p_0,t_s}^{PPS} \cdot n_{p_0,t_s}}{\sum_{p=1}^{N} GDP_{p,t_s}^{PPS} \cdot n_{p,t_s}}, \tag{12}$$

where $GDP^{PPS}_{p_0,t_s}$ represent the GDP per capita in country p_o in year t_s in Purchasing Power Stands (PPS) expressed in relation to EU-28 average, n_{p_0,t_s} represents the population of country p_o in year t_s (Gurgul & Lach, 2015).

In addition to weighted indicators, in their approach, Gurgul and Lach (Gurgul & Lach, 2015) also focused on the dynamic of these indicators. The proposed visualization tool that enables estimation of magnitude and projection of the direction shift between backward and forward linkages of sector *i* and for the considered periods on the time scale. In order to perform this additional analysis, the next formulas can be applied:

$$\Delta BL_i^{\star} = \sum_{p=1}^{N} (w_{p,t_k} \cdot BL_i^{p,t_k} - w_{p,t_0} \cdot BL_i^{p,t_0}); \tag{13}$$

$$\Delta FL_i^{\star} = \sum_{p=1}^{N} (w_{p,t_k} \cdot FL_i^{p,t_k} - w_{p,t_0} \cdot FL_i^{p,t_0}). \tag{14}$$

Usage of mentioned methodology enable comprehensive and clear insight in economy structure in analysed countries for considered years.

3. Results and discussions

In order to access the structural changes in CEE economies during the period 2000–2014, authors shed some light on the dynamics of changes in each country, having in mind that these developments sharpened the regional patterns. After that, the results of key sector analysis for the whole region is presented and discussed.

Namely, input–output tables used as an input for application of key sector analysis provide a comprehensive insight in the economic relationships between industries in a particular economy for a considered year. The comparisons of the strengths of backward and forward linkages between industries in a national economy enable identification of "key" or "leading" sectors in considered economies. In the framework of an input–output analysis, production of single sector has two types of economic effects on other sectors in the economy. The first of them implies the connection of the industry with its suppliers. If the increase of industry j output leads to increase demands on the other sectors whose goods are used as inputs to production in j such correlation is called backward linkage. This effect and shows the direction of causation in the usual demand-side model. On the other hand, the second effect refers to the connection of the particular sector with its consumers. The increased output in industry j means that additional amounts of its products are available to be used as inputs to other sectors for their own production – there will be increased supplies from sector j for the sectors that use its goods in their production. The term forward linkage is used to indicate this kind of interconnection, and it shows the direction of causation in the supply-side model (Górska, 2015).

Each of the analysed countries has some specificities of the economy structure and they are shown in Table 1. The key sector analysis was performed for 2000 (as the first year in sample and beginning of the new millennium), 2008 (global economic crisis) and 2014 (as the last year in the sample). The classification of sectors into key (K), forward-oriented (F),

Table 1. The results of key sector analysis in CEE transition economies based on 2000, 2008 and 2014

	2000											2008											2014										
	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO
Crop and animal production, hunting and related service activities	K	K	W	K	K	K	F	K	K	K	W	K	B	K	K	K	B	F	K	K	F	W	K	K	K	K	K	B	K	K	K	F	W
Forestry and logging	W	K	K	B	B	W	K	B	W	F	W	W	B	K	W	B	W	K	B	W	K	W	W	W	K	W	B	K	K	B	B	F	W
Fishing and aquaculture	B	B	B	B	B	B	B	B	B	B	B	W	W	W	W	B	B	W	W	B	W	B	W	W	W	W	B	B	W	W	W	W	B
Mining and quarrying	K	F	F	F	B	W	B	F	K	W	W	F	W	F	F	W	W	W	F	K	W	W	W	W	F	F	W	W	W	F	K	W	W
Manufacture of food products, beverages and tobacco products	B	K	B	K	K	B	K	K	K	B	B	B	K	K	B	K	B	B	K	K	B	B	B	K	B	B	K	B	B	K	K	B	B
Manufacture of textiles, wearing apparel and leather products	W	W	W	W	W	B	W	W	W	W	B	W	W	W	B	W	W	W	W	W	W	W	B	W	W	B	W	W	W	W	W	W	W
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	B	K	K	B	B	B	K	B	B	B	B	B	B	B	B	B	W	K	B	B	K	B	B	B	B	B	B	W	K	B	B	K	B
Manufacture of paper and paper products	B	K	B	B	K	B	W	K	B	B	B	W	B	B	B	B	W	W	B	B	B	W	W	B	B	B	B	W	W	K	B	B	W
Printing and reproduction of recorded media	B	B	W	B	K	W	W	B	B	W	K	K	K	F	B	K	W	F	B	W	W	K	K	K	W	B	K	F	F	B	W	W	K
Manufacture of coke and refined petroleum products	F	F	B	W	K	F	B	F	K	F	B	F	F	W	W	F	F	B	F	K	F	B	F	F	W	W	F	F	B	F	W	F	B
Manufacture of chemicals and chemical products	K	F	W	W	K	K	W	W	B	W	W	W	W	W	W	B	W	W	B	B	B	W	W	W	W	W	B	W	B	K	B	W	W
Manufacture of basic pharmaceutical products and pharmaceutical preparations	B	W	W	B	W	B	B	B	W	W	W	W	W	W	W	W	W	W	B	W	B	B	W	W	W	W	W	W	W	B	B	B	B
Manufacture of rubber and plastic products	B	W	W	W	W	W	W	B	B	W	B	W	W	W	W	W	W	W	B	W	W	W	W	W	W	W	W	W	W	K	B	W	W
Manufacture of other non-metallic mineral products	B	F	B	B	B	B	B	W	K	B	B	W	B	B	B	B	B	B	B	K	B	B	W	W	B	B	B	B	B	B	B	B	B
Manufacture of basic metals	K	K	W	B	B	B	W	K	B	K	F	F	W	W	B	W	B	W	B	K	W	W	K	W	W	B	W	W	W	B	K	W	W
Manufacture of fabricated metal products, except machinery and equipment	B	K	W	K	F	K	W	B	F	F	K	W	F	F	K	F	F	W	K	F	F	K	W	F	W	W	W	W	W	K	K	F	K
Manufacture of computer, electronic and optical products	B	W	W	W	W	K	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Manufacture of electrical equipment	B	W	W	B	F	W	W	W	W	W	W	W	W	W	B	W	W	W	B	W	W	W	W	W	W	B	W	W	W	W	W	W	W
Manufacture of machinery and equipment n.e.c.	B	W	W	B	W	B	W	W	W	W	W	W	W	W	B	W	W	W	W	W	W	W	B	W	W	B	W	W	W	W	W	W	W
Manufacture of motor vehicles, trailers and semi-trailers	B	B	W	W	F	K	W	B	B	W	B	B	W	W	W	W	B	W	B	W	W	W	B	F	W	W	W	B	W	B	B	F	W
Manufacture of other transport equipment	B	W	B	B	W	W	W	W	B	W	B	B	W	B	B	W	W	W	W	B	W	B	B	W	B	B	W	W	W	B	B	W	B
Manufacture of furniture; other manufacturing	B	W	B	B	W	B	B	B	W	B	B	W	W	B	W	W	B	B	B	W	B	W	B	W	B	W	W	B	B	B	B	B	W
Repair and installation of machinery and equipment	B	B	K	B	W	B	W	W	B	F	W	W	B	F	B	W	K	K	W	B	F	W	W	W	F	B	W	K	F	W	W	K	W
Electricity, gas, steam and air conditioning supply	F	F	K	F	F	K	K	F	K	K	F	F	F	K	K	K	K	K	F	K	K	F	F	F	K	K	F	K	K	F	F	K	F
Water collection, treatment and supply	W	B	W	W	W	W	W	W	B	W	W	W	B	W	W	B	W	W	W	B	W	W	W	B	W	W	B	W	W	W	W	B	B
Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services	B	B	B	W	B	B	W	W	B	W	W	B	B	B	W	B	B	W	W	B	W	W	B	B	B	W	B	B	W	W	B	B	B
Construction	K	K	K	K	B	K	K	K	K	K	K	K	K	K	K	B	K	K	K	F	K	K	K	K	K	K	K	K	K	K	K	K	K

End of Table 1

	2000											2008											2014										
	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO	BUL	CZE	EST	CRO	HUN	LTU	LAT	POL	HUN	SVK	SLO
Wholesale and retail trade and repair of motor vehicles and motorcycles	W	W	W	K	B	W	W	F	W	W	W	W	F	F	K	B	F	B	F	B	F	F	B	W	F	F	B	F	W	W	W	W	W
Wholesale trade, except of motor vehicles and motorcycles	K	F	K	K	K	F	K	F	F	K	K	K	F	K	K	K	K	K	K	F	K	K	K	K	K	K	K	K	K	F	K	K	K
Retail trade, except of motor vehicles and motorcycles	F	F	F	F	B	F	F	F	F	F	W	F	F	F	K	B	F	F	F	F	F	K	F	K	K	K	B	F	F	F	K	F	K
Land transport and transport via pipelines	F	F	K	B	F	F	K	F	F	K	K	K	K	K	B	K	K	K	K	F	K	K	K	K	K	B	K	K	K	K	K	K	K
Water transport	K	B	K	W	B	W	B	B	B	B	B	W	B	B	W	B	W	B	B	B	B	W	W	B	B	W	B	W	W	B	B	B	B
Air transport	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Warehousing and support activities for transportation	K	K	K	W	B	F	K	K	B	K	K	K	K	K	B	K	K	K	K	F	K	K	K	K	K	B	K	K	K	K	K	K	K
Postal and courier activities	F	W	W	W	W	W	W	B	W	W	W	B	W	W	W	W	W	W	W	W	B	W	B	W	B	W	W	W	W	W	W	K	W
Accommodation and food service activities	W	B	B	W	B	W	B	B	K	W	W	B	B	B	W	B	W	B	B	K	W	B	B	B	B	W	B	W	B	B	K	W	B
Publishing activities	B	B	B	B	B	B	B	W	B	W	B	W	B	B	B	B	B	B	W	B	W	B	W	W	B	B	B	B	B	W	W	W	B
Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	W	B	B	B	B	B	B	B	W	B	W	B	B	B	K	B	K	B	B	W	B	B	W	B	B	K	K	B	B	B	B	B	B
Telecommunications	W	F	F	F	F	F	F	K	F	F	K	F	F	K	F	F	F	K	F	F	K	K	F	F	K	K	W	F	K	W	W	B	K
Computer programming, consultancy and related activities; information service activities	B	W	W	W	F	W	W	W	W	W	W	W	F	W	W	F	W	W	W	W	W	F	F	F	F	W	F	W	F	F	F	F	F
Financial service activities, except insurance and pension funding	F	F	F	W	F	F	F	F	F	K	F	F	F	F	F	K	K	F	F	K	K	F	F	F	F	F	K	K	F	F	F	F	K
Insurance, reinsurance and pension funding, except compulsory social security	B	B	B	B	B	B	B	B	W	W	B	K	B	B	B	B	K	W	B	W	B	B	K	B	B	B	B	B	B	B	B	B	B
Activities auxiliary to financial services and insurance activities	W	W	W	W	F	W	W	W	W	B	W	W	B	B	W	F	B	W	B	W	K	B	W	K	K	W	F	B	W	B	W	K	B
Real estate activities	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	W	F	F	F	K	F	F	F	F	F	F	F	F	F
Legal and accounting activities; activities of head offices; management consultancy activities	B	W	F	F	F	F	F	F	B	K	F	B	F	F	F	F	K	F	F	K	F	F	K	F	F	F	F	K	F	F	K	K	F
Architectural and engineering activities; technical testing and analysis	B	K	W	K	F	B	W	W	W	F	K	B	K	W	K	F	K	B	B	F	F	K	B	K	B	K	F	B	B	B	K	K	K
Scientific research and development	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Advertising and market research	B	K	K	B	B	K	W	K	B	K	B	K	K	K	B	B	K	K	K	K	K	B	K	K	K	B	B	K	K	K	B	K	B
Other professional, scientific and technical activities; veterinary activities	B	B	W	W	W	W	W	W	B	B	W	B	B	W	W	W	W	B	W	B	B	W	B	K	B	W	W	W	W	W	B	B	W
Administrative and support service activities	K	K	K	F	F	F	K	F	W	F	F	K	K	F	K	F	K	K	K	K	F	F	K	K	F	K	F	K	K	F	K	K	F
Public administration and defence; compulsory social security	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	B	F	W	W	W	W	W	W
Education	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Human health and social work activities	W	W	W	W	W	B	W	W	B	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Other service activities	F	W	B	B	W	W	W	W	F	B	W	K	W	B	B	W	B	B	W	K	B	B	K	B	B	B	B	K	W	W	W	W	K

backward-oriented (B) and weak (W) is preformed according the values of calculated time-weighted indicators for backward and forward linkages presented by formulas (10) and (11). The key sectors (K) are those with both index higher than one, indicating that this sector is important as a supplier as well as consumer. The sector with the forward linkage higher than 1 and backward linkage lower than 1 is forward oriented sector (F), meaning that if the final demand for products of all industries increases by 1 unit, it will result in the increase in total output of this sector more than 1 unit. So, the most forward-linked industries provide the biggest supply-push effects on the economy (Górska, 2015). On the other hand, the sector with the backward linkage higher than 1 and forward linkage lower than 1 is backward-oriented sector (B), implying that the increase in final demand of its products by 1 unit will result in the higher than 1 increase in total output of the economy. The most backward-linked industries provide the biggest demand-pull effects on the economy (Górska, 2015).

According to the presented data, it can be concluded that all considered countries increased the number of key sectors in 2014 in comparison to 2000. After a slight decrease in 2008, the number of key sectors in the Czech Republic was increased to 14 in 2014. The number of weak sectors followed the same trend, but it was higher than the number of key sectors. Parallel with that, the number of backward sectors was decreased, indicating that backward linkages were weakened or, in other words, some sectors that contributed to the domestic demand lost their importance as a buyer of inputs. The deeper insight into the structure of sector categories can provide a clearer picture of structural change patterns in this economy. The categorization of sectors on tradable and non-tradable is performed according to Piton (2017). Considering that number of tradable sectors remained the same during the period and that the number of key sectors was increased, it can be concluded that such a trend is a result of increased importance of non-tradable sectors, like Real estate activities and Retail trade, except of motor vehicles and motorcycles (which was forward-oriented sector in the previous period). Primary sub-sectors were greatly affected by the global economic crisis, having in mind that two agriculture-related sectors lost their key role in the economy in 2008. However, one of them (Crop and animal production, hunting and related service activities) regained its key role. When it comes to secondary sub-sectors, it can be concluded that the number of key and backward sectors is gradually decreased, while the number of weak secondary sub-sectors is increased. They lost their role as a supplier of inputs and even more as a buyer of inputs. The secondary sub-sectors transferred their key role to service sub-sectors, the number of key service sub-sectors was increased and weak ones were reduced, which is in line with conclusions of Stojčić and Aralica (2017).

The number of key sectors in Hungary was slightly and gradually increased during the observed period, while the number of forward and backward ones was decreasing. The number of weak sectors grown in 2014 in comparison to 2000 and it was even higher in 2008. All these trends indicate a weakening of both backward and forward linkages among a large number of sectors in the economy. The number of key sectors was increased due to the increased importance of Construction, as a non-tradable sector, and joining an additional two tradable sectors in the structure of key sectors. Among the primary sector, Forestry and logging become key sector due to its increased importance of this sector as both buyer and

supplier of inputs. The shifts in the structure of secondary sub-sectors indicate the weakening of backward and especially forward linkages in 2008. The number of service-related key sectors was increased in 2008, as a result of their greater importance both as buyer and supplier, which is the result of strong FDI inflows and restructuring in the business service sub-sectors (Chilimoniuk-Przeździecka, 2011).

The number of key sectors in Poland was stable until 2014 when it was increased to 12. As a result of the weakening of forward linkages and strengthening of backward linkages in the 2008 year, the number of forward-oriented sectors was decreased and the number of them with backward status was increased. The number of key sectors was increased due to the increased importance of tradable sectors, before all Manufacture of chemicals and chemical products and Manufacture of rubber and plastic products, which recorded significant increase of both backward and forward linkage indices. Such a trend is the result of strong FDI inflow in those sectors and increased export of their products (Bohle & Greskovits, 2012; Landesmann & Stöllinger, 2019). The importance of primary sub-sectors was reduced, having in mind that both backward and forward linkages were weakened during the period. The exception of this rule is Crop and animal production, hunting and related service activities, which retained key sector role during the period. In 2008, the contribution of secondary sub-sectors as a buyer of inputs was increased compared to 2000, so the number of backward sectors was increased, while the number of all other sector categories was reduced. After the crisis, in 2014, their role on the supply side was strengthened, resulting in an increased number of key sectors. It is interesting to note that number of manufacturing activities was increased during the period, so it could be said that changes in economy structure in this country are in line with "Communication on the industrial policy" (European Commission, 2014) and results of Stojčić and Aralica 2017. The number of key service-related sectors was increased in 2008, as it was suggested by Chilimoniuk-Przeździecka (2011), and remained the same in 2014.

Slovak economy during the considered period experienced gradual growth of sectors with a key role in the economy. At the beginning of the new millennium there are 10 key sectors, 11 of them existed in 2008 and it ends up with 13 key sectors. Although this increase was gradual, only six sectors retained a key role during the period. Most of the key sectors were tradable ones. Among key non-tradable sectors only Retail trade, except motor vehicles and motorcycles lost its key sector role, due to weakening of its backward linkage. The importance of primary sub-sectors was decreased during the period, primarily as a buyer of inputs, as at the end of the period these sectors were either forward-oriented or weak sectors. Having in mind that 6 out 10 key activities in 2000 were service-related, it can be concluded, that process of deindustrialization is accelerated in the new millennium, so the number of service-related key sectors was increased, corresponding to conclusions of Stojčić and Aralica (2017).

The structure of the Slovenian economy was the most stable among the observed economies during the period, having in mind two facts. First of them is that the number of key sectors was slightly increased and another is that the all 8 key sectors from the beginning of the period retained that role in the economy. In 2000, most of the key sectors were tradable one, but in 2008 the number of non-tradable key sectors in the structure of key sectors was increased. It is interesting to note that only this country do not have any agriculture-related

activities among key sectors during the entire considered period. The share of service-related activities in the structure of key sectors was increased, indicating that the deindustrialization process was enchased during the period, like Stojčić and Aralica (2017) have pointed out in their research. Parallel with that, the number of weak services oriented sectors was reduced, primarily due to their greater importance as a buyer of inputs.

Although Estonia represents the small, open and vulnerable economy, its number of key sectors was unchanged during the observed period. Also, it should be emphasized that even eleven of them keep their key role in the economy during the period. The structure of sector categories also remained rather stable in all considered years – the share of tradable and non-tradable sectors did not change considerably, as well as the share of primary, secondary and service sub-sectors. It should be pointed out that the share of service-related activities in the group of key sectors in the post-crisis period is the highest and most of them that retained key sector role were less knowledge-intensive ones.

Lithuania experienced significant changes in the number and the structure of key sectors in considered years. The number of key sectors was increased to 15 in 2008 and at the end of the period, there are 13 of them. Parallel with that, the number of weak sectors was increased in 2008 and remained high in 2014. This is a result of a weakening of forward and especially backward linkages of a large number of sectors. The tradable sectors were more resistant to the crisis having in mind that the number of tradable key sectors was significantly increased in 2008. On the other hand, the number of non-tradable key sectors was gradually increased. Lithuanian economy is one of rare where primary sectors increased their importance in the economy, having in mind that the number of these sectors with the key role was increased, which is suggested by Török and Jambor (2013). This economy is one of those where deindustrialization was intensified somewhat later than in other transition economies. This country had only one service-related activity among key sector at the beginning of the new millennium. Most of the eight key sectors in 2000 were manufacturing activities and none of them was low-technology manufacturing industry. Besides the number of key sectors, the structure of key sectors was transformed to a great extent. Even 8 out of 12 sectors were service-related and most of them were knowledge-intensive services (Chilimoniuk-Przeździecka, 2011). Having in mind mentioned changes, it is not surprising that only three sectors retained a key role in the economy.

Similar to Estonia, Latvia had a relatively stable structure of the economy, although it is a small, open economy, characterized by cyclical fluctuations. This is supported by the fact that even 8 sectors retained a key role in the economy during the period. The number of tradable key sectors was gradually increased during the observed period, as it was suggested by Landesmann & Stöllinger (2019). It is worth to note that non-tradable sectors had greater importance as a user of inputs and created demand in the recession year. Two primary sub-sectors had a key role in the economy in 2014, one that had a key role during the entire considered period and another that joined this group in 2014, as greater competitiveness of their agriculture sector (Török & Jambor, 2013). Both secondary and service sub-sectors strengthened their role as a buyer of inputs in 2008. After the crisis, in 2014, the structure of analyzed sector categories was similar as in the pre-crisis period.

The number of key sectors in the Bulgarian economy was gradually increased during the period. It is worth to note that the number of weak sectors was almost doubled in 2008, due

to the weakening of backward linkages in the case of a large number of sectors. According to that, it can be concluded that this economy was hard hit by the global economic crisis. The number of weak sectors was only slightly decreased in 2014. By analyzing the structure of sector categories, it can be concluded that tradable sectors, which greatly contributed to domestic demand in the pre-crisis period, lost their importance in 2008 and haven't recovered until 2014. On the other hand, the structure of non-tradable sectors was rather stable and it is a result of strong FDI inflow in these sectors (Bohle & Greskovits, 2012; Landesmann & Stöllinger, 2019). The one primary sub-sector lost its importance, so the number of weak primary sub-sectors was increased in 2014, while one of them retained its key sector role during the period. Due to the crisis, the secondary sub-sectors have lost their demand-side importance, so the number of backward sub-sectors was decreased and the number of weak ones was increased in 2008 and remained rather high in 2014. The number key service-related sub-sectors was more than doubled in 2008, which is in line with the results of Chilimoniuk-Przeździecka (2011), and it was further increased in 2014. In the post-crisis period, the Bulgarian economy predominantly relied on service-related activities and most of them are knowledge-intensive services, having in mind strong inflow of FDI in those sectors (Bohle & Greskovits, 2012).

The most recent EU member – Croatia had a rather stable structure of sector categories. One of the most prominent changes is the decrease in key sectors number in 2014. The number of tradable sectors was gradually reduced, while a number of non-tradable ones were relatively stable and even more, it was increased in 2008. Such a trend indicates that this economy more relied on non-tradable sectors during the crisis. This economy was mostly relied on service-related activities, while the number of key primary and secondary subsectors was reduced by one sub-sector in 2014 in comparison to 2000.

There are significant changes in the group of key sectors in the Romanian economy, both in the number and the structure of sector categories. The number of key sectors is significantly increased in 2008 and it was further increased in 2014. The additional evidence of dynamic changes in the sectoral structure is the fact that only three activities keep this role during the period. All of them are sectors that had an important role in the economy in a centrally planned period (two agriculture-related and manufacture of basic metals). The number of key sectors was increased in 2008, due to an increase in key tradable sectors, while a number of non-tradable sectors were rather stable. It is interesting to emphasize that importance of non-tradable sectors as a supplier of inputs was reduced. The most interesting change of economy structure during the period is a significant increase in the number of key service-related activities. This country didn't have any service sub-sector in the structure of key sectors and the number of them was dramatically increased in 2008, due to strong inflow and restructuring in this sector of the economy during the crisis (Chilimoniuk-Przeździecka, 2011) and it was further increased in 2014. Parallel with that, the number of key secondary sub-sectors was reduced and most of the sectors from this group have a role as a buyer of inputs.

After this brief description of the economy structure in each considered economy individually, the regional key sector analysis should be analyzed. The outcomes are graphically presented in the two figures for each group of sectors. One figure present results before and

another after the crisis. Such an approach enables access to changes in the sectoral structure after the global economic crisis. The first two figures (Figure 1 and Figure 2) present a group of key sectors in CEE countries.

The first two figures (Figure 1 and Figure 2) present a group of key sectors in CEE countries. Comparing the results before and after the crisis it can be concluded that the majority of key sectors did not change their status. However, there are some minor but interesting changes in the structure of key sectors after the crisis. Crop and animal production, hunting and related service activities – A01 and Manufacture of food products, beverages, and tobacco products – C10-12 remained the key sectors in CEE economies during the whole observed period, which indicates food and agriculture-related activities still play an important role in the economy and even the crisis hasn't changed their importance, like in the study of Gurgul and Lach 2015. If the direction of vectors for these two activities is considered, it can be seen that importance of Crop and animal production, hunting and related service activities was

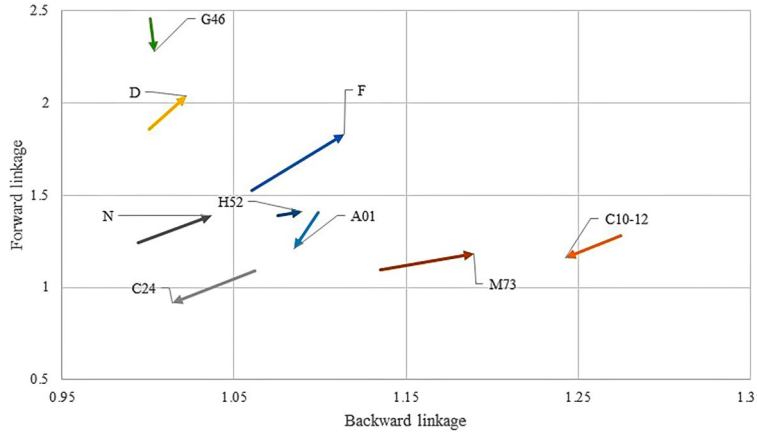

Figure 1. Key sectors in CEE economies in the period 2000–2008

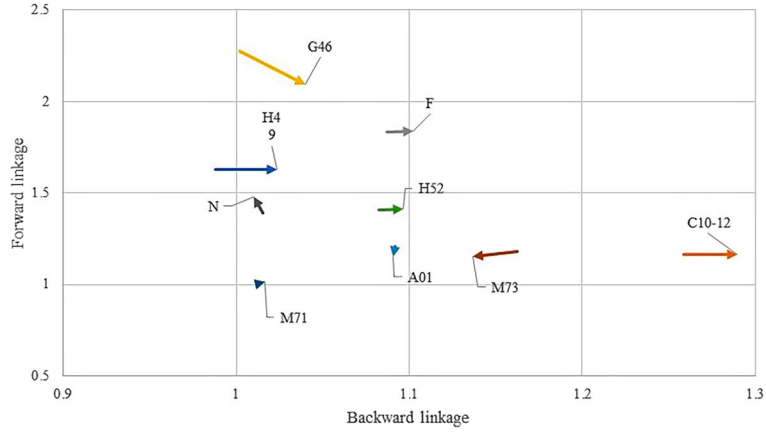

Figure 2. Key sectors in CEE economies in the period 2008–2014

raising, while Manufacture of food products, beverages, and tobacco products was dropping in the context of both forward and backward linkages in the pre-crisis period. On the other hand, the importance of both activities was increasing in the post-crisis period – for the first activity in the forward linkage and the last in the backward-linkage context. These activities retained their key role in CEE economies, despite stronger competitive pressures after EU accession (Jambor & Hubbard, 2013; Igan & Suzuki, 2012) and drop in food prices during the crisis.

The parallel analysis of Figure 1 and Figure 2 points out that number of service-related sectors was increased from four in pre-crisis period to six after the crisis, which clearly indicates the intensification of deindustrialization process in the CEE countries after the crisis and high immunity of service sector in CEE on crisis, as it was emphasized by Gál (2014), Olczyk and Kordalska (2018) and Chilimoniuk-Przeździecka (2011). The activities that kept the status of key sectors are Wholesale and retail trade and repair of motor vehicles and motorcycles – G45, Warehousing, and support activities for transportation – H52, Administrative and support service activities – N and Advertising and market research – M73. In the post-crisis period, two more sectors joined the group of key sectors: Land transport and transport via pipelines – H49 and Architectural and engineering activities and technical testing and analysis – M71. Such developments can be explained by a strong inflow of structural funds in these economies after the crisis and expansion of intermodal transport. It is worth to note that both knowledge-intensive services and less knowledge-intensive services are equally represented in a group of key sectors.

Beside a growing number of service-related sectors, the additional evidence for the on-going process of deindustrialization in CEE region is the fact that Electricity, gas, steam and air conditioning supply – D and Manufacture of basic metals – C24, traditionally known as important sectors in command economies, lost key sector status and become forward-oriented ones. These sectors were also hard hit by the drop in global prices during the crisis, which is particularly true for the Manufacture of basic metals.

In addition to key sectors, any economy has sectors that act as suppliers of inputs to the rest of economy and those sectors are called forward-oriented or "strategic" sectors (Figure 3 and Figure 4).

At first sight, it can be concluded that there are no activities from the primary sector in this group of sectors and that majority of them are service-related ones. Some of them kept forward-oriented status over the considered period, like *Financial service activities*, *except insurance and pension funding – K64*, *Real estate activities – L*, *Retail trade*, *except of motor vehicles and motorcycles – G47*, *Legal and accounting activities*; *activities of head offices*; *management consultancy activities – M69-70* and *Telecommunications – J61*. As a result of structural developments, the importance of these intermediate services to the rest of the economy increase over time (Gurgul & Lach, 2015). Moreover, one of them – *Land transport and transport via pipelines* gained key sector status in the post-crisis period. The exception to the rule examples is *Wholesale and retail trade and repair of motor vehicles and motorcycles – G45*, which became weak-oriented sector. It is also worth to note that *Computer programming*, *consultancy*, *and related activities*; *information service activities – J62-63* joined this group of sectors, indicating that ICT activities have gained in importance, as a result of strong FDI inflow from Western Europe in this sector (Belloc & Tilli, 2013).

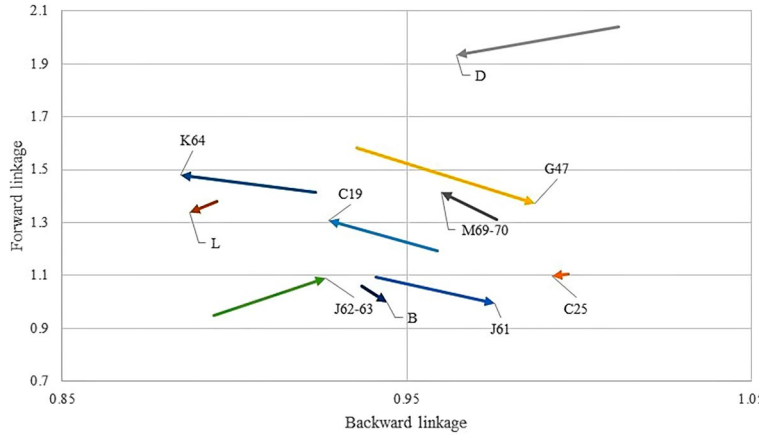

Figure 3. Forward-linkage-oriented sectors in CEE economies in the period 2000–2008

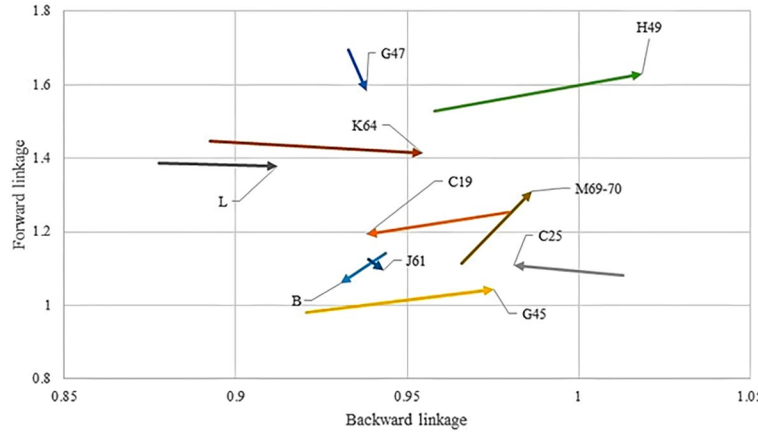

Figure 4. Forward-linkage-oriented sectors in CEE economies in the period 2008–2014

It is already mentioned that heavy industry was the main driver of economic activity in the centrally planned period and the first insight into the Figure 3 and Figure 4 suggests that it still has a great contribution to economic growth in the region. Some of these activities retained forward-oriented status during the period, like *Manufacture of coke and refined petroleum products – C19* and *Manufacture of fabricated metal products, except machinery and equipment – C25. Electricity, gas, steam and air conditioning supply – D* lost its key sector status and became forward-oriented sector, while *Mining and quarrying – B* turned into the weak sector in the post-crisis period.

In contrast to sectors that have the role of suppliers in the economy, there are sectors that have the role of input purchasers and those sectors are backward-oriented sectors or "driver" sectors (Figure 5 and Figure 6).

As one can see, the number of backward-linkage sectors is much higher than key sectors and forward-linkage ones and it is increased from 14 to 18 in the post-crisis period.

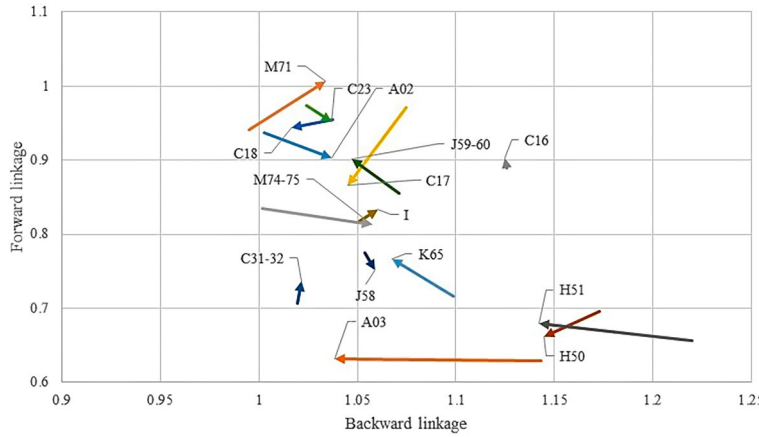

Figure 5. Backward-linkage-oriented sectors in CEE economies in the period 2000–2008

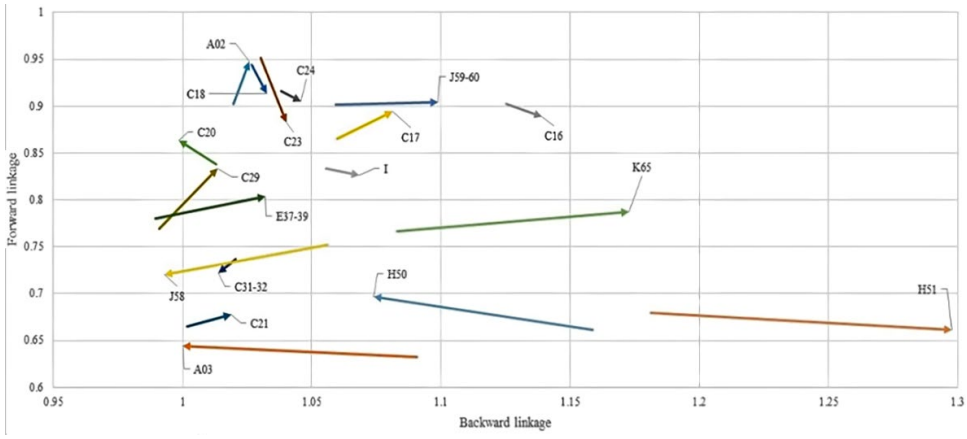

Figure 6. Backward-linkage-oriented sectors in CEE economies in the period 2008–2014

The rest of the activities from the primary sector (*Forestry and logging – A02* and *Fishing and aquaculture – A03*) are in this group and they retained their status in the post-crisis period. The secondary sector activities dominate in this group. Most of the activities from this group that retained backward-oriented status during the whole observed period are low-technology manufacturing industries. Others joined this group in the post-crisis period, like *Manufacture of chemicals and chemical products – C20*, *Manufacture of motor vehicles, trailers and semi-trailers – C29*, *Manufacture of basic pharmaceutical products and pharmaceutical preparations – C21*, *Sewerage*; *waste collection, treatment and disposal activities*; *materials recovery*; *remediation activities and other waste management services – E37-39* and *Manufacture of basic metals – C24* (which was key sector in the pre-crisis period). Unlike activities from the secondary sector, the number of service-related sectors decreased in the post-crisis period. *Architectural and engineering activities*; *technical testing and analysis – M71* became a key sector in the post-crisis period and *Other professional, scientific and technical activities*;

veterinary activities – M74-75 was transformed into the weak sector. Service sectors that retained backward-linkage status during the period belong to the group of knowledge-intensive services, except *Accommodation and food service activities – I.*

In addition, there are sectors that do not contribute to the rest of the economy as key, forward-oriented or backward-oriented sector. These sectors have the status of weak sectors. Having in mind that there are too many sectors that have such status, their presentation is decomposed in four plots – two for large changes and two for small changes. The sectors with a large overall shift are presented in Figure 7 and Figure 8.

As one can see from the Figure 7, most of the sectors in this group are high-technology and medium-high-technology manufacturing industries and their importance were dropping in context of both forward as well as backward linkages in 2008 in comparison to 2000. However, *Manufacture of motor vehicles, trailers, and semi-trailers – C29* and *Manufacture of basic pharmaceutical products and pharmaceutical preparations – C21* changed their status

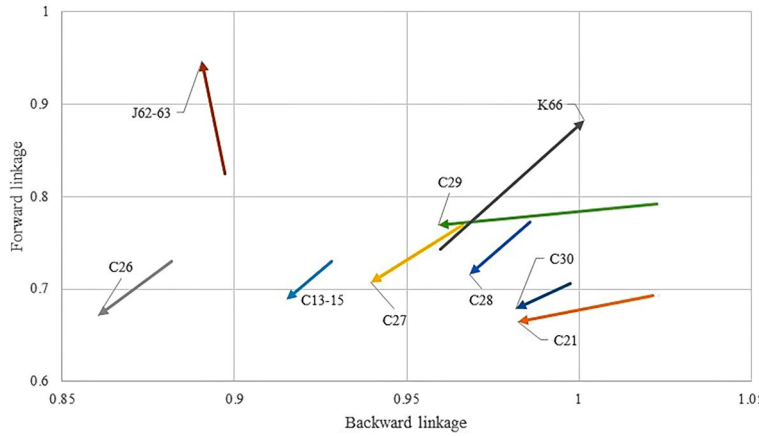

Figure 7. Weak-oriented sectors in CEE economies (large changes) in the period 2000–2008

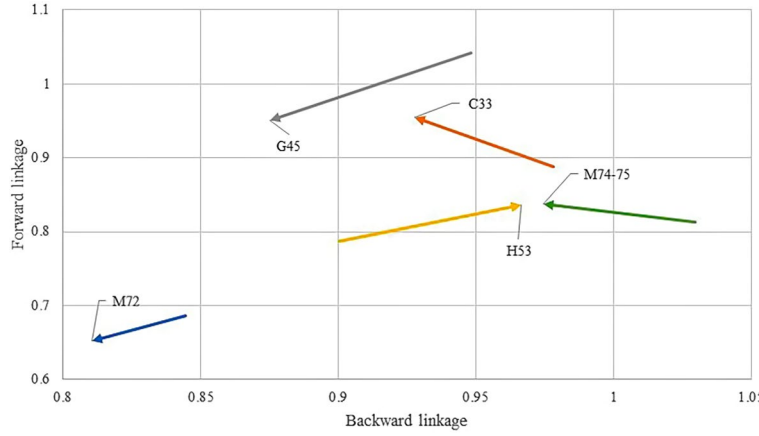

Figure 8. Weak-oriented sectors in CEE economies (large changes) in the period 2008–2014

in the backward-oriented sector in the post-crisis period. Besides manufacturing activities, large change in values of backward and forward linkages in pre-crisis period occurred in *Computer programming, consultancy, and related activities*; *information service activities – J62-63* (which was derailing in backward linkage context, but growing in forward linkage context and became forward-oriented sector in the post-crisis period) and *Activities auxiliary to financial services and insurance activities – K66* (which importance was rising in the both contexts in pre-crisis period).

On the other hand, the activities that recorded significant changes in their importance after 2008 was predominantly service related ones, as can be seen from Figure 8. It is important to emphasize that *Wholesale and retail trade and repair of motor vehicles and motorcycles – G45* recorded significant decline in both forward and backward linkage context in the post-crisis period, although it was forward-oriented sector before the crisis. *Mining and quarrying – B* was also forward-oriented sector and it became weak-oriented sector, with a significant drop in forward linkage context. Similarly, *Other professional, scientific and technical activities*; *veterinary activities – M74-75* was backward-oriented sector before 2008, but it lost that status because it experienced a significant decrease in values of the backward-linkage context.

Finally, there are weak-oriented sectors with small changes of backward and forward linkage values (see Figure 9 and Figure 10).

Parallel insight in Figure 9 and Figure 10 points out that the number of these sectors was increased in the post-crisis period and most of the activities that joined this group are from the secondary sector. Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services – E37-39 recorded some increase in both forward and backward linkage context in the pre-crisis period and become backward-oriented sector after 2008. Also, it should be noted that non-tradable knowledge-intensive services like education, public administration and defense, human health and social work activities remained in this group of sectors during the period. So, there are no significant changes in the importance of these activities.

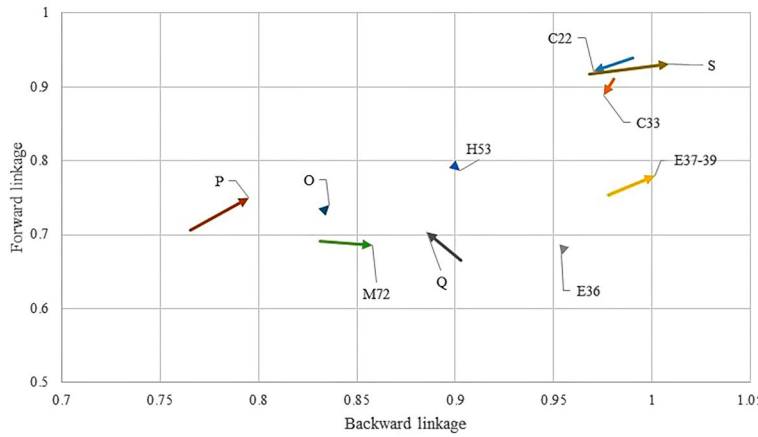

Figure 9. Weak-oriented sectors in CEE economies (small changes) in the period 2000–2008

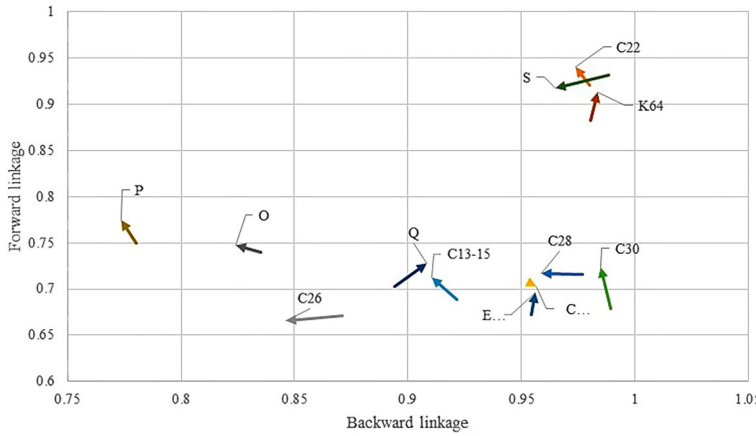

Figure 10. Weak-oriented sectors in CEE economies (small changes) in the period 2008–2014

Conclusions

As CEE economies entered the new millennium with significant differences in the economic, institutional and political environment, they had different starting positions for further reform processes implementation, as well as diverse reactions on challenges that new millennium put in front of them. The strong inflow of FDI and structural funds, as a result of the globalization, internationalization and EU accession, boosted the structural change and economic growth in these economies during the first half of new millennium. But, the occurrence of the global economic crisis influenced the structural reforms in the region, mainly through a significant reduction in FDI and structural funds inflow.

The obtained results pointed out that the structural changes were particularly intensive in the Czech Republic and Romania, while Slovenia had the most stable economy structure during the period, followed by Estonia and Latvia. One of the most common patterns of structural change in CEE economies during the period is intensive deindustrialization process and only Poland and Romania had a larger number of manufacturing activities at the end of the observed period. Although Hungary and Lithuania were characterized by slower deindustrialization process at the beginning of the period, they end up the period with the significant number of service sectors in their economy structure. Also, one of the interesting results is the fact that Slovenia was the only country where food and agriculture-related activities did not have a key role during the whole observed period.

When it comes to regional structural change patterns, it should be emphasized that there are seven economic activities that retained key sector role during the period: *Crop and animal production*, *hunting and related service activities*, *Manufacture of food products*, *beverages and tobacco products*, *Construction*, *Wholesale trade*, *except of motor vehicles and motorcycles*, *Warehousing and support activities for transportation*, *Advertising and market research* and *Administrative and support service activities*. As one can see, most of these activities are service related and their number has been increased at the end of the period, indicating further

progress in deindustrialization in the region. *Land transport and transport via pipelines* and *Architectural and engineering activities*; *technical testing and analysis* replaced the *Electricity*, *gas*, *steam and air conditioning supply* and *Manufacture of basic metals* (activities that traditionally had a significant role in the command economies) in the group of key sectors. This increase of service-related key sectors is also evidence that the service sector was more resistant to the crisis. The majority of activities in the group of forward-oriented sectors are intermediate service activities, while in the group of backward-oriented sectors there are mainly low technology manufacturing activities and knowledge intensive service activities. Finally, it should be emphasized that non-tradable activities, like education and health and social services, were in the group of weak-oriented sectors during the period.

Having in mind that in the post-crisis period the European Commission emphasized the importance of the secondary sector for economic recovery and improvement of competitive position among major competitors from the global market, the question of reindustrialization has arisen. It became one of the major policy objectives in the current EU programming period. Obtained results pointed out that Poland and Romania have a more favorable starting point for reindustrialization, considering that these countries had a larger number of manufacturing activities in the group of key sectors among CEE countries. In order to obtain faster integration into high value-added segments of global value chains, CEE economies, particularly Czech Republic, Slovakia, Slovenia and Lithuania (characterized by a large number of key service sectors), should revise their industrial policies in the future. The new policy framework should target medium and high-technology and medium-high-technology manufacturing activities.

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