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Structural and productivity changes of Central and Eastern Europe*[1]

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Abstract

The purpose of this paper is to analyse the structural and productivity changes of Central and Eastern European (CEE) countries. The research period covers the years following accession into the European Union, from 2004 until 2018. This study aims to answer the following question: What effects have resulted from the integration with the European Union in terms of the sphere of productivity? The analysis covers two main categories of labour productivity growth: pure labour productivity growth and structural labour productivity growth. Moreover, factors that may affect both pure and structural productivity changes are examined. The main research techniques are shift-share analysis and panel data methods. The analysis shows that all the CEE countries in the studied period improved in terms of both pure and structural productivity. The impact of pure labour productivity, however, was much smaller than that of structural labour productivity; this means that the main change in productivity level was more attributable to changes in employment between sectors than to the modernisation of technological processes. Productivity increased in all sectors, but the most significant growth occurred in service sectors, specifically in financial and insurance activities and real estate

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activities. Simultaneously, employment decreased in less productive sectors, such as agriculture, forestry, and fishing. Furthermore, the results of the panel data analysis confirm a significant impact of the evaluated factors on pure and structural productivity growth. Thus, aggregate productivity change in the CEE area can have a positive impact on both forms of productivity growth. Both structural and pure productivity growth are stimulated by research and development expenditures, information and communication technology (ICT) goods imports, and trade openness. Moreover, this research confirms the positive impacts of business enterprise research and development expenditure growth and an increase in the number of researchers to the workforce ratio on sector productivity, although there are substantial differences between sectors. This research can be used by government agencies in establishing industrial development policies.

Key words: *structural changes, productivity, shift-share analysis, Central and Eastern European countries (CEEC), panel data analysis*

JEL classification: *F0, D24, G34, L33, P31*

1. Introduction

Political and economic changes have had a significant impact on economic structure and productivity in Central and Eastern Europe (CEE). The first democratisation phase started in early 1990 and focused on building new public-administration systems. The second common stage for this region was the European Union (EU) pre-accession phase at the end of the 1990s and the beginning of the 21st century (Bouckaert et al., 2011).

The collapse of the communist system allowed CEE to transition from a centrally planned to a market economy. Central and Eastern European countries (CEEC) at this time adopted a reform package called the 'Washington Consensus'. Stabilisation and structural reforms proposed by the International Monetary Fund and World Bank included strict fiscal policy, full openness of markets to domestic and foreign trade, competitive exchange rates, price liberalisation, tax reforms, redefinition of public expenditure priorities, privatisation of state enterprises, protection of property rights, and deregulation (Williamson, 1993). These reforms were rapidly followed by the informal and formal growth of markets for consumer goods and eventually for money, industry, and services (Manning, 2004). The most important occurrence for economic structure was privatisation, which increased productivity and initiated the movement of resources from inefficient public enterprises to the nascent capitalist sector ruled by market forces.

In 2004, eight CEECs became members of the EU. These countries were Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Estonia, Lithuania, and Latvia. CEECs' membership in the EU helped to stabilise the region's new political and economic systems and assisted Europeans with competing in a globalising

economy (Carmin, 2004). EU integration influenced changes in economic structure and productivity through implementation of the four freedoms of the European Single Market, specifically free movement of goods, free movement of capital, free movement of persons, and free movement of services.

Political changes have significantly influenced the transformation of the economic structure, the economic transformation, of the CEECs. Trade liberalisation has resulted in export transformation and the restructuring of export manufacturing (Stojcic et. al., 2018; Petreski et al., 2017). In addition, CEECs have been among the largest recipients of foreign direct investment (FDI) in recent decades. FDI and absorptive capacity have been recognised as essential components for productivity convergence in CEE (Popescu, 2014). Other processes influencing the structure of CEECs' economies are both deindustrialisation and reindustrialisation (Stojcic et. al., 2019; Stojcic and Aralica, 2018; Rowthorn and Ramaswamy, 1999). The decline of traditional industries and the growth of the service sector was a popular trend in post-communist economies in the 1990s; however, the development paths differ between individual countries of the region, and in recent years the emergence of new knowledge- and technology-intensive industries has also been visible in the region. Furthermore, a significant challenge for CEECs' economies is meeting the new requirements imposed by the Fourth Industrial Revolution (so-called Industry 4.0) (Trasca et. al., 2019). Empirical studies have demonstrated that CEECs' economies do not grow based on research-driven innovation but instead depend on more advanced imported technology. Production capability is the most significant driver of productivity growth in CEE (Radosevic, 2017).

The empirical literature investigating structural and productivity changes in CEECs and Central and Eastern European regions has focused mainly on productivity convergence or the impact of individual factors on productivity (Ezcurra and Pascual, 2007; Bijsterbosch and Kolasa, 2010; Nitoi and Pochea, 2016; Skorupinska and Torrent-Sellens, 2015; Stojcic and Orlic, 2019; Radosevic, 2017; Friesenbichler and Peneder, 2016; Habib et. al., 2019; Stojcic et al., 2018). Analysis combining the subjects of productivity and structural changes of CEE has received less attention (Ezcurra and Pascual, 2007; Bah and Brada, 2009; Kutan and Yigit, 2009; Havlik, 2015; Stojcic et al., 2019; Dobrzanski and Olszewski, 2019; Dobrzanski, 2019). The research results of this paper enrich the existing literature with analysis of productivity and structural changes from accession into the EU in 2004 until the most recent available data from 2018. Furthermore, the analysis in this paper also identifies factors affecting both pure and structural productivity.

The main aim of this article is to analyse structural and productivity changes among CEECs. Three research questions are answered in this paper. First, changes in the sphere of productivity in CEECs since integration with the EU are analysed. Second, the role of structural changes, technological changes, and improvement of production processes in productivity growth are evaluated. Third, factors that

can affect pure and structural productivity changes are examined. The research period covers the years after accession into the EU, from 2004 until 2018. The analysis concerns two main categories of labour productivity growth: pure labour productivity growth and structural labour productivity growth. To the best of our knowledge, such an analysis has not previously been undertaken for CEECs in the considered period. In addition, this study enriches the existing literature through the analysis of factors that may affect pure and structural productivity change as well as sectoral productivity change in CEECs.

This paper is organised as follows. The second section presents a literature review regarding structural changes, productivity, and economic growth. The third section describes the shift-share methodology. The fourth section presents the data chosen for analysis. The fifth section contains the research findings, and the final section concludes the research.

2. Literature review

One central issue in the analysis of economic growth in developing economies is structural changes, which can be defined as the reallocation of labour across sectors. According to Kuznets (1966), the transfer of labour from sectors with low productivity to other, more dynamic sectors is one of the main factors influencing overall productivity growth. Developing countries aim to reduce the productivity gaps between sectors and move away from focusing on unproductive sectors. The speed of structural transformation is the key factor that determines the competitiveness of the economy. Today, developed economies are moving towards high-productivity manufacturing and high-quality services; this triggers wage and salary improvements and has a positive impact on economic growth. At the same time, there can be a noted use of production factors in less modern and more traditional economic activities. The most developed economies are able to diversify away from agriculture and other traditional products (Yilmaz, 2015).

Sectoral labour productivity differs between countries. Duarte and Restuccia (2010) concluded that any lag in structural transformation is systematically related to the level of development of the country. Poor countries can be characterised as displaying the largest shares of hours in agriculture, while rich countries in comparison show the smallest shares. In addition, countries that start the process of structural transformation later accomplish a given amount of labour reallocation faster than countries that initiated the process earlier. Labour productivity differences between rich and poor countries are large in the areas of agriculture and services and smaller in manufacturing. As countries progress through the process of structural transformation, relative aggregate labour productivity can initially increase and then later stagnate or decline.

McMillan and Rodrik (2011) state that developing economies can be characterised by large productivity gaps between traditional and modern sectors. Allocation may be an important engine of economic growth because, even if there is no productivity growth within sectors, the economy grows when labour and other production resources transition from less productive to more productive activities. This kind of growth-enhancing structural change can be an important contributor to overall economic growth. High-growth countries are typically those that have experienced extensive structural change.

Numerous studies have been conducted on the subject of structural changes and productivity in CEECs and Central and Eastern European regions. Productivity convergence is a frequent subject of scientific publications. Ezcurra and Pascual (2007) found an overall reduction in regional inequality over the period from 1992 to 2001 and observed simultaneous between-country convergence and within-country divergence. Regional disparities in output per worker are linked to intrinsic differences between regions. The results of their study also confirm that the main factors that play a role in determining regional inequality in productivity have a uniform effect on output per worker across all sectors. For the period from 1995 to 2006, Bijsterbosch and Kolasa (2010) found a strong productivity convergence among CEECs at both the country level and the industry level. At the sectoral level, manufacturing has been identified as the main driver of productivity convergence, while gains in services have been less pronounced. Conversely, Nitoi and Pochea (2016) rejected the convergence hypothesis for productivity for all CEECs in most of the sectors in the period from 1995 to 2014. They found that productivity gaps in CEE decreased over this period, but significant disparities between CEECs in terms of labour productivity were still noted.

Other works have focused on the impact of individual factors on productivity. Skorupinska and Torrent-Sellens (2015) concluded that information and communication technology (ICT) capital has a significant and positive impact on productivity in CEECs. Stojcic and Orlic (2019) focused on the relation between FDI and technology spillovers and its impact on productivity in manufacturing and services. Their results suggest that FDI exerts negative intra- and interregional market-stealing effects on direct rivals and positive spillover effects on downstream firms and that these effects are larger from FDI in neighbouring regions and increase with distance. Radosevic (2017) highlights the importance of upgrading technology in improving productivity; however, the findings of his research confirm that production capability, not innovation capability, is the most significant driver of productivity growth in CEE. In addition to the impact of innovation on productivity, Friesenbichler and Peneder (2016) examined the impact of competition on productivity. Their findings confirm that competition and innovation simultaneously exert a positive effect on labour productivity in terms of either sales or value added per employee. Habib et. al. (2019)

investigated the impact of human capital, intellectual property rights, and research and development expenditures on total factor productivity in CEECs and Brazil, Russia, India, China, and South Africa (BRICS) countries in the period from 2007 to 2015. Their results indicate that all these factors are statistically significant and have a significant impact on changes in productivity. According to the results obtained by Stojcic et al. (2018), the timing of trade liberalisation also influenced the structural transformation in new member states: Trade liberalisation increased the quality of their export manufacturing and the share of high-technology-intensive industries in their economic structures.

Studies combining the subjects of productivity and structural changes in CEE have been less frequently undertaken. Using shift-share analysis, Ezcurra and Pascual (2007) investigated the origins of regional disparities in productivity. Their research results reveal an insignificant impact of industry mix and structural components on regional dispersion in average productivity. Their analysis highlights the prominent role of the national component and the economic impact of neighbouring regions in explaining the observed disparities in sectoral productivity levels in CEE, with a declining trend over the research period. Bah and Brada (2009) studied total factor productivity growth and structural changes for new members of the EU for the years 1995, 2000, and 2005 and the basic sectors breakdown for agriculture, services, and industry. Their main conclusion was that transition economies are not a homogeneous group, as there are huge differences between them in terms of total factor productivity (TFP). In some of the new member states, productivity was not improving in industry or services, or both, making the task of catching up with the EU average an impossible one to achieve. For new member states in the analysed period, a decrease of employment in agriculture and industry was noted; meanwhile, the services sector exhibited the highest employment rate. Kutan and Yigit (2009) demonstrated that FDI and exports improve productivity but that imports exert a negative effect. Among domestic variables, human capital is the most important source of labour productivity growth in the new member states. Havlik (2015) conducted shift-share analysis of CEECs' economies for the period from 1995 to 2011. A deconstruction of value-added growth revealed that the 'within growth' effect naturally dominates the overall structural change. Haylik's (2015) analysis also revealed a distinct North-South pattern of growth: Manufacturing and trade have driven growth in the North, while there has been much less structural change in the South. Stojcic et al. (2019) investigated the determinants of structural and productive transformation in the NUTS 2 regions of CEE. Their analysis showed a decline in manufacturing employment with a simultaneous increase in the value-added share of manufacturing, which indicates productive transformation towards high-technology-intensive activities. Moreover, their study explored the role of spatial linkages in regional industrial development, and they recommend strengthening the linkages between the manufacturing core and its periphery.

The aforementioned studies discuss the topics of structural and productivity changes in CEE from the productivity convergence perspective, the impact of individual factors on productivity, and analysis combining structural and productivity changes. The analysis performed in this paper focuses on the newest data from the period from the accession year, 2004, to 2018. The novelty of our study lies in dividing productivity growth into two sub-indexes: pure productivity growth and structural productivity growth. Furthermore, this study seeks an answer to questions concerning the impact of structural changes and technological progress on productivity after EU accession and which of these categories is the more important engine of productivity growth. Another important question concerns the factors that affect the structural and pure productivity sub-indexes.

3. Methodology

Shift-share analysis is a method one can use to deconstruct the change in an aggregate into two structural components. The first component involves changes in the composition of the aggregate, while the second component involves changes within the individual units that comprise the aggregate (Fagerberg, 2000). Fabricant (1942) was a pioneer in applying shift-share analysis to measure the reallocation of labour among sectors. In recent years, many reviews and extensions of shift-share analysis have been introduced. Two of the most important extensions were introduced by Esteban-Marquillas (1972) and Arcelus (1984). In Esteban-Marquillas's model, homothetic employment in sectors and regions led to the identification of an additional allocation effect. The regional share effect was deconstructed into two components, isolating a regional shift component not correlated with the industrial mix. Arcelus's model extended Esteban-Marquillas's model further. This model also used the concept of homothetic employment to represent the degree of specialization of a region. Arcelus's model, however, enabled the provision of rough estimates of the effects of local and export markets, while the original formulation by Esteban-Marquillas assumed no local market. Arcelus also emphasises that the population quotient method is a more reliable measure than employment for the analysis of market size changes. Limitations of the homothetic concept, however, have been demonstrated empirically by Loveridge and Selting (1998). Barff and Knight (1988) developed dynamic shift-share models, which implement continuous changes in both the regional industrial mix and the size of the employment base. A dynamic model enables more accurate allocation of job change and eliminates the problems seen with static models. Nazara and Hewings (2004) emphasise the importance of the spatial effect, explaining that the location of a particular region should be included in the growth accounting.

As is true of many research methods, the shift-share methodology has both advantages and disadvantages. Stevens and Moore (1980) emphasise that the shift-share approach is a technically simple procedure, which makes the analysis fast and reasonably accurate. Barff and Knight (1988) underline that the main advantage of shift-share analysis is that the model does not require detailed data, which, especially for less developed countries, are not easy to collect. The most frequently cited limitation of shift-share analysis is its static nature, as it is mostly applied only over a period of several years, examining the changes between the start and end dates. As stated by Sirakaya et al. (2002), however, this limitation can be overcome by calculating time-series data. Knutsen (2000) also underscores the limited predictive capabilities of this method. Moreover, the credibility of the model is questionable, and whether it explains significant changes in the industry is not certain. Therefore, some researchers are conducting additional further analysis, that is, regression analysis of the competitive effect (Andrikopoulos, et al.

Although the shift-share analysis methodology has some limitations, some of its extensions are used in the literature to analyse structural changes and their impact on economic growth. Labour productivity growth can be achieved in two ways. The first route is related to technological changes and improvement of production processes, and it is called pure labour productivity growth or within productivity growth. The second way to improve productivity is by moving labour from low-productivity sectors to high-productivity sectors; this is called structural labour productivity growth. McMillan and Rodrik (2011) propose a basic shift-share equation that deconstructs the change in aggregate productivity into a pure and structural change effect as follows:

$$\Delta AP_t = \sum_j \varphi_{j,t-k} \, \Delta SP_t^j + \sum_j SP_t^j \, \Delta\varphi_{j,t} \tag{1}$$

AP_t denotes the aggregate labour productivity, and SP_t^j represents the labour productivity level of sector j at time t. Labour productivity is the ratio of aggregate/sectoral real output to the corresponding employment. Additionally, $\varphi_{j,t}$ represents the employment share of sector j at time t in overall employment. In the aggregate productivity growth equation, the first term represents the 'pure' productivity growth component, while the second term denotes the 'structural change' component. Pure labour productivity growth can be calculated as a weighted sum of productivity growth within individual sectors, with weights measured as the employment share of each sector in the context of total employment. Structural labour productivity growth is correlated with labour reallocations across different sectors. This term will be positive when employment is moving from low-productivity sectors to high-productivity sectors; thus, structural change will increase economy-wide productivity growth.

Moreover, to elucidate the role of macroeconomic variables in explaining structural changes and productivity changes in the CEECs, we estimate the parameters of the following panel models:

$$SC_{it} = \boldsymbol{x1}_{it}\boldsymbol{\gamma}_1 + \varepsilon_{1it}, \tag{2}$$

$$PC_{it} = \boldsymbol{x2}_{it}\boldsymbol{\gamma}_2 + \varepsilon_{2it}, \tag{3}$$

where SC_{it} denotes the structural change in the i-th country in period t, while PC_{it} denotes the productivity change in the i-th country in period t. Vector $\boldsymbol{x1}_{it}$ consists of factors affecting the structural change, while $\boldsymbol{x2}_{it}$ contains variables influencing the productivity change. The vectors of parameters $\boldsymbol{\gamma}_1$ and $\boldsymbol{\gamma}_2$ reflect the impact of macroeconomic variables on pure and structural labour productivity changes. ε_{1it} and ε_{2it} are error terms, which are assumed to have white noise properties. In order to avoid the endogeneity problem, lagged values of explanatory variables are used on the right sides of equations (2) and (3).

The choice of the appropriate panel specification depends on the results of testing. We use the traditional F-statistic in order to choose between pooled regression and the model with fixed effects (see Baltagi, 2013). The Breusch-Pagan test (see Breusch, Pagan, 1980) is used in order to choose between pooled regression and the panel model with random effects. If the fixed-effects model outperforms the pooled regression model and the random-effects model outperforms the pooled regression model, the Hausman (1978) test is used in order to choose between these two models.

After the estimation of the parameters of the models (2) and (3) is conducted and the pooled regression or the model with fixed effects is chosen as an appropriate one, serial correlation of error term is tested with the use of the Wooldridge (2002) test. If the problem of serial correlation exists, the dynamic panel model and systemic estimation with the use of Generalized Method of Moments is considered (see e.g. Blundell, Bond, 1998). Moreover, the test for cross-sectional dependence as well as the poolability test are conducted (Pesaran 2004).

Aside from models 2 and 3, which explain changes in pure and structural productivity in the period from 2004 to 2017 in the group of eight CEECs, we consider the estimation of the parameters of the models explaining productivity growth for all industries as follows:

$$\Delta SP_t^j = \boldsymbol{x3}_{it}^j\,\boldsymbol{\gamma}_3^j + \varepsilon_{3it}^j, \tag{4}$$

where SP_t^j is defined as in equation 1, $\boldsymbol{x3}_{it}^j$ consists of determinants of productivity growth in the j-th sector, $\boldsymbol{\gamma}_3^j$ contains appropriate parameters, and ε_{3it}^j is the white noise error term.

4. Empirical data and analysis

In the empirical investigation, we use data concerning gross value added and level of employment in the whole economies of Poland, the Czech Republic, Slovakia, Slovenia, Hungary, Latvia, Lithuania, and Estonia and the following 10 sectors: agriculture, forestry, and fishing; industry, including energy; construction; distributive trade, repairs, transport, accommodation, and food; information and communication; financial and insurance activities; real estate activities; professional, scientific research, technical, administrative, and support service activities; public administration, compulsory s.s., education, and human health; and other service activities. Gross value added and employment data used for productivity calculation has been presented in the appendices in Tables A1-A8.

On the basis of formula 1, pure productivity change and structural productivity change are calculated. Table 1 presents a deconstruction of productivity growth in the CEECs into three sub-periods: 2004 to 2008, 2009 to 2013, and 2014 to 2018. In the first sub-period, the highest labour productivity growth occurred in Slovenia, which obtained 42.94%; a very high score was also obtained in Lithuania (22.50%). It is worth underlining that all the analysed CEECs, with the sole exception of Slovakia, achieved positive results in the first four years after accession into the EU. In the second sub-period, a slight slowdown can be seen. Furthermore, Hungary recorded a decrease in labour productivity growth (-2.99%). The decline in labour productivity growth in this country is noticeable in both pure productivity (-0.024%) and structural productivity (-2.96%). The decrease in productivity growth is believed to be related to the subprime mortgage crisis that took place in the United States in 2008, as this had a very strong impact on the productivity of some CEECs. Worse results in the CEECs persisted for many years after the crisis. In the third sub-period, the highest labour productivity growth was again attained in Slovenia, but the result was much lower (9.93%). Just like Slovenia, Poland and Latvia obtained positive results in all three analysed sub-periods.

Table 1: Labour productivity growth and pure and structural productivity in CEE countries

Country	Mean	Pure productivity	Structural productivity	Labour productivity growth % (component due to pure and structural productivity)
Poland	Mean (2004–2008)	0.165	2.862	3.027
	Mean (2009–2013)	0.012	4.156	4.168
	Mean (2014–2018)	0.011	3.261	3.272
The Czech Republic	Mean (2004–2008)	0.166	10.209	10.374
	Mean (2009–2013)	−0.019	1.651	1.631
	Mean (2014–2018)	0.023	−1.457	−1.434
Estonia	Mean (2004–2008)	0.178	8.169	8.347
	Mean (2009–2013)	0.023	12.508	12.532
	Mean (2014–2018)	0.025	−6.970	−6.945
Lithuania	Mean (2004–2008)	0.201	22.303	22.503
	Mean (2009–2013)	0.026	17.746	17.772
	Mean (2014–2018)	0.019	−1.395	−1.377
Latvia	Mean (2004–2008)	0.220	8.235	8.456
	Mean (2009–2013)	0.004	3.906	3.910
	Mean (2014–2018)	0.031	3.825	3.855
Slovakia	Mean (2004–2008)	0.218	−0.437	−0.219
	Mean (2009–2013)	0.010	12.032	12.042
	Mean (2014–2018)	0.002	2.715	2.717
Slovenia	Mean (2004–2008)	0.116	42.822	42.939
	Mean (2009–2013)	−0.014	14.863	14.849
	Mean (2014–2018)	0.014	9.920	9.934
Hungary	Mean (2004–2008)	0.138	13.698	13.837
	Mean (2009–2013)	−0.024	−2.963	−2.987
	Mean (2014–2018)	0.007	−1.746	−1.739
CEE average	Mean (2004–2008)	0.175	13.483	13.658
	Mean (2009–2013)	0.002	7.987	7.990
	Mean (2014–2018)	0.016	1.019	1.036

Source: Authors' own study based on the OECD database

In Table 2, productivity by country is presented. Descriptive statistics illustrate that, in the studied period, all the CEECs improved in terms of both pure and structural productivity. The impact of pure labour productivity, however, was ultimately much smaller. This means that the main change in the productivity level was due to changes in employment among sectors rather than the modernisation of technological processes.

Table 2: Productivity by country

	2004	2005	2006	2007	2008	2009	2010	2011	2012
POLAND									
Pure productivity	0.21	0.15	0.08	0.20	0.18	−0.16	0.11	0.11	−0.05
Structural productivity	5.75	−8.56	−4.94	11.38	10.68	21.64	13.31	−0.75	−10.64
Overall productivity	5.96	−8.41	−4.87	11.59	10.86	21.48	13.42	−0.65	−10.69
CZECH REPUBLIC									
Pure productivity	0.19	0.12	0.13	0.18	0.21	−0.12	0.02	0.10	−0.10
Structural productivity	2.61	12.51	14.20	5.96	15.76	15.21	1.20	−26.62	16.26
Overall productivity	2.80	12.63	14.33	6.14	15.97	15.09	1.22	−26.52	16.16
ESTONIA									
Pure productivity	0.22	0.13	0.13	0.31	0.10	−0.12	0.06	0.12	−0.03
Structural productivity	−3.50	−9.10	1.11	22.07	30.27	10.06	17.26	15.22	6.52
Overall productivity	−3.28	−8.98	1.24	22.38	30.37	9.94	17.33	15.33	6.49
LITHUANIA									
Pure productivity	0.22	0.14	0.15	0.27	0.22	−0.14	0.05	0.18	−0.02
Structural productivity	−5.04	49.10	10.24	−7.29	64.50	24.02	33.11	−1.12	10.23
Overall productivity	−4.82	49.24	10.39	−7.02	64.73	23.88	33.16	−0.95	10.21
LATVIA									
Pure productivity	0.23	0.14	0.17	0.39	0.18	−0.13	−0.02	0.17	−0.04
Structural productivity	8.32	−4.47	−1.96	25.10	14.18	5.37	−3.18	6.15	4.04
Overall productivity	8.55	−4.32	−1.79	25.49	14.36	5.24	−3.21	6.32	4.01
SLOVAKIA									
Pure productivity	0.26	0.12	0.16	0.32	0.23	−0.05	0.02	0.07	−0.04
Structural productivity	−6.63	15.54	1.04	21.90	−34.05	13.87	27.98	25.63	3.66
Overall productivity	−6.37	15.66	1.20	22.22	−33.82	13.82	28.01	25.70	3.62
SLOVENIA									
Pure productivity	0.17	0.06	0.06	0.17	0.12	−0.09	−0.02	0.10	−0.09
Structural productivity	3.26	37.92	58.92	50.96	63.05	51.76	18.37	−8.70	−1.80
Overall productivity	3.43	37.98	58.98	51.14	63.16	51.67	18.34	−8.60	−1.89
HUNGARY									
Pure productivity	0.24	0.09	0.02	0.20	0.15	−0.17	0.01	0.09	−0.10
Structural productivity	13.55	7.37	13.28	5.20	29.09	−4.90	−7.06	−0.80	−11.39
Overall productivity	13.79	7.46	13.30	5.40	29.24	−5.08	−7.05	−0.71	−11.49

	2013	2014	2015	2016	2017	2018	Sum (2004–2018)	Mean
POLAND								
Pure productivity	0.06	0.01	−0.15	−0.02	0.11	0.10	0.94	0.06
Structural productivity	−2.78	19.45	8.79	−9.90	−13.41	11.38	51.40	3.43
Overall productivity	−2.72	19.46	8.64	−9.92	−13.30	11.48	52.33	3.49
CZECH REPUBLIC								
Pure productivity	0.00	0.00	−0.11	0.03	0.09	0.12	0.84	0.06
Structural productivity	2.20	1.32	−5.70	0.04	−1.81	−1.13	52.01	3.47
Overall productivity	2.20	1.32	−5.82	0.06	−1.72	−1.01	52.86	3.52
ESTONIA								
Pure productivity	0.08	0.05	−0.17	0.04	0.09	0.12	1.13	0.08
Structural productivity	13.48	−27.41	−6.83	37.23	−27.98	−9.86	68.53	4.57
Overall productivity	13.56	−27.37	−7.00	37.27	−27.89	−9.73	69.67	4.64
LITHUANIA								
Pure productivity	0.07	0.03	−0.16	0.01	0.11	0.11	1.23	0.08
Structural productivity	22.49	−11.03	−4.95	−2.96	5.32	6.65	193.27	12.88
Overall productivity	22.56	−11.01	−5.10	−2.95	5.43	6.76	194.49	12.97
LATVIA								
Pure productivity	0.04	0.04	−0.15	0.02	0.12	0.12	1.27	0.08
Structural productivity	7.15	10.07	1.67	4.68	1.06	1.65	79.83	5.32
Overall productivity	7.19	10.12	1.52	4.69	1.18	1.77	81.10	5.41
SLOVAKIA								
Pure productivity	0.05	0.03	−0.15	0.00	0.04	0.09	1.15	0.08
Structural productivity	−10.98	−7.85	−0.37	23.21	11.33	−12.75	71.55	4.77
Overall productivity	−10.93	−7.82	−0.52	23.21	11.37	−12.67	72.70	4.85
SLOVENIA								
Pure productivity	0.04	0.05	−0.15	0.02	0.05	0.10	0.58	0.04
Structural productivity	14.69	3.08	−1.25	11.46	22.04	14.27	338.03	22.54
Overall productivity	14.73	3.12	−1.40	11.48	22.10	14.36	338.61	22.57
HUNGARY								
Pure productivity	0.06	−0.01	−0.15	0.00	0.09	0.09	0.61	0.04
Structural productivity	9.33	−5.83	0.02	−1.07	−5.69	3.84	44.95	3.00
Overall productivity	9.39	−5.84	−0.13	−1.06	−5.59	3.93	45.56	3.04

Source: Authors' own study based on the OECD database

Results in Table 2 indicate that there are differences between the countries in terms of pure and structural productivity changes in the period from 2004 to 2018. Considering the entire analysed period (2004–2018), Slovenia experienced rapid overall labour productivity growth of almost 22.57% per annum, most of which was accounted for by structural change. Hungary attained the lowest overall productivity growth. Separately, the fastest pure productivity growth is observed in the Baltic countries and Slovakia, while the slowest pace of growth can be noticed in such countries as Hungary and Slovenia. Conversely, structural productivity improved at the fastest pace in Slovenia and at the slowest pace in Hungary, Poland, and the Czech Republic. One very positive finding is that, despite large fluctuations in several countries, an increase in productivity can be observed in all the CEECs analysed after their accession into the EU.

Table 3 presents the labour productivity gaps between different sectors. In all the CEECs, the highest productivity can be observed in sector 7 (real estate activities (ISIC rev4)); very high productivity can also be noted in sectors 5 (information and communication (ISIC rev4)) and 6 (financial and insurance activities (ISIC rev4)), while the lowest productivity is found in sector 1 (agriculture, hunting and forestry, and fishing (ISIC rev4), AGRI). Across all the CEECs, the productivity in sector 7 is almost 17 times higher than that in sector 1. It is worth underlining that productivity in all sectors increased during the analysed period. In almost all the analysed CEECs, the highest change can be noted in sector 1 (AGRI); this is a very agreeable phenomenon because it suggests that the productivity in the sector with the least productivity increased. Analysing the above statistics, it can be concluded that all employees should work in sectors 5, 6, and 7. Of course, such a situation cannot take place; however, it can be more meaningful to compare productivity levels across sectors with similar levels of potential to absorb labour. In all the analysed periods, labour productivity in agriculture was usually 3 times less than labour productivity in all other sectors with similar potential to absorb labour.

Table 3: Productivity by sectors in CEE

Country	Sector productivity	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	**TGVA**
Poland	2003	2.241	15.136	16.449	17.568	42.204	28.082	87.121	21.679	11.058	11.935	14.083
	2009	5.216	27.073	26.097	28.093	50.823	41.941	129.492	33.426	19.308	20.382	24.766
	2014	7.895	33.851	33.450	34.503	52.946	57.841	158.063	36.274	22.268	24.107	30.744
	2018	9.307	33.400	34.529	36.152	48.182	50.049	165.563	40.903	21.461	18.401	31.321
	% change 2003–2018	415%	221%	210%	206%	114%	178%	190%	189%	194%	154%	222%
	Mean (2003–2018)	6	28	28	29	52	46	141	33	19	20	26
Czech	2003	12.696	18.644	13.963	16.717	44.703	38.135	98.912	15.913	16.114	15.597	18.817
	2009	20.166	39.366	27.053	27.274	74.170	92.214	165.698	30.244	31.654	25.766	36.485
	2014	31.059	41.838	25.129	27.141	70.697	83.143	168.299	28.273	31.090	22.520	36.762
	2018	29.866	42.418	31.421	32.453	76.205	94.169	196.701	31.373	34.082	24.342	40.426
	% change 2003–2018	235%	228%	225%	194%	170%	247%	199%	197%	211%	156%	215%
	Mean (2003–2018)	24	36	24	26	69	78	156	27	28	23	34
Estonia	2003	3.298	13.936	11.140	14.732	56.313	18.913	114.916	13.972	8.305	9.885	11.818
	2009	8.033	29.815	19.675	28.618	57.707	42.830	222.270	26.521	19.116	13.418	25.657
	2014	13.775	44.722	32.500	38.301	58.354	47.768	185.585	27.981	20.943	15.462	33.320
	2018	14.039	42.137	34.046	41.878	56.501	52.171	205.189	30.014	22.229	16.541	34.960
	% change 2003–2018	327%	302%	308%	236%	131%	203%	361%	246%	325%	206%	278%
	Mean (2003–2018)	23	29	27	28	53	78	178	39	20	16	30
Lithuania	2003	9.604	13.316	13.312	14.499	40.750	41.876	74.998	19.090	9.012	9.363	14.602
	2009	18.540	26.782	24.242	24.579	64.484	65.862	200.987	41.755	22.308	16.393	29.603
	2014	35.521	40.560	29.782	35.407	54.106	103.043	202.348	47.241	24.528	19.593	38.338
	2018	31.413	40.152	40.998	34.268	53.558	84.880	270.560	46.905	29.244	19.254	40.533
	% change 2003–2018	426%	302%	306%	284%	100%	276%	179%	215%	268%	167%	296%
	Mean (2003–2018)	11	33	24	30	54	46	186	25	17	14	26
Latvia	2003	3.820	9.862	10.055	12.535	23.078	23.280	51.665	13.658	8.660	7.899	10.992
	2009	11.332	26.004	25.082	24.395	50.652	43.683	123.798	28.339	20.934	15.329	26.044
	2014	16.068	30.628	27.784	29.508	45.414	80.126	166.418	25.760	23.765	20.457	31.472
	2018	17.610	34.535	30.898	31.453	46.795	69.893	162.585	29.306	25.915	22.133	33.690
	% change 2003–2018	461%	350%	307%	251%	203%	300%	315%	215%	299%	280%	306%
	Mean (2003–2018)	12	25	22	24	43	57	126	25	19	16	25

Country	Sector productivity	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	**TGVA**
Slovakia	2003	13.489	15.498	13.875	12.897	28.574	32.990	129.867	12.663	10.192	12.595	14.775
	2009	34.649	36.803	41.752	29.343	72.845	75.702	288.152	31.922	26.544	42.699	36.592
	2014	56.276	46.215	44.215	33.039	63.045	86.419	254.173	33.281	26.853	52.709	41.123
	2018	44.572	42.430	47.275	30.175	60.668	60.260	256.951	34.785	29.383	45.147	39.527
	% change 2003–2018	330%	274%	341%	234%	212%	183%	198%	275%	288%	358%	268%
	Mean (2003–2018)	35	36	36	27	57	67	231	27	23	38	33
Slovenia	2003	6.578	28.563	23.589	26.187	52.216	54.655	526.491	23.454	28.580	25.861	27.921
	2009	10.180	45.241	37.504	41.534	69.235	91.290	663.213	36.106	44.840	37.211	44.716
	2014	13.254	55.620	39.562	43.708	67.659	75.023	621.511	35.859	40.309	31.694	46.348
	2018	14.205	54.901	42.078	44.715	62.072	80.366	540.092	36.125	39.460	30.089	46.454
	% change 2003–2018	216%	192%	178%	171%	119%	147%	103%	154%	138%	116%	166%
	Mean (2003–2018)	11	46	35	39	65	75	593	33	38	33	41
Hungary	2003	8.225	17.266	13.593	13.080	42.257	39.846	104.105	25.269	16.025	13.327	17.350
	2009	13.626	29.885	18.783	20.310	67.948	57.569	138.766	34.239	23.496	19.603	27.660
	2014	19.745	36.130	18.849	21.951	51.851	48.567	154.834	25.311	21.290	20.365	28.044
	2018	22.353	36.479	22.236	21.519	44.752	53.384	154.046	24.919	22.298	18.337	28.316
	% change 2003–2018	272%	211%	164%	165%	106%	134%	148%	99%	139%	138%	163%
	Mean (2003–2018)	16	31	18	20	54	52	139	30	21	18	26

Note: AGRI – Agriculture, forestry, and fishing (ISIC rev4); INDU – Industry, including energy (ISIC rev4); CONS – Construction (ISIC rev4); DISTR – Distributive trade, repairs, transport, accommodations, food service (ISIC rev4); INFO – Information and communication (ISIC rev4); FIN – Financial and insurance activities (ISIC rev4); RE – Real estate activities (ISIC rev4); SCIEN – Professional, scientific research, technology, administration, support service activities (ISIC rev4); ADMIN – Public administration, compulsory s.s., education, human health (ISIC rev4); OS – Other service activities (ISIC rev4); TGVA – Total gross value added

Source: Authors' own study based on the OECD database

Aside from collecting data on productivity, we also gathered data concerning factors that may affect pure and structural productivity change as well as sectoral productivity change. Table 4 consists of definitions of variables with justifications concerning the impact of these categories on pure and structural productivity change as well as on sectoral productivity change.

Table 4: Variables that are considered as determinants of pure and structural productivity change as well as determinants of sectoral productivity change

Variables observable at a country level explaining structural and pure productivity change		
Variable	Definition	Expected impact of variable on productivity change
RD_change	Change in the ratio of Research and development expenditure to GDP	The relationship between innovativeness and productivity has been broadly studied within the CDM model framework (see e.g., Crepon et al., 1998; Szczygielski & Grabowski 2014; Fazlioglu et al., 2019). According to the conceptual model, R&D efforts positively affected innovativeness, which has a positive impact on productivity. It is expected that there is a positive correlation between investing in R&D and productivity growth when enterprises from the same industry are considered. Therefore, the positive estimate of a parameter for this variable in the equation explaining pure productivity change is expected.
ICT_IMPORT	Change in the ratio of ICT goods imports to total goods imports	Since CEE countries are not technology leaders, they must import ICT goods in order to improve production processes. A higher level of imports of ICT goods means that the use of ICT is more frequent. A positive relationship between using ICT and productivity in the group of enterprises from the same industry was identified among others by Arendt and Grabowski (2017), so the positive relationship between this variable and pure productivity change is expected. However, the use of ICT is industry-dependent, so this variable should have a positive impact on structural productivity change.
TO_CHANGE	Change in the level of trade openness (export + import to GDP ratio)	Higher level of trade openness informs about higher propensity to import new products and higher level of internationalization of domestic enterprises. Internationalization seems to have a positive impact on productivity (Sun et al., 2019). Therefore, a positive estimate of the parameter for this variable is expected in equations explaining pure productivity growth as well as structural productivity growth.
Variables observable at a sectoral level explaining sectoral productivity change		
Δ*BERD*	Change in business enterprise R&D expenditure per worker in constant prices	Higher values of these variables inform about higher levels of innovativeness of a sector. Therefore, positive estimates of parameters are expected.
RES	Ratio of number of researchers to the number of all workers within sector	

Source: Authors' own study based on literature review and the OECD database

Table 5 consists of descriptive statistics for potential explanatory variables (in equations 2 and 3).

Table 5: Descriptive statistics for potential explanatory variables

Variable	Mean	Standard deviation	Minimum	Maximum
RD	0.027	0.149	-0.400	0.725
ICT_IMPORT	9.86	4.67	3.28	21.20
TO_CHANGE	3.02	9.42	−26.22	27.15

Source: Authors' own study based on the OECD database

The results of testing the order of integration for variables on the basis of the Hadri test (Hadri, 2000) are presented in Table 6.

Table 6: Results of testing the order of integration on the basis of the Hadri test

Variable	Statistic	p-value	Decision
SC	−1.74	0.959	Stationary
PC	−2.12	0.983	Stationary
RD	1.15	0.126	Stationary
ICT_IMPORT	0.06	0.477	Stationary
TO_CHANGE	-1.36	0.913	Stationary

Source: Authors' own study based on the OECD database

The results of testing the order of integration for the variables used in model 4 for all sectors are presented in Table 7.

Table 7: Results of testing the order of integration for sectoral variables for sectors on the basis of the Hadri test

Activity	*ΔSP*		*ΔBERD*		*RES*	
	p-value	Decision	p-value	Decision	p-value	Decision
Agriculture, forestry, and fishing	0.873	I(0)	0.653	I(0)	0.765	I(0)
Industry, including energy	0.753	I(0)	0.783	I(0)	0.673	I(0)
Construction	0.912	I(0)	0.821	I(0)	0.540	I(0)
Distributive trade, repairs, transport, accommodation, food services	0.723	I(0)	0.562	I(0)	0.611	I(0)
Information and communication	0.651	I(0)	0.712	I(0)	0.529	I(0)
Financial and insurance activities	0.412	I(0)	0.612	I(0)	0.487	I(0)
Real estate activities	0.712	I(0)	0.632	I(0)	0.791	I(0)
Professional, scientific research, technical; administrative, support service activities	0.932	I(0)	0.689	I(0)	0.673	I(0)
Public administration, compulsory s.s., education, human health	0.721	I(0)	0.590	I(0)	0.873	I(0)
Other service activities	0.652	I(0)	0.629	I(0)	0.721	I(0)

Source: Authors' own study based on OECD Data Base

The results in Tables 6 and 7 indicate that all the variables are stationary and that the problem of spurious regression does not exist.

Due to the stationarity of all the variables, standard panel data methods are applied.

Table 8 consists of the results of testing for the presence of fixed and random effects in equations 2 and 3.

Table 8: Results of testing for the presence of fixed and random effects in panel regression

	Equation explaining SC			Equation explaining PC		
	Statistic	p-value	Decision	Statistic	p-value	Decision
Testing for presence of fixed effects	1.46	0.20	Random effects	0.44	0.88	Random effects
Testing for presence of random effects	4.04	0.04		2.78	0.09	

Source: Authors' own study based on the OECD database

The results of this testing indicate that at the 0.1 level of significance the random effects model is the best option in both cases. Table 9 presents the results of the estimation of the parameters of both models, with the results of testing significance. Since all variables are stationary (see Table 6), cointegration test is not conducted.

Table 9: Results of the estimation of the parameters of the random effects model explaining pure and structural productivity change[4]

Explanatory variable	Equation explaining SC		Equation explaining PC	
	Estimate	Standard error	Estimate	Standard error
RD	0.227***	0.084	0.043*	0.026
ICT_IMPORT	2.24**	1.09	0.029***	0.011
TO_CHANGE	0.012***	0.004	0.008***	0.001

Note: *,** and *** denote significance at the 0.1, 0.05, and 0.01 levels of significance, respectively.

Source: Authors' own study based on OECD database

The results of the estimation indicate that the factors shaping pure and structural productivity growth are substantially effective.

[4] As a robustness check, parameters of the model with time-effects were estimated. Similar impact of R&D expenditure, ICT import and trade openness on productivity growth was identified.

Conversely, the ICT goods imports to total goods imports ratio exhibited positive and statistically significant impacts on pure and structural productivity change. Since the purchasing of information and communication technology results in higher capabilities within enterprises, this result is not surprising. An improvement in trade openness may be associated with an increase in high-technology imports, which positively affects the productivity level. Therefore, the positive and significant impact of the variable *TO_CHANGE* is also in line with expectations.

In order to test validity of assumptions, the poolability test as well as the test for cross-sectional dependence is conducted. Results of testing are presented in the table 10.

Table 10: Results of testing poolability and cross-sectional dependence

Testing	Equation explaining SC		Equation explaining PC	
	Statistic	p-value	Statistic	p-value
Poolability	1.181	0.310	0.725	0.817
Cross-sectional dependence	0.920	0.359	1.525	0.217

Source: Authors' own study based on the OECD database

Testing results indicate that there is no cross-sectional dependence problem. Moreover, the results of testing poolability indicate that parameters are stable across countries.

Due to the stationarity of the dependent and explanatory variables in equation 4, standard panel data methods are applied. Table 11 consists of the results of testing for the presence of fixed and random effects using equation 4 for all sectors.

Table 11: Results of testing for the presence of fixed and random effects in panel regressions for all sectors

Activity	Testing for presence of fixed effects (p-value)	Testing for presence of random effects (p-value)	Decision
Agriculture, forestry, and fishing	0.46	1.00	Pooled regression
Industry, including energy	0.95	0.97	Pooled regression
Construction	0.91	0.99	Pooled regression
Distributive trade, repairs, transport, accommodations, food services	0.73	1.00	Pooled regression
Information and communication	0.77	0.96	Pooled regression
Financial and insurance activities	0.75	0.98	Pooled regression

Activity	Testing for presence of fixed effects (p-value)	Testing for presence of random effects (p-value)	Decision
Real estate activities	0.59	1.00	Pooled regression
Professional, scientific research, technical, administrative, support service activities	0.96	0.34	Pooled regression
Public administration, compulsory s.s., education, human health	0.64	0.98	Pooled regression
Other service activities	0.74	0.25	Pooled regression

Source: Authors' own study based on the OECD database

The results in Table 11 indicate that the pooled regression model is the best choice for all the industries. Table 12 provides estimates of parameters for the variables *ΔBERD* and *RES* for all 10 sectors. It should be stressed that variables that are not significant at the 0.1 level of significance are excluded from the final discussion.

Table 12: Results of the estimation of the parameters for different sectors

Activity	Estimate for intercept	Estimate for *ΔBERD*	Estimate for *RES*
Agriculture, forestry, and fishing	0.035	-	0.554***
Industry, including energy	0.064**	0.029**	-
Construction	0.023	0.065*	-
Distributive trade, repairs, transport, accommodation, food services	0.029	0.044*	-
Information and communication	0.019	0.012**	-
Financial and insurance activities	0.011	0.071*	0.098**
Real estate activities	0.021	0.153**	-
Professional, scientific research, technical, administrative, support service activities	0.004	-	0.020**
Public administration, compulsory s.s., education, human health	0.030	-	0.010*
Other service activities	0.045*	-	0.026**

Note: *,** and *** denote significance at the 0.1, 0.05, and 0.01 levels of significance, respectively.

Source: Authors' own study based on the OECD database

5. Results and discussion

Research and development (R&D) expenditure as a percentage of gross domestic product (GDP) positively and significantly affects structural productivity growth. This means that a greater investment in R&D is associated with increasing employment rates in productive sectors and decreasing employment rates in less productive ones. This result, however, is in line with expectations, since findings from studies based on cross-country data indicate that an increase in R&D should positively affect structural productivity growth as well as pure productivity growth (Guellec et al., 2004; Wang & Huang, 2007; Wang, 2007). The obtained result may indicate that the absorptive capacity of the eight CEECs is limited and that the effect of increasing R&D investments within the same sector seems to be weak.

The results of the estimation indicate that there are substantial differences between sectors in terms of the impact of business enterprise R&D expenditure growth and the number of researchers to the workforce ratio. The variable *RES* is statistically significant in 5 out of 10 equations, explaining the following sectors: agriculture, forestry, and fishing; financial and insurance activities; professional, scientific research, technical, administrative, and support service activities; public administration, compulsory s.s., education, and human health; and other service activities. For the more sophisticated services sectors, these results are not surprising, but the high value for the agriculture sector is astounding. Variable *ΔBERD* is statistically significant in 6 out of 10 equations, explaining the following sectors: industry, including energy; construction; distributive trade, repairs, transport, accommodation, and food services; information and communication; financial and insurance activities; and real estate activities. It is worth underlining that only the financial and insurance activities sector exerts an impact on productivity for both *ΔBERD* and *RES*; this reflects the high level of innovation in this sector. Moreover, all the estimates of parameters are positive, which is in line with the expected impact of the variables on productivity change, presented in Table 4.

6. Conclusions

The aim of this study was to analyse the structural and productivity changes of CCECs after their accession into the EU. The results of this analysis confirm that positive changes in productivity occurred both within and among structural components. The reallocation of employees to more modern and technologically advanced sectors can be noted in all the analysed countries. The cross-country comparisons demonstrate the same pattern and direction of employment reallocation in all the CEECs. In all the CEECs, a sustained decrease in the agriculture employment can be noted; this is the sector with the lowest productivity. Simultaneously, employment increased in the services sector, especially in the

professional, scientific research, technical, administrative, and support service activities. Productivity increased in all sectors, but the most significant growth can be noted in the service sectors, including the areas of financial intermediation, real estate, renting, and business activities. During the research period, labour productivity growth within individual sectors can be observed; this is mainly courtesy of the improvement of technology and production processes. Both of these effects lead to an increase in economy-wide productivity. Moreover, it is worth underlining that sharing high-technology sectors led to an overall production increase over the research period in all the analysed countries.

This research also confirms that structural changes have played an important role in all the analysed CEECs' economies and made a positive contribution to overall growth. The impact of pure labour productivity has been much smaller. Undoubtedly, accession into the EU has a positive impact on the productivity level in CEECs' economies, which is evinced in the high productivity growth that occurred in almost all the analysed CEECs in the first four years after accession. The speed of change, however, differed between the countries in terms of pure and structural productivity change. Among the CEECs, productivity increased the most in Slovenia and the Baltic countries, while the lowest increase can be noted in Hungary. Other analysed countries also showed an increase in productivity growth, but the growth was less significant.

Additionally, the results of the panel data analysis confirm the significant impact of the evaluated factors on pure and structural productivity growth. Research and development (R&D) expenditure as a percentage of gross domestic product (GDP) positively and significantly affects structural productivity growth. However, the obtained result indicate limited absorptive capacity of the eight CEECs, as the effect of increasing R&D investments within the same sector seems to be weak. The ICT goods imports to total goods imports ratio exhibited positive and statistically significant impacts on pure and structural productivity change. Trade openness also has the positive and significant impact on pure and structural productivity. Furthermore, the results of the estimation of the parameters of the models explaining productivity growth confirm a positive impact of business enterprise R&D expenditure growth and the number of researchers to the workforce ratio on sector productivity; however, the results indicate that there are substantial differences between sectors. The results of this study can be used by policymakers formulating policies. In CEE, countries' innovative capacities are still limited, and a more reasonable strategy would seem to promote a more gradual increase in R&D spending; this may produce conditions that would be more conducive to innovation-driven growth. Policymakers should support R&D expenditure, ICT use and trade openness.

There are a number of limitations associated with this study. The shift-share analysis technique is merely a descriptive tool and does not consider many factors, such as the impact of business cycles, identification of actual comparative advantages, and

differences caused by levels of industrial detail. A shift-share analysis offers a glance at a local economy at two points in time. This technique should be used in combination with other methodologies to determine a country's economic potential. For this purpose, the authors additionally introduced panel analysis to increase the precision of research on structural changes. In addition, it would be worth considering whether the panel analysis should not include or replace variables; this is also the main limitation of this research. Furthermore, analysis of a longer period could foster more general conclusions and recommendations for policymakers. It is worth noting that this article could be enriched by an analysis from the beginning of the 1990s, but the data that could be found were sorted by different sector divisions, which prevented us from comparing this data. Moreover, further analysis could be enriched by an examination of marginal productivity at the sectoral and country levels, which can allow one to determine the optimal structure of the economy. Finally, this research could be improved through analysis at lower levels of regional aggregation, such as at the NUTS 2 or NUTS 3 level of regions, which could be investigated in further analysis. Some policy implications can be extracted from our analysis.

References

Andrikopoulos A., Brox, J. A. and Carvalho, E. (1990) "Shift-Share Analysis and the Potential for Predicting Regional Growth Patterns: Some Evidence for the Region of Quebec, Canada", *Growth and Chane, 21*, pp. 1–10.

Arcelus, F. (1984) "An extension of shift-share analysis". *Growth and Change 15*, pp. 3–8.

Arendt, L. & Grabowski, W. (2017) "Innovations, ICT and ICT-driven labour productivity in Poland. A firm-level approach." *Economics of Transition*, 25 (4), pp. 723–758, https://doi.org/10.1111/ecot.12135.

Bah, E. M., & Brada, J. C. (2009) „Total Factor Productivity Growth, Structural Change and Convergence in the New Members of the European Union." *Comparative Economic Studies*, 51(4), 421–446, https://doi.org/10.1057/ces.2009.8.

Barff, R. A., & Knight III, P. L. (1988) "Dynamic Shift-Share Analysis", *Growth and Change*, 19(2), pp. 1–10, https://doi.org/10.1111/j.1468-2257.1988.tb00465.x.

Bijsterbosch, M., & Kolasa, M. (2010) "FDI and productivity convergence in Central and Eastern Europe: An industry-level investigation". *Review of World Economics*, 145, pp. 689–712.

Blundell, R., Bond, S. (1998) "Initial conditions and moment restrictions in dynamic panel data models." *Journal of Econometrics*, 87, pp. 115–143, https://ideas.repec.org/a/eee/econom/v87y1998i1p115-143.html.

Bouckaert, G., Nakrošis, V., & Nemec, J. (2011) "Public Administration and Management Reforms in CEE: Main Trajectories and Results". *NISPAcee*

Journal of Public Administration and Policy, 4(1), https://doi.org/10.2478/v10110-011-0001-9.

Bregman, A., Fuss, M. & Regev, H. (1991) "High tech and productivity: Evidence from Israeli industrial firms." *European Economic Review*, 35 (6), pp. 1199–1221, https://doi.org/10.1016/0014-2921(91)90115-Y.

Breusch, T.S., & Pagan, A.R. (1980) "The Lagrange Multiplier test and its applications to model specification in econometrics." *Review of Economic Studies,* 47, pp. 239–253, https://www.jstor.org/stable/2297111.

Carmin, J., & Vandeveer, S. D. (2004) "Enlarging EU Environments: Central and Eastern Europe from Transition to Accession". *Environmental Politics*, 13(1), pp. 3–24, https://doi.org/10.1080/0964401041000168511 9.

Crepon, B., Duguet E., Mairesse J. (1998) "Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level.", *Economics of Innovation and New Technology*, 7 (2), pp. 115–158.

Dobrzanski, P. (2019) "Productivity performance of the Czech Republic – Shift-Share Analysis". In T. Loster & T. Pavelka, T. Loster & T. Pavelka (Eds.), *The 13th International Days of Statistics and Economics : Conference Proceedings* (pp. 317–326). Melandrium, https://doi.org/10.18267/pr.2019.los.186.31.

Dobrzanski, P., & Olszewski L. (2019) "Structural Change Path and Economic Growth Performance of Polish Economy." In *New Challenges of Economic and Business Development – 2019: Incentives for Sustainable Economic Growth. Proceedings*, University of Latvia, pp. 230–39.

Duarte, M., & Restuccia, D. (2010) "The Role of the Structural Transformation in Aggregate Productivity". *Quarterly Journal of Economics*, 125(1), pp. 129–173, https://doi.org/10.1162/qjec.2010.125.1.129.

Esteban-Marquillas, J.M. (1972) "A reinterpretation of shift-share analysis". *Regional and Urban Economics 2*, pp. 249–255.

Ezcurra R., Pascual P. (2007) "Spatial Disparities in Productivity in Central and Eastern Europe", Eastern European Economics, 45(3), pp. 5–32, https://doi.org/10.2753/EEE0012-8775450301.

Fabricant, S. (1942) "Employment in Manufacturing", 1899-1939. NBER, New York.

Fagerberg, J. (2000) "Technological progress, structural change and productivity growth: a comparative study". *Structural Change and Economic Dynamics*, 11(4), pp. 393–411.

Fazlioglu, B., Dalgic, B. & Yereli A.B. (2019) "The effect of innovation on productivity: evidence from Turkish manufacturing firms." *Industry and Innovation*, 26(4), pp. 439–460.

Friesenbichler, K., & Peneder, M. (2016) "Innovation, competition and productivity". *Economics of Transition,* 24(3), pp. 535–580*,* https://doi.org/10.1111/ecot.12100.

Guellec, D., & Van Pottelsberghe de la Potterie, B. (2004) "From R&D to Productivity Growth: Do the Institutional Settings and the Source of Funds of R&D Matter?" *Oxford Bulletin of Economics and Statistics*, 66 (3), pp. 353–378, https://doi.org/10.1111/j.1468-0084.2004.00083.x.

Habib M., Abbas J., Noman R., (2019) "Are human capital, intellectual property rights, and research and development expenditures really important for total factor productivity? An empirical analysis", *International Journal of Social Economics*, https://doi.org/10.1108/IJSE-09-2018-0472.

Hadri, K., (2000) "Testing for stationarity in heterogeneous panel data." *Econometrics Journal*, 3, pp. 148–161, https://www.jstor.org/stable/23114886?seq=1.

Hausman, J.A., (1978) "Specification tests in econometrics", *Econometrica*, 46(6), pp. 1251–1271, https://doi.org/10.2307/1913827.

Havlik, P. (2015) "Patterns of Structural Change in the New EU Member States". DANUBE: *Law and Economics Review*, 6(3), pp. 133–157, https://doi.org/10.1515/danb-2015-0009.

Knudsen, D. C. (2000) "Shift-share analysis: further examination of models for the description of economic change" *Socio-Economic Planning Sciences*, 34(3), pp. 177–198, https://doi.org/10.1016/s0038-0121(99)00016-6.

Kutan, A. M., Yigit, T. M. (2009) "European integration, productivity growth and real convergence: Evidence from the new member states". *Economic Systems,* 33(2), pp. 127–137, https://doi.org/10.1016/j.ecosys.2009.03.002.

Kuznets, S. (966). "Modern Economic Growth: Rate, Structure andSpread". Yale University Press, London.

Loveridge, S., & Selting A.C. (1998) "A review and comparison of shift-share identities". *International Regional Science Review*, 21, pp. 37–58.

McMillan, M. & Rodrik, D. (2011) "Globalization, Structural Change, and Productivity Growth". NBER *Working Paper* 17143.

Manning, N. (2004) "Diversity and Change in Pre-Accession Central and Eastern Europe Since 1989". *Journal of European Social Policy*, 14(3), pp. 211–232, https://doi.org/10.1177/0958928704044620.

Nazara, S., & Hewings, G. J. D. (2004) "Spatial Structure and Taxonomy of Decomposition in Shift-Share Analysis". *Growth and Change*, 35(4), pp. 476–490.

Niţoi M. & Pochea M. (2016) "Productivity clustering and growth in Central and Eastern Europe", *Baltic Journal of Economics*, 16(2), p. 151, https://doi.org/10.1080/1406099X.2016.1189267.

Pesaran, M.H.(2004) "General diagnostic tests for cross section dependence in panels." University of Cambridge, Faculty of Economics, *Cambridge Working Papers in Economics* No. 0435.

Petreski, M., Jovanovic, B., & Velickovski, I. (2017) "Tariff-Induced (De) industrialization: An Empirical Analysis". *Comparative Economic Studies,* 59(3), pp. 345–381, https://doi.org/10.1057/s41294-017-0030-8.

Popescu, G. (2014) "FDI and Economic Growth in Central and Eastern Europe" *Sustainability*, 6 (11), pp. 8149–8163.

Radosevic, S. (2017) "Upgrading technology in Central and Eastern European economies". *IZA World of Labor*, p. 338, https://doi.org/10.15185/izawol.338.

Rowthorn, R., Ramaswamy, R. (1999) Growth, Trade and Deindustrialization, *IMF Staff Papers*, 46(1).

Silajdzic, S. & Mehic, E. (2015) "Knowledge spillovers, absorptive capacities and the impact of FDI on economic growth: empirical evidence from transition economies." *Procedia – Social and Behavioral Sciences*, 195, pp. 614–623.

Sirakaya, E., Choi, H.-S., & Var, T. (2002) "Shift-Share Analysis in Tourism: Examination of Tourism Employment Change in a Region." *Tourism Economics*, 8(3), pp. 303–324, https://doi.org/10.5367/000000002101298142.

Skorupinska A. & Torrent-Sellens J. (2015) "The role of ICT in the productivity of Central and Eastern Europe an countries: cross-country comparison", *Revista de Economía Mundial*, 39, pp. 201–221.

Stevens, B. H. & Moore, C. L. (1980) "A critical review of the literature on shift-share as a forecasting technique". *Journal of Regional Science*, 20(4), pp. 419–437, https://doi.org/10.1111/j.1467-9787.1980.tb00660.x.

Stojcic, N. & Aralica, Z. (2018) "(De)industrialization and lessons for industrial policy in Central and Eastern Europe". *Post Communist Economies*, 30(6), pp. 713–734.

Stojcic, N. & Orlic, E. (2019) Spatial dependence, foreign investment and productivity spillovers in new EU member states. *Regional Studies*. Online first, https://doi.org/10.1080/00343404.2019.1653451.

Stojcic, N., Vojinic, P. & Aralica, Z. (2018) "Trade liberalization and export transformation in new EU member states." *Structural Change and Economic Dynamics*. 47, pp. 114–126.

Stojcic, N., Aralica, Z., & Anic, I.-D. (2019) „Spatio-temporal determinants of the structural and productive transformation of regions in Central and East European countries". *Economic Systems*, Online first, https://doi.org/10.1016/j.ecosys.2019.100715.

Sun, W., Price, J. & Ding, Y. (2019) "The longitudinal effects of internalization on firm performance: The moderating role of marketing capability." *Journal of Business Research*, 95, pp. 326–337, https://doi.org/10.1016/j.jbusres.2018.08.014.

Szczygielski, K., Grabowski, W. (2014) "Innovation strategies and productivity in the Polish services sector." *Post-Communist Economies*, 26(1), pp. 17–38, https://doi.org/10.1080/14631377.2014.874226.

Trasca, D. L., Ștefan, G. M., Sahlian, D. N., Hoinaru, R., & Șerban-Oprescu, G.-L. (2019) "Digitalization and Business Activity. The Struggle to Catch Up in CEE Countries." *Sustainability,* 11(8), p. 2204, https://doi.org/10.3390/su11082204.

Wang, E.C. (2007) "R&D efficiency and economic performance: A cross-country analysis using the stochastic frontier approach" *Journal of Policy Modelling*, 45 (4), pp. 770–784, https://doi.org/10.1016/j.respol.2016.01.003.

Wang, E.C. & Huang, W. (2007) "Relative efficiency of R&D activities: A cross-country study accounting for environmental factors in the DEA approach" *Research Policy*, 36 (2), pp. 260–273, https://doi.org/10.1016/j.respol.2006.11.004.

Williamson, J. (1993) "Democracy and the Washington consensus" *World Development*, 21(8), pp. 1329–1336, https://doi.org/10.1016/0305-750x(93)90046-c.

Yilmaz G. (2015) "Decomposition of Labor Productivity Growth: Middle Income Trap and Graduated Countries", *Working Papers 1527*, Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Strukturalne i produktivne promjene zemalja srednje i istočne Europe[1]

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Sažetak

Svrha ovog rada je analizirati strukturalne i produktivne promjene zemalja srednje i istočne Europe (CEE). Razdoblje istraživanja obuhvaća godine nakon pristupanja Europskoj uniji, od 2004. do 2018. godine. Ova studija želi odgovoriti na sljedeće pitanje: Koji su učinci rezultat integracije s Europskom unijom u području produktivnosti? Analiza pokriva dvije glavne kategorije rasta produktivnosti rada: čisti rast produktivnosti rada i strukturalni rast produktivnosti rada. Nadalje, ispituju se čimbenici koji mogu utjecati na čiste i strukturne promjene produktivnosti. Glavne metode istraživanja primijenjene u ovom radu su analiza pomaka udjela i metode panel podataka. Analiza pokazuje da su se u promatranom razdoblju sve zemlje

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središnje i istočne Europe poboljšale i u smislu čiste i strukturalne produktivnosti. Međutim, utjecaj čiste produktivnosti rada bio je znatno manji od utjecaja strukturalne produktivnosti rada; to znači da se glavna promjena na razini produktivnosti više može pripisati promjenama u zapošljavanju između sektora, nego li modernizaciji tehnoloških procesa. Produktivnost se povećala u svim sektorima, ali najznačajniji rast dogodio se u uslužnim sektorima, posebno u financijskim i osiguravajućim djelatnostima i nekretninama. Istodobno, smanjila se zaposlenost u manje produktivnim sektorima, poput poljoprivrede, šumarstva i ribarstva. Nadalje, rezultati analize panel podataka potvrđuju značajan utjecaj procijenjenih faktora na čisti i strukturalni rast produktivnosti. Stoga, ukupna promjena produktivnosti na području Srednje i Istočne Europe može imati pozitivan utjecaj na oba oblika rasta produktivnosti. I strukturalni i čisti rast produktivnosti potiču ulaganje u istraživanje i razvoj, uvoz roba informacijske i komunikacijske tehnologije (IKT) i otvorenost trgovine. Nadalje, ovo istraživanje potvrđuje pozitivan utjecaj koje ima povećanje ulaganja u istraživanje i razvoj poslovnih poduzeća i porast broja istraživača na omjer radne snage na produktivnost sektora, iako postoje bitne razlike između sektora. Ovo istraživanje mogu koristiti vladine agencije u izradi politika industrijskog razvoja.

Ključne riječi: *strukturne promjene, produktivnost, analiza udjela pomaka, zemlje srednje i istočne Europe (CEEC), analiza panel podataka*

JEL klasifikacija: *F0, D24, G34, L33, P31*

Appendices

Table A1: Total gross value added at basic prices, total employment in Hungary

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	3281,6	18352,0	3957,9	12659,5	3845,7	3074,8	5962,6	5811,9	14204,2	2187,6	73337,8
2004	4465,4	22880,8	4745,8	15488,6	4493,5	3835,1	6958,6	7050,2	16589,4	2538,4	89045,8
2005	4150,0	24895,8	5566,6	16791,5	4979,2	4664,5	7666,5	7859,4	17988,3	2817,0	97378,7
2006	4028,7	25870,4	5335,4	17872,9	5161,4	4851,8	7884,3	8315,0	17979,1	2819,4	100118,3
2007	4758,4	31309,3	5929,9	22361,6	6463,8	5467,2	9695,9	9714,2	21077,7	3475,4	120253,4
2008	5315,4	33974,3	6636,6	25426,4	7242,3	5930,5	11230,7	11596,6	23904,5	4084,3	135341,6
2009	3873,9	27359,5	5390,3	19584,8	6226,9	5586,6	9992,0	9755,0	19945,0	3281,4	110995,4
2010	3910,4	28503,5	4655,2	19590,6	5966,2	5486,4	10072,6	9913,4	19493,9	3274,2	110866,4
2011	5499,2	30851,6	4909,3	21594,3	6307,4	5688,2	10562,1	10754,8	20045,6	3448,8	119661,2
2012	4916,7	28153,5	4148,3	19200,8	5690,7	4887,3	9488,9	9652,2	18241,0	3087,5	107466,9
2013	5207,8	29429,6	4599,5	21299,6	6054,1	4618,2	9862,2	10338,3	19361,7	3315,2	114086,3
2014	5557,5	31117,9	5038,6	21930,0	6149,3	4487,6	9773,1	10612,2	20039,8	3460,4	118166,3
2015	4604,7	28464,9	4279,7	19148,2	5101,8	3577,2	8274,8	9283,0	17662,8	2984,6	103381,7
2016	4879,1	28486,4	3954,0	19516,9	5328,2	3742,2	8650,6	9895,6	19001,6	3120,7	106575,3
2017	5247,1	30785,0	5031,7	21785,6	6009,2	4254,1	9511,0	11505,9	20713,5	3431,2	118274,4
2018	5604,2	33930,3	6994,1	24304,6	6554,8	4533,8	10652,3	12858,3	22060,8	3735,1	131228,3

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	399,0	1062,9	291,2	967,8	91,0	77,2	57,3	230,0	886,4	164,1	4226,9
2004	366,9	1021,2	298,2	966,2	84,7	84,8	61,4	251,5	885,7	165,8	4186,4
2005	344,9	991,6	303,6	1002,3	87,5	85,5	63,0	259,8	863,3	172,6	4174,2
2006	336,6	992,3	307,6	1007,8	99,1	88,9	66,5	257,4	868,3	167,8	4192,2
2007	314,4	979,9	313,8	1017,5	98,9	90,3	67,7	267,5	863,8	184,3	4198,0
2008	292,6	967,5	305,2	993,7	100,1	96,2	75,2	294,3	821,9	168,7	4115,5
2009	284,3	915,5	287,0	964,3	91,6	97,0	72,0	284,9	848,9	167,4	4012,9
2010	286,9	891,3	265,5	968,9	95,0	94,7	67,7	276,5	864,1	158,6	3969,2
2011	274,1	888,0	259,7	965,6	100,1	93,7	65,0	312,0	849,7	161,6	3969,4
2012	284,8	881,3	258,7	985,0	102,3	94,7	60,3	301,8	851,4	155,4	3975,8
2013	277,7	836,5	258,8	985,3	110,4	92,8	63,2	337,4	896,7	160,9	4019,5
2014	281,5	861,3	267,3	999,0	118,6	92,4	63,1	419,3	941,3	169,9	4213,6
2015	270,5	854,1	272,4	1024,7	122,1	89,5	65,6	439,0	990,7	186,9	4315,5
2016	268,9	880,9	280,6	1063,2	132,2	87,7	67,3	468,0	1011,0	187,4	4447,3
2017	261,6	909,2	292,6	1093,9	138,3	83,5	66,8	491,1	1004,7	195,0	4536,8
2018	250,7	930,1	314,5	1129,4	146,5	84,9	69,2	516,0	989,4	203,7	4634,4

Note: AGRI – Agriculture, forestry, and fishing (ISIC rev4), INDU – Industry, including energy (ISIC rev4), CONS – Construction (ISIC rev4), DISTR – Distributive trade, repairs; transport; accommod., food serv. (ISIC rev4), INFO – Information and communication (ISIC rev4), FIN – Financial and insurance activities (ISIC rev4), RE – Real estate activities (ISIC rev4), SCIEN – Prof., scientific, techn.; admin., support serv. activities (ISIC rev4), ADMIN – Public admin.; compulsory s.s.; education; human health (ISIC rev4), OS – Other service activities (ISIC rev4), TGVA – Total gross value added, TE – Total employment

Source: Authors' own study based on OECD Data Base

Table A2: Total gross value added at basic prices, total employment in Slovenia

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	627,1	7434,6	1586,6	4928,2	964,2	1185,4	1942,9	2226,7	4362,4	744,5	26002,6
2004	786,8	8632,6	1843,8	5707,0	1141,8	1361,8	2239,5	2620,8	5042,3	872,5	30249,0
2005	830,5	8809,1	2075,4	6178,8	1265,4	1447,5	2411,3	2645,4	5329,6	943,6	31936,7
2006	788,4	9549,7	2453,0	6820,1	1393,9	1687,2	2543,0	2945,9	5633,3	977,9	34792,4
2007	902,3	11463,6	3358,8	8541,4	1688,8	1954,3	2972,0	3702,7	6464,8	1118,2	42166,9
2008	919,8	12571,6	4049,1	10021,7	1953,3	2347,4	3527,8	4417,9	7594,8	1272,4	48675,9
2009	831,5	10372,6	3423,4	8811,6	1716,4	2324,2	3662,0	3988,0	7610,2	1211,7	43951,7
2010	829,1	10133,2	2668,7	8343,3	1702,9	2248,1	3360,2	3959,7	7431,6	1152,3	41828,9
2011	1020,3	11179,3	2620,4	8954,4	1826,0	2292,7	3431,6	4199,3	7876,7	1230,3	44630,9
2012	831,3	10401,0	2334,6	8003,1	1715,2	1738,6	3080,2	3805,7	7198,0	1107,3	40215,1
2013	865,2	11082,1	2196,6	8320,3	1726,7	1659,9	3415,7	3959,7	7195,0	1129,3	41550,6
2014	1006,3	11685,1	2464,3	8591,0	1817,7	1721,4	3353,1	4242,9	7114,5	1126,7	43123,0
2015	883,2	10089,6	2045,5	7500,6	1556,9	1524,2	2927,9	3686,9	6073,5	981,7	37270,0
2016	868,5	10493,3	2042,4	7872,4	1582,7	1510,6	2964,7	3842,5	6433,9	1045,7	38656,7
2017	829,4	11507,2	2310,6	8684,8	1744,1	1588,3	3146,1	4319,3	6867,3	1110,9	42107,8
2018	1039,7	12855,7	2842,1	9770,3	1924,5	1745,1	3513,1	4858,7	7503,2	1204,0	47256,6

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	95,3	260,3	67,3	188,2	18,5	21,7	3,7	94,9	152,6	28,8	931,3
2004	92,9	258,2	66,2	188,9	18,6	22,2	3,7	98,4	156,4	28,5	934,0
2005	90,2	253,5	68,3	190,9	19,5	22,9	3,9	91,8	159,4	29,0	929,5
2006	87,0	249,8	72,8	196,2	20,9	23,1	4,3	99,0	161,8	29,1	944,1
2007	85,0	251,9	82,1	203,9	22,5	23,9	4,8	108,4	163,0	30,3	975,8
2008	83,2	251,0	92,1	211,7	23,8	25,0	5,3	111,0	166,0	31,6	1000,8
2009	81,7	229,3	91,3	212,2	24,8	25,5	5,5	110,5	169,7	32,6	982,9
2010	80,0	216,5	83,0	207,5	25,0	25,2	5,5	113,0	173,5	32,9	962,1
2011	78,0	216,0	73,2	202,0	25,0	24,6	5,4	114,1	175,1	32,5	946,0
2012	77,3	213,6	67,7	199,6	25,6	24,2	5,3	114,6	176,9	32,5	937,2
2013	77,2	209,5	63,0	197,1	26,2	23,5	5,3	114,5	175,8	34,5	926,7
2014	75,9	210,1	62,3	196,6	26,9	22,9	5,4	118,3	176,5	35,5	930,4
2015	75,3	212,5	62,6	200,1	27,7	22,7	5,5	121,9	177,9	36,5	942,6
2016	74,3	217,4	61,9	205,0	28,7	22,3	5,7	124,9	181,7	37,5	959,5
2017	73,5	224,5	63,5	211,9	29,8	22,0	6,1	131,2	186,4	38,8	987,8
2018	73,2	234,2	67,5	218,5	31,0	21,7	6,5	134,5	190,1	40,0	1017,3

Source: Authors' own study based on OECD Data Base

Table A3: Total gross value added at basic prices, total employment in Slovakia

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	1352,8	8807,5	1902,9	6703,9	1170,2	1144,3	2370,9	1702,6	4633,8	654,3	30443,3
2004	1568,8	11602,1	2361,8	8618,7	1494,8	1470,5	3017,3	2194,3	5383,3	836,3	38547,8
2005	1576,7	12837,0	2857,6	10017,9	1702,8	1836,2	2947,1	2585,4	5938,9	1157,6	43457,1
2006	1834,0	15957,0	3917,0	10965,1	2015,3	1949,7	3467,8	3199,8	6827,7	1313,1	51446,5
2007	2771,6	20771,8	5477,0	14954,8	2838,3	2387,5	4703,6	4531,3	8939,4	1933,2	69308,5
2008	3575,7	24958,9	8301,6	19284,0	3518,8	2826,6	5966,0	6131,4	11165,8	1881,5	87610,2
2009	2688,9	19539,3	7827,1	17470,4	3817,6	3124,1	5637,4	6051,0	11946,2	2516,7	80618,8
2010	2286,6	21412,3	7218,4	17411,2	3645,3	3269,8	5590,4	6030,1	11932,1	2481,3	81277,6
2011	3003,2	23644,9	7941,8	19017,8	3937,6	3735,3	5999,5	6359,6	12430,4	2873,1	88943,2
2012	3021,0	22490,2	7691,6	17993,6	4008,9	3481,6	5783,2	6147,1	11796,0	2914,7	85328,0
2013	3564,8	22639,2	7006,9	18491,9	3823,0	3593,3	7876,9	6796,3	12791,8	3067,4	89651,6
2014	4075,2	24362,4	7257,7	19967,3	3736,2	3796,9	5685,6	7002,9	12279,8	3258,0	91421,8
2015	2963,8	21152,2	6432,3	17211,9	3263,7	3233,2	4916,1	6481,9	10541,6	3041,9	79238,6
2016	3021,8	21579,9	6349,9	16193,2	3425,5	2944,1	5697,2	7297,6	11925,4	2797,1	81231,6
2017	2959,6	22975,3	7069,0	17383,7	3709,2	2700,9	5915,2	7815,9	12700,6	2899,3	86128,8
2018	3202,4	25014,6	8338,0	19295,2	4186,1	2778,8	6834,4	8664,3	14125,6	3212,4	95651,6

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	100,3	568,3	137,1	519,8	41,0	34,7	18,3	134,5	454,7	52,0	2060,5
2004	96,5	556,0	139,6	516,9	40,4	33,8	17,4	146,2	449,4	59,4	2055,7
2005	95,1	556,6	152,0	529,7	42,6	34,3	19,3	161,3	441,1	57,2	2088,9
2006	85,9	566,1	159,3	555,6	46,2	36,4	19,5	163,5	443,7	56,1	2132,4
2007	82,8	573,3	165,6	574,0	48,2	38,0	22,1	176,0	445,4	51,6	2177,0
2008	81,8	591,7	181,0	595,4	51,0	41,1	19,7	181,8	448,8	54,8	2247,1
2009	77,6	530,9	187,5	595,4	52,4	41,3	19,6	189,6	450,1	58,9	2203,2
2010	73,1	511,8	183,8	586,2	50,2	40,1	21,6	190,2	454,0	58,9	2169,8
2011	73,0	529,7	177,3	596,8	55,4	40,6	24,0	198,6	453,5	59,3	2208,3
2012	70,6	524,8	171,8	598,9	54,7	41,8	24,4	214,3	449,2	59,0	2209,4
2013	73,9	518,1	166,5	593,5	57,0	42,4	22,9	210,0	448,3	59,6	2192,3
2014	72,4	527,2	164,1	604,3	59,3	43,9	22,4	210,4	457,3	61,8	2223,1
2015	73,4	537,9	163,2	609,0	60,9	45,7	22,6	228,5	463,2	62,7	2267,1
2016	72,5	556,1	165,8	615,8	64,2	46,4	25,4	239,2	468,5	67,0	2321,0
2017	72,3	576,3	169,7	626,5	67,1	46,0	27,3	241,9	474,5	70,6	2372,3
2018	71,8	589,5	176,4	639,4	69,0	46,1	26,6	249,1	480,7	71,2	2419,9

Source: Authors' own study based on OECD Data Base

Table A4: Total gross value added at basic prices, total employment in Latvia

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	477,0	1869,2	647,0	3098,1	566,6	375,9	945,1	583,6	1696,4	274,5	10533,5
2004	616,8	2262,6	838,3	3821,5	635,3	488,7	1203,2	674,3	2006,1	354,8	12901,5
2005	644,4	2427,5	1013,5	4562,4	687,6	660,7	1425,8	909,4	2274,1	434,3	15039,7
2006	706,7	2864,1	1613,8	5334,4	777,4	981,2	2148,3	1100,4	2897,9	551,5	18975,7
2007	1028,1	3938,2	2769,2	7063,4	982,1	1423,6	3369,9	1761,5	4283,6	833,4	27453,1
2008	1057,8	4542,1	3233,5	8016,5	1231,7	1789,6	3568,5	2247,4	5409,2	931,6	32028,0
2009	865,0	3683,9	1826,0	6403,7	992,3	844,8	2640,1	1658,6	4001,0	621,1	23536,4
2010	936,4	3877,5	1063,7	5878,3	978,8	713,7	2165,9	1547,5	3376,3	589,0	21127,0
2011	981,9	4476,7	1506,2	6828,4	1097,7	1019,5	2800,6	1957,0	3895,1	728,5	25291,7
2012	920,4	4308,5	1598,4	6558,8	1084,8	1036,3	2977,9	1894,4	3756,8	748,8	24885,0
2013	992,3	4421,9	1753,0	6958,3	1192,1	1085,6	3384,2	1985,5	4079,1	795,8	26647,7
2014	1047,1	4331,8	1853,6	7202,0	1220,6	1250,9	3660,9	1932,8	4275,4	814,8	27589,7
2015	982,5	3736,5	1537,3	6063,2	1083,7	1112,3	2965,2	1777,8	3734,9	698,0	23691,4
2016	887,8	3901,0	1309,3	6143,3	1185,6	1155,5	3075,4	1848,6	3910,5	732,9	24149,9
2017	972,6	4394,9	1614,1	6898,1	1339,7	1034,0	3221,1	2066,8	4265,9	816,9	26624,2
2018	1149,3	4888,6	2145,9	7708,2	1655,4	1107,5	3642,9	2358,1	4779,1	893,7	30328,8

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	124,9	189,5	64,4	247,2	24,6	16,1	18,3	42,7	195,9	34,8	958,3
2004	103,4	185,8	67,6	259,7	24,8	17,2	19,5	48,6	197,4	36,5	960,6
2005	92,4	183,0	69,4	275,0	19,7	18,8	19,3	49,9	200,9	40,8	969,2
2006	105,7	182,5	97,1	284,1	18,1	18,8	20,9	52,7	202,4	42,5	1024,9
2007	86,6	178,5	108,2	309,5	21,5	20,3	23,5	66,0	206,2	43,8	1064,1
2008	79,7	177,3	108,7	302,6	22,2	21,7	24,0	65,5	206,7	46,7	1055,1
2009	76,3	141,7	72,8	262,5	19,6	19,3	21,3	58,5	191,1	40,5	903,7
2010	66,2	138,4	58,4	254,0	19,9	17,2	19,2	53,6	178,3	38,2	843,5
2011	68,6	142,2	61,7	245,1	21,5	17,4	19,5	58,6	182,4	39,2	856,2
2012	68,0	148,0	60,8	239,5	21,8	16,9	20,3	70,3	184,0	39,1	868,6
2013	67,8	148,9	64,6	243,5	24,1	16,1	21,5	76,6	183,5	42,1	888,6
2014	65,2	141,4	66,7	244,1	26,9	15,6	22,0	75,0	179,9	39,8	876,6
2015	69,8	140,6	65,5	247,8	28,7	15,9	22,2	77,7	179,8	40,9	889,0
2016	67,4	141,0	60,2	245,3	30,7	16,5	22,1	77,5	181,9	43,7	886,3
2017	65,2	140,9	63,5	241,1	32,5	16,4	21,9	79,4	184,0	41,1	886,0
2018	65,3	141,6	69,5	245,1	35,4	15,8	22,4	80,5	184,4	40,4	900,2

Source: Authors' own study based on OECD Data Base

Table A5: Total gross value added at basic prices, total employment in Lithuania

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	830,7	4061,8	1170,5	4783,5	840,8	322,8	1034,6	792,5	2605,9	406,8	16849,7
2004	944,1	5208,9	1484,6	5711,7	901,9	391,6	1269,0	992,9	3108,4	475,2	20488,4
2005	1130,3	5897,1	1842,9	6671,4	958,4	521,6	1515,1	1212,0	3375,3	537,0	23661,2
2006	1166,1	6483,0	2578,9	7494,0	1068,3	778,2	1796,9	1437,6	3920,1	542,9	27266,0
2007	1379,4	7766,3	3989,2	9957,6	1335,5	1247,8	2404,0	2094,7	4877,8	624,0	35676,2
2008	1571,1	9167,3	4813,0	12073,3	1442,8	1456,4	3028,7	2448,5	6272,0	719,6	42992,7
2009	948,3	7155,7	2225,4	9950,4	1322,5	861,4	2533,9	2161,6	5920,7	697,6	33777,4
2010	1110,5	7758,6	1948,5	10345,4	1235,4	944,9	2238,3	1936,6	5249,4	629,5	33397,2
2011	1511,8	9645,1	2525,0	12176,0	1217,6	1045,1	2441,0	2196,4	5736,2	694,4	39188,7
2012	1722,2	9631,1	2295,7	12388,7	1169,3	805,2	2369,8	2221,8	5474,3	694,4	38772,5
2013	1661,0	9888,9	2760,9	13608,3	1361,6	912,1	2658,5	2511,9	5887,8	817,0	42068,1
2014	1662,0	10132,0	3219,4	14066,9	1395,2	879,2	2849,7	2669,1	6133,1	902,4	43908,9
2015	1427,9	8356,2	2695,2	11691,1	1303,6	783,3	2545,7	2430,8	5340,0	819,9	37393,8
2016	1322,5	8551,7	2529,2	12173,0	1426,2	847,2	2681,3	2665,2	5584,4	888,1	38668,7
2017	1481,4	9568,5	2811,3	13598,9	1597,4	871,5	2846,6	2972,7	6018,8	960,8	42727,9
2018	1433,3	10470,4	3405,8	15406,5	1777,5	1005,6	3054,4	3406,0	6825,2	1054,3	47838,9

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	251,8	291,4	105,1	324,7	14,9	17,1	9,0	56,7	313,8	41,2	1425,7
2004	220,4	281,8	113,0	327,6	18,7	14,9	8,0	49,0	319,1	57,6	1410,1
2005	199,7	290,5	127,8	337,8	19,5	16,3	10,4	56,9	321,3	40,4	1420,7
2006	195,2	274,3	159,4	340,4	18,3	15,8	11,0	62,4	294,6	44,9	1416,3
2007	146,5	279,6	162,9	375,5	21,8	21,4	9,6	69,1	319,5	39,2	1445,1
2008	114,6	280,3	154,2	376,8	24,4	18,9	11,5	79,4	313,9	52,1	1426,1
2009	118,1	240,0	113,1	347,7	22,9	20,1	11,4	81,5	309,7	52,0	1316,5
2010	110,0	219,3	86,8	340,1	22,1	20,3	12,7	85,5	303,1	46,9	1246,8
2011	106,2	222,6	85,0	346,0	25,5	17,7	12,7	87,2	299,4	50,3	1252,7
2012	112,0	230,3	89,4	348,7	28,3	18,2	13,3	88,8	293,4	52,5	1274,9
2013	108,7	230,5	99,1	354,9	24,8	17,7	15,8	94,0	290,7	55,9	1291,9
2014	120,7	226,6	99,1	367,3	23,9	18,4	15,4	95,4	292,9	58,4	1317,8
2015	120,9	229,6	104,8	358,4	27,2	18,6	14,5	100,9	304,4	55,4	1334,7
2016	108,4	238,5	103,4	366,1	28,7	19,6	14,3	109,1	313,0	60,2	1361,2
2017	105,2	241,2	98,7	363,8	28,1	20,1	14,6	111,6	309,6	61,2	1354,1
2018	102,1	248,5	100,0	367,9	31,5	19,3	14,9	113,5	307,0	63,7	1368,4

Source: Authors' own study based on OECD Data Base

Table A6: Total gross value added at basic prices, total employment in Estonia

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	354,4	1992,1	577,7	2209,6	436,0	326,6	870,0	570,8	1200,4	239,7	8777,3
2004	415,7	2328,5	749,8	2695,4	524,1	405,8	1033,1	763,9	1464,5	297,1	10678,0
2005	434,2	2630,6	1061,5	3045,6	578,2	487,4	1211,0	953,5	1654,1	343,8	12400,0
2006	461,5	3109,1	1464,0	3641,2	675,1	662,9	1449,6	1169,4	1889,4	400,6	14922,9
2007	674,2	3943,6	2071,2	4529,3	890,6	920,3	1863,9	1567,3	2538,7	512,9	19512,0
2008	590,7	4275,5	2076,3	4775,7	1063,2	1168,9	2084,5	1800,9	3188,6	510,7	21535,0
2009	417,2	3390,6	1207,3	3605,7	941,5	750,8	1808,9	1553,3	2982,6	411,5	17069,2
2010	544,7	3761,6	1010,7	3792,5	902,1	695,0	1672,7	1532,9	2760,9	388,0	17061,3
2011	788,6	4539,2	1392,2	4590,3	1024,8	784,6	1968,0	1797,5	2992,5	441,0	20318,7
2012	735,9	4311,0	1479,6	4656,1	1032,8	781,8	1980,5	1805,3	2903,0	455,6	20141,5
2013	751,5	4796,5	1534,4	5094,1	1122,5	793,9	2196,2	1985,3	3235,7	518,3	22028,4
2014	802,8	5134,9	1429,5	5431,5	1190,3	845,0	2286,5	2078,6	3456,0	558,4	23213,5
2015	613,3	4270,6	1209,0	4482,6	1058,0	771,0	2048,1	1803,1	3111,8	501,0	19868,6
2016	500,4	4412,5	1345,3	4639,9	1140,5	788,1	2180,5	1872,2	3297,9	510,5	20687,7
2017	618,6	4869,1	1635,3	5031,1	1354,0	881,0	2315,4	2188,8	3616,6	567,2	23077,0
2018	675,4	5472,7	2033,5	5551,3	1590,7	1035,5	2651,5	2570,4	4105,9	639,2	26326,2

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	36,9	149,6	43,4	152,4	10,7	7,8	11,6	29,9	133,2	25,6	601,1
2004	34,6	156,9	45,5	140,9	13,5	7,9	10,1	27,9	135,8	25,6	598,7
2005	30,8	157,1	48,0	150,3	15,5	6,5	10,0	33,3	131,7	29,1	612,3
2006	30,8	150,8	60,2	165,3	14,9	7,4	10,1	33,4	136,7	32,6	642,2
2007	29,9	145,3	76,0	159,8	13,6	9,5	9,8	35,6	130,4	33,5	643,4
2008	25,0	148,5	72,2	162,8	15,5	10,4	10,4	37,7	130,2	29,4	642,1
2009	22,5	126,6	49,8	146,7	14,6	11,4	9,0	37,2	133,7	25,1	576,6
2010	22,8	121,8	36,8	138,1	12,7	9,4	10,2	39,0	131,5	25,8	548,1
2011	25,7	135,0	45,9	143,6	16,7	10,2	10,7	40,1	132,2	23,9	584,0
2012	26,5	129,7	47,1	143,4	18,2	10,6	10,8	42,8	139,0	25,4	593,5
2013	24,9	128,6	47,2	145,3	19,6	10,2	11,6	47,6	137,6	28,3	600,9
2014	22,6	126,6	48,0	153,4	22,0	8,2	11,3	44,0	140,9	28,5	605,5
2015	24,3	131,5	51,9	151,9	26,3	9,4	10,3	43,0	143,8	30,5	622,9
2016	24,5	131,0	45,6	156,5	27,6	10,9	11,7	45,1	138,7	33,1	624,7
2017	22,3	137,6	47,0	162,2	31,0	12,1	10,0	51,8	135,2	32,3	641,5
2018	21,5	136,3	49,6	162,0	29,7	12,2	9,8	54,8	140,4	33,2	649,5

Source: Authors' own study based on OECD Data Base

Table A7: Total gross value added at basic prices, total employment in Estonia

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TGVA
2003	2353,9	26637,1	5869,3	19402,4	4224,3	3061,6	7149,8	5840,0	14056,2	2443,1	91037,5
2004	2746,7	33465,9	7145,1	22015,1	4818,8	3563,3	8347,6	6978,2	15985,1	2763,1	107829,1
2005	3014,6	38225,0	8224,4	24499,7	5958,5	3895,7	9866,6	7938,2	18530,5	3018,8	123172,0
2006	3222,5	44932,3	8994,5	28167,4	7099,4	4374,4	11265,9	8971,8	20647,9	3551,7	141227,7
2007	3716,0	54343,8	11120,8	33583,6	8935,4	6223,8	13533,2	11394,0	24283,2	4146,9	171280,7
2008	4561,2	66516,4	14016,1	40882,5	11049,0	8750,6	17846,8	14850,8	30485,9	4799,7	213758,9
2009	3386,1	56003,1	12545,4	33905,2	9909,4	8336,5	16864,4	12788,5	28420,7	4282,8	186442,2
2010	3152,6	56119,9	12885,2	34985,0	9626,6	8852,7	16875,4	12414,9	28455,4	4247,5	187615,2
2011	4895,6	63454,9	12698,6	37435,1	10615,3	9539,8	18086,0	13472,8	30720,4	4797,7	205716,1
2012	4872,7	57863,1	10911,1	34039,0	9513,0	8387,0	16313,5	12107,4	28123,0	4232,7	186362,5
2013	5033,3	58014,3	10775,3	33669,9	9427,1	8722,0	16431,0	12596,7	28574,9	4196,8	187441,1
2014	5141,3	60829,4	10339,8	33452,3	9426,3	8097,9	16078,1	12205,9	28131,4	4114,1	187816,4
2015	4162,4	54065,1	9441,9	31067,2	8625,9	7199,0	14158,3	11044,3	24645,3	3712,1	168121,5
2016	4028,5	55865,8	9617,0	32577,4	9182,4	7327,2	14897,8	11967,1	25924,7	3974,3	175362,1
2017	4442,6	61397,1	10322,3	36662,1	10203,6	7774,3	16578,6	13144,7	28966,4	4257,4	193749,1
2018	4769,2	67118,8	12590,2	41744,8	11793,3	8697,5	19595,5	14637,5	33761,2	4790,3	219498,3

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	9. ADMIN	10. OS	TE
2003	185,4	1428,7	420,3	1160,6	94,5	80,3	72,3	367,0	872,3	156,6	4838,1
2004	189,2	1444,1	424,7	1137,9	96,2	80,4	73,0	369,3	860,7	153,4	4828,9
2005	180,4	1479,5	435,8	1154,5	103,7	81,4	81,3	381,6	876,0	148,3	4922,6
2006	174,6	1484,6	437,4	1173,8	110,3	84,3	89,2	390,8	890,7	153,4	4989,0
2007	170,1	1523,4	434,2	1194,0	117,1	87,7	92,2	414,5	899,9	160,0	5093,1
2008	168,4	1537,1	444,3	1240,8	126,7	90,0	100,2	423,5	909,4	163,9	5204,1
2009	167,9	1422,6	463,7	1243,1	133,6	90,4	101,8	422,8	897,8	166,2	5110,1
2010	159,1	1378,8	471,5	1242,3	129,9	87,8	103,2	419,5	896,1	169,1	5057,2
2011	162,9	1423,9	447,3	1237,4	124,5	89,0	89,8	405,2	889,3	174,2	5043,4
2012	165,4	1436,6	441,5	1230,9	126,8	94,6	95,1	414,2	879,5	180,0	5064,6
2013	167,1	1434,0	431,1	1235,9	129,1	95,6	95,6	422,0	890,4	180,0	5080,9
2014	165,5	1453,9	411,5	1232,6	133,3	97,4	95,5	431,7	904,8	182,7	5109,0
2015	163,3	1500,7	409,6	1242,9	136,3	95,0	95,2	441,8	913,7	183,4	5181,9
2016	160,9	1536,2	402,7	1248,5	143,7	95,8	96,0	455,4	936,2	188,9	5264,3
2017	162,4	1554,3	402,3	1266,2	147,9	92,4	98,4	461,1	967,4	193,7	5346,1
2018	159,7	1582,3	400,7	1286,3	154,8	92,4	99,6	466,6	990,6	196,8	5429,7

Source: Authors' own study based on OECD Data Base

Table A8: Total gross value added at basic prices, total employment in Poland

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	ADMIN	10. OS	TGVA
2003	5614,7	46762,0	13108,5	49288,1	8521,0	7186,3	12606,3	12469,5	31513,7	4547,4	191617,5
2004	8333,0	57583,0	16318,7	56464,8	10635,5	8593,0	13712,9	14065,1	35066,6	4876,9	225649,5
2005	8871,3	67718,8	20523,7	68278,5	11828,5	10772,7	16250,1	17270,4	41170,7	6316,5	269001,2
2006	9202,9	76733,4	23341,7	77459,1	12718,3	11634,3	18239,5	19907,5	45988,3	6927,5	302152,5
2007	12899,4	94757,9	29543,2	94537,5	15367,7	16748,9	21454,5	25354,1	55441,0	8355,6	374459,8
2008	13537,0	116834,7	38545,3	116125,8	19737,3	19727,0	26196,6	33159,4	71360,2	11238,4	466461,7
2009	10929,3	97657,4	33424,8	99357,3	16065,3	15606,3	20200,7	28087,8	60344,7	9365,6	391039,3
2010	12298,9	104050,7	35800,7	108507,6	16439,8	17472,2	22483,0	29628,2	65292,3	9701,2	421674,8
2011	14975,8	117173,1	40587,6	117360,1	17469,3	20357,1	24263,8	32355,0	69999,5	10203,0	464744,4
2012	13331,0	113526,6	35295,7	115777,4	16865,4	17849,6	22468,0	31699,0	65658,3	10838,8	443309,9
2013	15066,0	115649,9	34395,5	122817,8	18059,1	19825,2	23831,7	34641,0	70095,2	11007,7	465389,2
2014	14245,8	122568,7	37939,0	122112,5	19065,8	21886,9	25369,1	36719,8	72318,9	11414,7	483641,1
2015	10513,3	110670,9	33819,1	106986,3	17106,5	17220,1	20800,4	34219,7	62598,8	9782,2	423717,2
2016	11237,7	110518,1	29058,7	104590,1	17225,9	18340,6	21645,9	32969,9	61651,9	9720,8	416959,5
2017	14489,1	117220,4	32440,9	118769,4	19134,9	20547,3	22694,5	39283,9	67432,0	10250,2	462262,5
2018	14516,4	131419,8	41006,8	134324,2	20010,2	20525,1	24983,4	43226,3	71634,9	11049,9	512696,9

Year	1. AGRI	2. INDU	3. CONS	4. DISTR	5. INFO	6. FIN	7. RE	8. SCIEN	ADMIN	10. OS	TE
2003	2505,6	3089,5	796,9	2805,5	201,9	255,9	144,7	575,2	2849,9	381,0	13606,1
2004	2469,3	3205,3	797,4	2925,9	217,9	272,4	146,3	608,6	2743,0	374,2	13760,3
2005	2426,6	3313,8	839,9	2996,3	215,9	294,7	136,0	640,9	2813,4	379,5	14057,0
2006	2276,3	3466,2	914,8	3123,1	252,7	328,7	123,1	669,6	2920,7	428,7	14503,9
2007	2218,6	3634,2	1047,0	3372,1	285,5	363,2	128,8	753,8	2927,5	425,2	15155,9
2008	2196,4	3784,8	1212,3	3513,6	296,7	341,5	142,8	777,6	3018,6	447,6	15731,9
2009	2095,4	3607,2	1280,8	3536,7	316,1	372,1	156,0	840,3	3125,3	459,5	15789,4
2010	2003,9	3403,8	1220,7	3470,3	299,7	352,7	167,5	872,0	3113,3	466,4	15370,3
2011	1994,7	3458,9	1246,4	3470,9	298,9	370,6	164,3	919,7	3086,0	446,9	15457,3
2012	1945,9	3454,8	1211,2	3495,0	315,4	392,6	146,8	938,7	3120,9	453,6	15474,9
2013	1852,7	3536,6	1144,1	3460,7	332,8	383,1	142,8	940,7	3203,9	466,4	15463,8
2014	1804,3	3620,8	1134,2	3539,2	360,1	378,4	160,5	1012,3	3247,7	473,5	15731,0
2015	1841,9	3676,3	1156,3	3608,2	374,6	396,5	172,5	1003,3	3261,6	478,8	15970,0
2016	1701,0	3833,2	1170,8	3697,8	366,2	386,5	162,4	1038,9	3254,7	488,2	16099,7
2017	1659,9	3936,8	1169,0	3731,2	385,9	396,4	146,6	1081,4	3305,2	502,6	16315,0
2018	1559,8	3934,7	1187,6	3715,5	415,3	410,1	150,9	1056,8	3337,9	600,5	16369,1

Source: Authors' own study based on OECD Data Base