# STRUCTURAL DECOMPOSITION ANALYSIS OF CHANGES IN MANUFACTURING EMPLOYMENT IN SLOVAKIA

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## Štruktúrna dekompozícia zmien v zamestnanosti v spracovateľskom priemysle na Slovensku

***Abstract:*** *The paper deals with the structural decomposition of changes in the overall manufacturing employment in Slovakia. In recent years, we have observed a trend of deindustrialisation that is visible considering the direct but also the indirect employment or value added in manufacturing in many economies. Therefore, the aim is to recognize which factors and to what extent contributed to the changes in manufacturing employment growth index between different time periods. Attention will be focused mainly on the development in manufacturing employment in Slovakia from 1995 to 2014. In contrast to some recent studies, we provide a decomposition which truly accounts for the total employment in manufacturing, i.e. direct and indirect. Moreover, we provide our analysis using both current and constant prices.*

***Keywords:*** *manufacturing, employment, input-output analysis, structural decomposition analysis, industrial policy.*

**JEL Classification:** C67, L60, O14

## 1 Introduction and Literature Review

In general, manufacturing has also been considered as engine of growth. It has major effect on employment, and it is considered to be one of the key sectors for job creation which has also traditionally absorbed significant quantities of unskilled labour in contrast to other high-productivity sectors.

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Moreover, its importance is further increased by its ability to attract R&D investments. Another advantage of manufacturing is its tradability and unlike whole economies, manufacturing industries exhibit a strong unconditional convergence in labour productivity. In addition, industry is strongly resilient to crises, i.e. countries with a strong industrial base are able to recover from the financial and economic crisis better and more quickly compared to other countries (European Commission, 2014).

However, in recent years, there has been clear evidence for the presence of deindustrialisation in many countries. Thus, also the European Commission calls for an 'industrial renaissance' and believes that building a strong industrial base will lead to a revival of the European economy and to a strengthening of its competitiveness (European Commission, 2014). This has been frequently highlighted in the communications of European Commission dealing with industry. Even in 2012, the Commission introduced an ambitious target of achieving a 20% share of manufacturing on GDP by 2020 (European Commission, 2010). Further, what is interesting is that deindustrialisation has not only been an issue for advanced economies, but it is becoming a hot topic in the developing world as well. This has been happening there at an even faster pace and at much lower levels of income and productivity compared to the early industrialists, which could be harmful to these countries (Dasgupta and Singh, 2006; Rodrik, 2016).

There are many theories trying to explain the decline in manufacturing output and employment in recent decades. The productivity-based theory can be considered the most common. It says that with the rise in productivity, fewer workers are needed to produce a higher volume of manufacturing goods (Matsuyama, 2009). Other drivers intensifying the deindustrialisation processes may include commercialisation of services for households, increasing importance of educational services, and growing outsourcing of services by manufacturing companies (Mucha-Leszko, 2016). Moreover, globalisation and offshoring are responsible for the shift of some manufacturing activities from their countries of origin and thus also for the deindustrialisation in many countries (Peneder and Streicher, 2018; Rodrik, 2016).

However, it is necessary to be careful when explaining the reasons why some countries have been going through the deindustrialisation process. The story for the emerging and the advanced economies is not the same. It seems that productivity improvements and offshoring have played a major role in advanced economies, while globalisation and outsourcing may be

to blame in the developing world (Baldwin, 2016; Rodrik, 2016). Overall, deindustrialisation is stronger in terms of employment rather than output, which is definitely true for the advanced world economies. In many cases, increasing automation of some manufacturing activities is held responsible for the employment deindustrialisation as well. The computer revolution certainly increased the demand for cognitive skills while reducing the demand for workers performing routine jobs (Berger and Frey, 2016).

According to Peneder and Streicher (Peneder and streicher, 2018), within the highly developed economies, deindustrialisation is mainly driven by the declining share of manufacturing on domestic final demand expenditures. In contrast, in some individual countries like Taiwan and South Korea, the positive net trade effect can outweigh the decline in domestic expenditures for manufacturing and cause its value added share to grow. Similarly, China and some Central and Eastern European countries prove the point that the net trade channel, i.e. comparative advantage, can make a difference in structural change and deindustrialisation. The picture is somewhat mixed for other developing nations. Some of them experienced a decline in the comparative advantage of their manufacturing products, some of them an improvement, however, neither could stop the deindustrialisation process, which was driven to a higher extent by the declining share of manufacturing on domestic final expenditures.

In addition, due to a rapid growth of new technologies and the automation of manufacturing jobs, many workers may be reallocated to technologically stagnant sectors of the economy or entirely new service industries. This all implies that manufacturing jobs as we know them will not come back or at least not in the desired amount (Prettner, Strulik and Krenz, 2018).

## 2 Methodology and Data

Structural decomposition analysis represents a way of determining major sources of changes in an economy. Therefore, it can be a good tool for identifying potential cause of the so-called deindustrialisation. Since the input-output analysis enables us to quantify also the indirect employment connected to manufacturing, we were able to decompose the changes in the overall manufacturing employment. There is an extensive literature dealing with this methodology in the framework of input-output, for instance chapter 13 in the monograph by Miller and Blair (2009) or papers by De Boer (2009)

and Dietzenbacher and Los (1998). Because of the inconsistency of the data from different releases, we provide a decomposition analysis in three version: (i) SDA of changes in the overall manufacturing employment for 1995 – 2009 in constant prices, (ii) SDA of changes in the overall manufacturing employment for 1995– 2009 in current prices and (iii) SDA of changes in the overall manufacturing employment for 2000 – 2014 in current prices.

In general, we distinguish an additive and a multiplicative forms of the decomposition, where the aggregate change in each variable is the difference or the ratio between its value in the 'current' period 1 and the base period 0, respectively. In this paper, we considered the multiplicative decomposition of the variable, since the aim is to decompose the index of employment growth into the contributions of several determinants. Using this method, we are able to say which determinants caused the growth in manufacturing employment over time. This helps us determine whether we should predominantly blame the changes in the productivity of labour, or rather changes in the technology of production or changes in the structure of the final demand.

As far as data is concerned, our decomposition is based on the world input – output tables in current prices covering the periods of 1995 – 2009 (Release 2013) and 2000 – 2014 (Release 2016). Using the previous years prices (available for 1995 – 2009), we were also able to perform the decomposition in constant prices, but only for the older period. Thus, using this approach, we broke down the change in the manufacturing employment growth index into the contributions of several factors: changes in labour productivity, changes in the structure of production, changes in the use of domestic intermediates (offshoring/outsourcing), changes in the use of domestic intermediates (insourcing), changes in the manufacturing final demand structure, changes in the share of manufacturing expenditures on the total final demand, changes in the final demand structure and changes in the final demand volume. In a final step, the multiplicative structural decomposition can be expressed in the following way:

$$\frac{E_1^m}{E_0{}^m} = \frac{e_1^c (I - A_1^T \circ D_1)^{-1} \hat{B}_1^m s_1^m s_1^y y_1}{e_0^c (I - A_0^T \circ D_0)^{-1} \hat{B}_0^m s_0^m s_0^y y_0} \tag{1}$$

where $D = D_o + D_i$

The manufacturing employment growth index is given by changes in the above-mentioned determinants, thus:

$$D_E = \frac{E_1^m}{E_0{}^m} = D_{ec} \times D_{At} \times D_{Do} \times D_{Di} \times D_{Bm} \times D_{sm} \times D_{sy} \times D_y \qquad (2)$$

where DE is the manufacturing employment growth index,

$D_{ec}$ is a weighted change in labour productivity,

$D_{At}$ is a weighted change in the total technical coefficient matrix (in the structure of production),

$D_{Do}$ is a weighted change in the use of domestic intermediates (off-shoring/ outsourcing)

$D_{Di}$ is a weighted change in the use of domestic intermediates (insourcing),

$D_{Bm}$ is a weighted change in the manufacturing final demand structure,

$D_{sm}$ is a weighted change in the structure of the final demand for manufacturing,

$D_{sy}$ is a weighted change in the final demand structure, and

$D_y$ is a weighted change in the final demand volume.

The first polar decomposition starts with the base period weights (0) for the first factor and ends with the current period weights (1) for the last factor. The upper index stands for the first polar decomposition. Thus, we can write it as follows:

$$D_{ec}^1 = \frac{e_1^c (I - A_0^T \circ (Do_0 + Di_0))^{-1} \hat{B}_0^m s_0^m s_0^y y_0}{e_0^c (I - A_0^T \circ (Do_0 + Di_0))^{-1} \hat{B}_0^m s_0^m s_0^y y_0}$$

$$D_{At}^1 = \frac{e_1^c (I - A_1^T \circ (Do_0 + Di_0))^{-1} \hat{B}_0^m s_0^m s_0^y y_0}{e_1^c (I - A_0^T \circ (Do_0 + Di_0))^{-1} \hat{B}_0^m s_0^m s_0^y y_0}$$

...

$$D_y^1 = \frac{e_1^c (I - A_1^T \circ (Do_1 + Di_1))^{-1} \hat{B}_1^m s_1^m s_1^y y_1}{e_1^c (I - A_1^T \circ (Do_1 + Di_1))^{-1} \hat{B}_1^m s_1^m s_1^y y_0} \qquad (3)$$

On the other hand, the second polar decomposition starts with the weights (1) for the first factor and ends with the base period weights (0) for the last determinant. So, the second decomposition is obtained by reversing the index for weights. Again, the change in the total manufacturing employment can be decomposed to the contributions of. In this case, the upper index stands for the second polar decomposition. Then, we calculate a mean for the contribution of each factor. In a final step, for example, the contribution of labour productivity to the manufacturing employment growth, where avg stands for an average, can be expressed as:

$$D_{ec}^{avg} = (D_{ec}^{1} \times D_{ec}^{2})^{\frac{1}{2}} \tag{4}$$

The same procedure was applied to all determinants and the final decomposition can be written as:

$$D_E = D_{ec}^{avg} \times D_{At}^{avg} \times D_{Do}^{avg} \times D_{Di}^{avg} \times D_{Bm}^{avg} \times D_{sm}^{avg} \times D_{sy}^{avg} \times D_{y}^{avg} \tag{5}$$

### 2.1 Data

The analysis is mainly based on data from the World Input-Output Database (WIOD). The version released in 2013 covers the period from 1995 to 2011 including data on employment (Socio-Economic Accounts). The coverage of the data is for 1995 – 2009 and 40 countries, in particular 27 EU countries and 13 other major countries in the world. We also used the world input–output tables in previous years prices available for 1995 – 2009. It enabled us to perform a decomposition in constant prices, as well. The new release, an update of the WIOD from 2016, features data from 2000 to 2014. They are available for 43 countries (28 EU countries and 15 other major economies) which together represent more than 85% of the world GDP. Details about how the database is created are described e.g. in Timmer (2012) or Timmer et al. (2015). Moreover, this release includes data on 56 industries and products, which are structured according to the industry and product classification ISIC Rev. 4.

## 3 Empirical Results

As mentioned before, structural decomposition analysis represents a way of determining major sources of changes in an economy, i.e. it can be a good tool for identifying potential drivers of the so-called deindustrialisation. Because of the inconsistency of the data from different WIOD releases, we provide a decomposition analysis in three version considering changes in the overall manufacturing employment for 1995 – 2009 in constant prices, changes in the overall manufacturing employment for 1995 – 2009 in current prices and changes in the overall manufacturing employment for 2000 – 2014 in current prices.

First of all, it should be recalled that the data from different releases are not comparable. Even though both versions contain the same type of data and tables and are constructed using the same methodology, major improvements and extensions make the comparison impossible. As can be seen in Table 1, the new release has already reflected the changes in the reorganisation of production processes and various activities have been disaggregated into more industries. The major shifts were mainly done from manufacturing to services (e.g. a shift from manufacturing to various auxiliary activities to services etc.), i.e. the early signs of outsourcing and yet deindustrialisation are visible even from the direct statistics. For instance, in 2007 (the most recent year from the older release not yet affected by the crisis), according to WIOD13, the overall employment connected to manufacturing in Slovakia has been almost 800 thousand jobs, while looking at the same type of data in the newest release, it has been less than 700 thousand. Approximately the same differences are visible among all countries in the sample. The number for manufacturing employment calculated from the newest release represented roughly 86% of the previous value. The smallest difference in the sample of countries in Table 1 was in Poland, -4%. When looking only at the direct employment in manufacturing, differences between the two versions are not major, but they are still present. For instance, in Slovakia in 2007, roughly 516 thousands (WIOD16) of people worked for manufacturing compared to approximately 527 thousands according to WIOD 2013 Release. Still, the numbers are not fully compatible. Countries presented in Table 1 and 2 were chosen arbitrarily trying to reflect all types of changes in manufacturing employment in absolute terms, i.e. a decline, an increase or almost no change during the observed period.

**Table 1**: Overall manufacturing employment (direct and indirect) according to WIOD 2013 Release and WIOD 2016 Release (2007, in thousands of persons employed)

| | **Overall manufacturing employment (WIOD13)** | **Overall manufacturing employment (WIOD16)** |
|---|---|---|
| Germany | 12649,00 | 11348,59 |
| Slovakia | 783,72 | 674,75 |
| Poland | 5018,18 | 4841,65 |
| China | 284411,84 | 260444,88 |
| Great Britain | 4321,08 | 3951,33 |

**Source:** Author's calculations based on WIOD data.

Thanks to the availability of the world input–output tables in previous years' prices for 1995 – 2009, we were able to provide a version of decomposition in constant prices, as well. Leaving out the effect of inflation between the individual years, we suppose that a decline in manufacturing employment should be a bit smaller in the case of constant prices. It is true for most of the countries in the sample, as we can see in Table 2. The average annual indices for individual countries differ in the two versions by -0.94 to 1.59 pp, with the average rate of change of 0.27 pp. Supposedly, it would be a larger difference, when looking at the production or value-added indicators.

**Table 2:** Generated manufacturing employment growth index, average annual indices for 1995 – 2009 in %, WIOD 2013 Release in current prices vs WIOD 2013 Release inconstant prices

| | **WIOD13 current prices** | **WIOD13 constant prices** |
|---|---|---|
| Germany | 1,0036 | 1,0041 |
| Slovakia | 1,0077 | 1,0196 |
| Poland | 0,9998 | 1,0111 |
| China | 1,0152 | 1,0300 |
| Great Britain | 0,9685 | 0,9677 |

**Source:** Author's calculations based on WIOD data.

In Table 3, we can see a manufacturing employment growth in Slovakia in a more detailed structure. Again, we provide a decomposition in current and constant prices. Since we have used a multiplicative form of a structural decomposition, the results are expressed as average annual indices and by multiplying all determinants of changes, we get a manufacturing employment growth index for a particular period. First, for all time periods, there has been an increase in manufacturing employment (calculated as an average of chain indices of people employed in manufacturing in subsequent time periods), which is visible in both versions.

**Table 3:** Structural decomposition analysis of manufacturing employment growth in Slovakia, 1995– 2009, average annual indices

| | Man. empl. growth index | Changes in labour productivity | Changes in the structure of production | Changes in the use of domestic intermediates (Do) | Changes in the use of domestic intermediates (Di) | Changes in the man. final demand structure | Changes in the share of man. expenditures on total final demand for man. | Changes in the final demand structure | Changes in the final demand volume |
|---|---|---|---|---|---|---|---|---|---|
| **Slovakia - current prices** | | | | | | | | | |
| **1995-2002** | 1,0074 | 0,9604 | 1,0030 | 0,9842 | 0,9992 | 0,9956 | 1,0075 | 1,0096 | 1,0501 |
| **2003-2009** | 1,0080 | 0,8620 | 0,9991 | 0,9990 | 1,0008 | 0,9934 | 0,9880 | 1,0002 | 1,1925 |
| **1995-2009** | 1,0077 | 0,9099 | 1,0010 | 0,9916 | 1,0000 | 0,9945 | 0,9977 | 1,0049 | 1,1190 |
| **Slovakia - constant prices** | | | | | | | | | |
| **1995-2002** | 1,0144 | 0,9420 | 1,0010 | 0,9773 | 1,0064 | 0,9915 | 1,0208 | 1,0192 | 1,0603 |
| **2003-2009** | 1,0249 | 0,9532 | 0,9907 | 0,9965 | 0,9995 | 0,9805 | 1,0090 | 1,0266 | 1,0729 |
| **1995-2009** | 1,0196 | 0,9476 | 0,9959 | 0,9868 | 1,0030 | 0,9860 | 1,0148 | 1,0229 | 1,0666 |

**Source:** Author's calculations based on WIOD data.

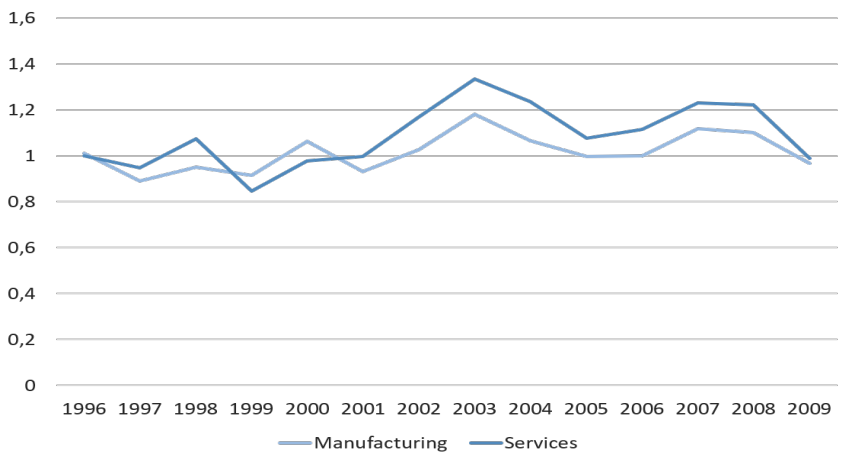
Again, considering the constant prices, an increase is larger, so an indication of deindustrialisation is less evident. In both versions, we can see that the changes in labour productivity contribute to the manufacturing employment growth most negatively, while changes in the final demand volume most positively. However, in current prices, the effect of a change in the final demand volume is 'overestimated' since it has not been inflated. Also, the effect of a change in labour productivity appears to be larger (more negative) in current prices. If we multiply these two effects, we can calculate a common growth of labour

productivity and a final demand volume and get an unbiased effect of this change on a manufacturing employment growth.

Next, changes in the final demand structure and changes in the domestic final expenditures on manufacturing had the second largest effect on a manufacturing employment growth, regardless of a type of prices. This suggests that an increasing share of exports of a Slovak GDP and an increase in the use of domestic expenditures on manufacturing affect the employment in manufacturing quite significantly. The latter has a more negative contribution in the case of current prices, which is in compliance with a character of this type of a price.

Besides, for example, in Great Britain, where we observe the value of a manufacturing employment growth index below one, a decrease in the domestic manufacturing expenditures seems to be even more prominent, again with a less negative impact in constant prices. If there are some minor discrepancies in the expectations on the effects in current and constant prices (e.g. a more negative contribution of the labour productivity improvements in constant prices in Slovakia for 1995–2002), they can be explained by the different development of prices between the two periods. This is however individual for each of the countries. The development of a price index in Slovakia for 1995 – 2009 can be seen in Figure 1.

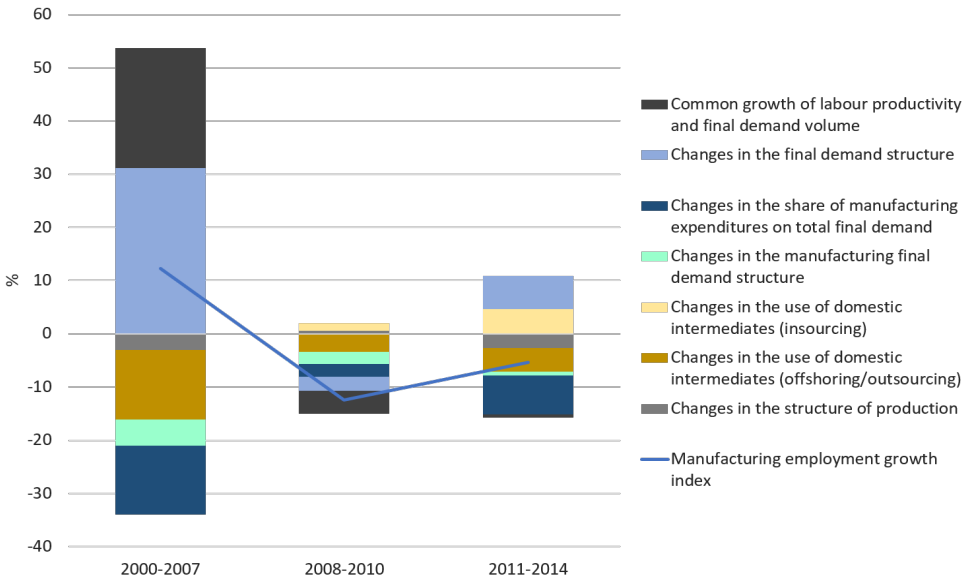
**Figure 1**: Development of a price index in Slovakia, 1995 – 2009




**Source:** Author's calculations based on WIOD data.

After identifying the differences coming from different measures of changes (constant vs current prices), we redirect our attention to more up-to-date data and provide an SDA of changes in overall manufacturing employment for 2000 to 2014, in current prices. These results have already offered some clue on which determinants play a crucial role in the process of deindustrialisation and could be considered as its drivers. We examine it in more detail in the following part of the paper and provide a comparison for different time periods (pre-crisis, crisis and post-crisis), as well.

**Figure 2**: Structural decomposition of changes in manufacturing employment in Slovakia, cumulative changes in %




**Source:** Author's calculations based on WIOD data.

In Figure 2, we decompose the changes in manufacturing employment in Slovakia into the contribution of seven factors. For a deeper insight into the changing growth indices, we divided the observed time range into three periods: pre-crisis (2000 – 2007), crisis (2008– 2010) and post-crisis period (2011–2014). In the first period, 12% growth of manufacturing employment has been observed. Slovakia experienced a significant increase in labour productivity at this time. This period was also characterised by an increasing share of exports on the Slovak GDP, together with the exports of manufacturing products, which meant a positive contribution to the employment growth in manufacturing. On

the contrary, the share of inputs from domestic producers and other industries started to decline, which was likely caused by the increased imports of inputs.

Also, the share of domestic expenditures on manufacturing has been decreasing. Between 2008 and 2010, the number of persons employed in manufacturing decreased in all countries, except for Russia, India, Indonesia, and Turkey. In Slovakia, there has been a 12% decrease in the manufacturing employment. In comparison with the first period, labour productivity experienced a slump. Changes in the final demand volume represented a negative contribution to the growth index, decline of expenditures on manufacturing included. Positive changes in the use of domestic intermediates (insourcing) were outweighed by the increased imports of inputs in some industries. Recently, the share of employment in manufacturing dropped to roughly 6%. This period is also characterised by the increase in the labour productivity; however, not so major compared to the first period. It seems that the main factors causing the manufacturing employment decline are declining share of domestic expenditures on manufacturing and declining share of domestic inputs. This is consistent with the authors like Rodrik (2016) or Matsuyama (2009).

In the case of the Slovak Republic, the decline between 2000 and 2014 was only minor; however, we can identify some common patterns with Great Britain and Ireland. In these countries, the employment in manufacturing dropped by almost 50%. This was mainly caused by a decreasing share of domestic expenditures on manufacturing and a decrease in the use of domestic inputs in the production process.

## 4 Conclusions

Although there was an increase in manufacturing employment growth index measured as a share of people working for manufacturing in chosen periods, i.e. in absolute terms the number of people working for manufacturing was increasing, in relative terms, the share of manufacturing employment on the total employment was decreasing throughout the examined period. This is true considering both current and constant prices. Some of the potential drivers which could possibly cause and speed up the process of deindustrialisation were introduced in the first section. The most common to blame are rapid productivity improvements, commercialisation of services for households, outsourcing, offshoring, automation, globalisation and trade or decline in the domestic final expenditures on manufacturing. In this paper, we examined

the contributions of several determinants coming from the direct and also the indirect calculation of manufacturing employment like changes in the productivity of labour, changes in the using of the domestic intermediates or changes in the domestic expenditures on manufacturing. We examined the contributions of these changes towards the manufacturing employment growth index using the method of structural decomposition.

To conclude, based on all versions of decomposition analyses, the factors contributing to overall manufacturing employment changes are: negative effects of a labour productivity increase, a positive effect of increasing domestic expenditures for manufacturing, next, a positive effect of changes in the use of domestic intermediates and a positive contribution of changes in the final demand structure. In a further analysis, to verify the significance of these potential drivers of deindustrialisation identified by the structural decomposition analysis, we can include them as covariates in a regression model of deindustrialisation proposed by Rodrik (2016).

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**REFERENCES**

**[1]** BALDWIN, R. 2016. The Great Convergence: Information Technology and the New Globalization. Belknap Press: An Imprint of Harvard University.

**[2]** BERGER, T. – FREY, C. 2016. Structural transformation in the OECD: Digitalisation, deindustrialisation and the future of work. OECD Social, Employment and Migration Working Papers No 193.

**[3]** DASGUPTA, S. ─ SINGH, A. 2006. Manufacturing, services and premature deindustrialization in developing countries: A Kaldorian analysis. Number 2006/49. UNU-WIDER Research Paper, United Nations University (UNU).

**[4]** DE BOER, P. 2009. Multiplicative decomposition and index number theory: An empirical application of the Sato-Vartia decomposition. *Economic Systems Research*. 2009, 21(2), 163 – 174.

**[5]** DIETZENBACHER, E. – LOS, B. 1998. Structural decomposition techniques: Sense and sensitivity. *Economic Systems Research.* 1998, 10(4), 307 – 324.

**[6]** European Commission. 2010. EUROPE 2020: A Strategy for Smart, Sustainable and Inclusive Growth. [online]. [accessed 14.05.2019]. Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC2020&from=EN>

**[7]** European Commission. 2014. For a European Industrial Renaissance. [online]. [accessed 16.05.2019]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0014&from=SK

**[8]** MATSUYAMA, K. 2009. Structural change in an interdependent world: A global view of manufacturing decline. *Journal of the European Economic Association.* 2009, 7(1-2), 478 – 486.

**[9]** MILLER, R. E. – BLAIR, P. D. 2009. Input-Output Analysis: Foundations and Extensions. 2nd Edition. Cambridge University Press, 2009. ISBN 978-0-521-51713-3.

**[10]** MUCHA-LESZKO, B. 2016. Causes and consequences of deindustrialization in the euro area. *Scientific Journal Warsaw University of Life Sciences: Problems of World Agriculture/ Problemy Rolnictwa Åświatowego.* 2016, 16(4), 240 – 252.

**[11]** PENEDER, M. R. – STREICHER, G. 2018. De-industrialization and comparative advantage in the global value chain. *Economic Systems Research*, 2018, 30(1), 85 ─ 104.

**[12]** PRETTNER, K. – STRULIK, H. – KRENZ, A. 2018. Robots, reshoring, and the lot of low-skilled workers. Cege Discussion Papers, July 2018.

**[13]** RODRIK, D. 2016. Premature deindustrialization. *Journal of Economic Growth*. 2016, 1, 1 – 33.

**[14]** TIMMER, M. P. 2012. The World Input-Output Database (WIOD): Contents, Sources and Methods. WIOD working paper 10. Liberec: Technická univerzita v Liberci.

**[15]** TIMMER, M. P. ─ DIETZENBACHER, E. ─ LOS, B. ─ STEHRER, R. ─ DE VRIES, G. J. 2015. An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production. *Review of International Economics*. 2015, 23(3), 575 – 605.