SUBSYSTEM ANALYSIS OF THE DEINDUSTRIALIZATION TRENDS AND THEIR DRIVERS IN EUROPEAN COUNTRIES

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Abstract

In this paper, we analyze the extent and main drivers of the so-called deindustrialization in European countries over the last decades. The analysis is based on a subsystem perspective that allows us to reveal the proportion of the activity of each industry that comes under the individual subsystems. We analyze several research questions. Have the European countries become more deindustrialized considering both direct and indirect effects? Does the magnitude of the changes (direct vs. direct and indirect) differ? How did market services integrated into the manufacturing help to mitigate the deindustrialization effects? Is manufacturing more integrated at the subsystem level? What was the role of international trade and 'tertiarization' in this process? Based on the results, we conclude that the outsourcing process is presented in most developed counties, as well as in developing one. Such an outsourcing process confirms the premature deindustrialization hypothesis. Furthermore, there is a clear shift of value added activities that come from manufacturing subsystems from G7 countries and Developed countries to the rest of the world.

Keywords

Input-Output Analysis, Deindustrialization, World Input-Output Tables, Subsystem Analysis

I. Introduction

Over the last decades, technological progress and reorganization of production activities across industries and national borders has led to an overall decline in employment and value added shares of manufacturing in advanced countries. After the recent economic crisis, policymakers across the globe called for an 'industrial renaissance' and took steps for a re-industrialization of their economies. On the other hand, outsourcing and continuous fragmentation of global value chains decrease the relevance of direct employment and value added effects of manufacturing for overall economic performance. Many activities, once taking part in manufacturing, are now supplied by businesses in the service sector and many high value added activities are being outsourced to companies outside the manufacturing industry. Thus, the analysis of deindustrialization processes calls for an approach that considers complex linkages among industries. Input-output analysis is a useful tool for capturing these indirect effects, which are not visible in simple statistics. The aim of the paper is to investigate the extent and the main drivers of the so-called deindustrialization in European countries over the last decades. The analysis is based on a subsystem perspective. It shows the proportion of the activity of each branch that comes under the individual subsystems. This allows us to reclassify any variable from a sector base into a subsystem base. For instance, it is possible to calculate the amount of labor required, both directly and indirectly, from sector i in order to satisfy the final demand in sector j. Several research questions are analyzed: Have the European countries become more deindustrialized considering both direct and indirect effects? Does the magnitude of the changes (direct vs. direct and indirect) differ? How did market services integrated into the manufacturing help to mitigate the deindustrialization effects? Is manufacturing more integrated at the subsystem level? What was the role of international trade and 'tertiarization' in this process?

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The paper is organized as follows. In the next section, we review the literature on deindustrializing processes. Then we present the methodology applied in the paper and explain the advantages of subsystem approach for the analysis of deindustrialization processes and their drivers. In the last part we present the main empirical results, conclusion and new questions for further research.

II. LITERATURE REVIEW

In general, manufacturing has a major effect on employment and it is considered to be one of the key sectors for job creation. According to the European Commission (2014), on average, 1 in 4 jobs is created in industry and it generates 0.5 to 2 jobs in other industries. Moreover, its importance is further increased by its ability to attract R&D investments. In particular, more than 80% of private investments into science and research are directed into industry and industrial products account for about 80% of the export from Europe. These facts are also emphasized in a study dealing with the manufacturing industry in Slovakia and its importance for the Slovak economy (Luptáčik et al., 2016). While less than one quarter of the whole working population is directly employed in manufacturing, more than one third of jobs is generated by the final demand for manufacturing products in Slovakia. Even though the R&D expenditures are still rather low in Slovakia, on average, 62% of all private investments in 2011–2013 was used by manufacturing.

This also draws the attention of the European Commission, which is reflected in frequent Commission communications in this field. A strong industrial base and resilience of the industry to economic crises is highlighted in the most recent communication called For a European Industrial Renaissance. The heading itself indicates that 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).

Nowadays, a decreasing share of industry on the overall value added and employment in national economy can be observed, which leads to a discussion about deindustrialization. Many activities, once taking part in manufacturing, are now supplied by businesses in the service sector and many high value added activities are being outsourced to companies outside the manufacturing industry. By definition, deindustrialization involves a decrease in the size and relative importance of manufacturing (Bernard et al., 2016). This is not only a phenomenon of the developed economies but this trend is observable in the developing countries as well.

According to Mucha-Leszko (2016), some of the drivers intensifying the deindustrialization processes are commercialization of services for households, increasing importance of educational services and growing service outsourcing by manufacturing companies. First, the commercialization of services for households is represented by more intense linkages between traditional manufacturing products and new modern services (e. g. the tracking of some products after they are sold by a producer to a customer). Second, the importance of a highly-skilled and qualified labor force for manufacturing is constantly increasing. Most importantly, a major growth of services outsourced by manufacturing companies has been observed. In this context, outsourcing is represented by the share of total employment and value added generated by the final demand for manufacturing products in market services. This process is characterised by redrawing boundaries between existing industries (Jacobides and Winter, 2005). According to Rodrik (2015), the shift of some manufacturing activities towards services has caused a decrease of the manufacturing sector. Paradoxically, this has been happening in developing countries at an even faster pace. This implies that these economies are running out of industrialization opportunities sooner than today's developed countries. This could lead to a change in the process of creating modern states and democratic policies, as was historically documented in the case of Western Europe and North America. Thus, the problem of premature deindustrialization, as mentioned by Dasgupta and Singh (2006), is identified in many countries of the developing world.

Our analysis is closely related to the work of Italian authors Montresor and Vittucci (2008) that dealt with the so called 'Deindustrialization/Tertiarization (DT) hypothesis'. In order to reveal the real extent of the DT process, they used a subsystem analysis and used it on the artificial world consisting of the OECD7 countries covering the time period of 1980s and 1990s. Their results strongly support the DT hypothesis. They claim that although the weight of market services in the manufacturing subsystem increases (providing a counterbalance to manufacturing decline), subsystem shares decrease significantly, which means that the actual extent of this hypothesis is quite large. Moreover, not only the increased integration of manufacturing in services but also the increased integration of services into manufacturing (possibly due to diffusion of ICT) is responsible for the decline in manufacturing mentioned before. To sum up, rather than a simple reorganization of the manufacturing subsystem, the OECD7 appears to be less manufacturing-based economy and this actual deindustrialization appears to be accompanied by an actual tertiarization process. Moreover, the role of services has both increased and changed.

III. METHODOLOGY

Leontief model and subsystem analysis

The main purpose of production activities taken by different economic subjects is to satisfy the final demand. Because of high division of labor, these production activities are organized within and across different industries. Firms operate at distinct stages of production. To deliver products and services for final consumers, various intermediate goods must be produced and exchanged through complex linkages among industries in domestic economy and in abroad. An input-output analysis based on Leontief model is a standard economic approach that allows as to capture the link between final demand and production activities in economic systems. The key part of the model is the so-called Leontief inverse matrix that shows the total production of commodity i in order to satisfy the final demand for one unit of commodity j. Formally, the final demand translates to overall production in following way

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{1}$$

where $\mathbf{x}$ is a vector of total production of commodity $i=1 \ldots n$, $\mathbf{y}$ is a final demand vector and $(\mathbf{I} - \mathbf{A})^{-1}$ is a Leontief inverse matrix calculated from identity matrix $\mathbf{I}$ and matrix of domestic flow-based input-output coefficients $\mathbf{A}$. The Leontief matrix plays a key role in a subsystem analysis because it allows as to construct a matrix $\mathbf{B}$ that can be used as an operator to reclassify any variable from a sector base into a subsystem base (Montresor and Vittucci, 2008). We calculate the matrix using the diagonalized vector of gross production $\hat{\mathbf{x}}$ and diagonalized final demand vector $\hat{\mathbf{y}}$

$$\mathbf{B} = \hat{\mathbf{x}}^{-1}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{y}} \tag{2}$$

Matrix $\mathbf{B}$ shows the proportion of the activity of an industry *i* which comes under the subsystem *j*. The sum of each row of $\mathbf{B}$ adds up to 1 by definition[4].

$\mathbf{B}$ can be used to reclassify the data on employment by industries in a vector $\mathbf{l}$ from industrial base into the subsystem base by multiplying the matrix $\mathbf{B}$ by diagonalized vector $\mathbf{l}$.

$$\mathbf{N} = \hat{\mathbf{l}}\mathbf{B} \tag{3}$$

The elements in matrix $\mathbf{N}$ show the amount of labor required directly and indirectly from industry *i* in order to satisfy the final demand for commodity *j*. The sum of rows of $\mathbf{N}$ equals the number of

[4] The sum of rows of matrix $\mathbf{B}$ is given by $\mathbf{Bi}$ where $\mathbf{i}$ is a summation vector. Thus, $\mathbf{Bi} = \hat{\mathbf{x}}^{-1}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{y}}\mathbf{i}$. Because $\mathbf{y} = \hat{\mathbf{y}}\mathbf{i}$ and equation (1) holds, we can write $\mathbf{Bi} = \hat{\mathbf{x}}^{-1}\mathbf{x} = \mathbf{i}$.

workers in each industry. The sum of columns of matrix $\mathbf{N}$ shows the total number of worker from each industry that is necessary to satisfy the final demand for commodity j[5].

By dividing each element in matrix $\mathbf{N}$ by the total of the corresponding column, we can calculate the matrix $\mathbf{C}$ that measures the share accounted for by industry i in total labor required by final demand of subsystem j.

$$\mathbf{C} = \mathbf{N}\hat{\mathbf{n}}^{-1} \tag{4}$$

Where $\mathbf{n} = \mathbf{i}'\mathbf{N}$ is a sum of each column in matrix $\mathbf{N}$. Montresor and Vittucci (2008) show that all previous matrices are invariant to relative prices. In a similar way, we can calculate the amount and share of value added that is required by individual subsystems. We only need to substitute vector of labor requirements $\mathbf{l}$ in equation (3) by a vector of value added by industries.

Subsystems in inter-country models

The analysis performed by Montresor and Vittucci (2008) suffers with several drawbacks due to the data constrains. The analysis relies on hypothetical input-output matrix for seven OECD countries and ignores the international trade with intermediate products. They focus exclusively on outsourcing of industrial activities to service sector and do not analyze the offshoring – the shift of domestic activities abroad – explicitly. The analysis of international trade is very vague and only compares the net balance of trade in goods and services. In this section, we discuss the possibilities for the extension of subsystem analysis to international context.

We start with a global input-output table for country s and region r containing all other countries in the world, and calculate the input coefficient matrix $\mathbf{A}$ as follows

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}_{ss} & \mathbf{A}_{sr} \\ \mathbf{A}_{rs} & \mathbf{A}_{rr} \end{bmatrix}$$

Similarly, final demand block is defined by

$$\mathbf{Y} = \begin{bmatrix} \mathbf{y}_{ss} & \mathbf{y}_{sr} \\ \mathbf{y}_{rs} & \mathbf{y}_{rr} \end{bmatrix} \tag{6}$$

Calculating the sum of final demand in each row of matrix $\mathbf{Y}$ and using the data for employment coefficients in each country (region) and industry, allow us to apply the formula (3) and calculate the matrix $\mathbf{B}$ in a following way

$$\mathbf{B} = \begin{bmatrix} \mathbf{B}_{ss} & \mathbf{B}_{sr} \\ \mathbf{B}_{rs} & \mathbf{B}_{rr} \end{bmatrix} \tag{7}$$

Based on equation (7) we can analyze complex subsystems of final products originated from different countries. In these subsystems, we see the effects on domestic economy (matrices on main diagonal) and in abroad (off-diagonal matrices).

[5] Usually, in input-output analysis we do not reffer to the concept of subsystems explicitly. For example, it is common to analyze the complex linkages in the economy related to employment throurgh the so called matrix of cummulative employment coefficients $\mathbf{R}^l$ that show the total number of workers in industry i in order to satisfy one unit of final demand for commodity j. Formally, $\mathbf{R}^l = \hat{\mathbf{l}}_c(\mathbf{I}-\mathbf{A})^{-1} = \mathbf{l}'\hat{\mathbf{x}}^{-1}(\mathbf{I}-\mathbf{A})^{-1}$, where $\mathbf{l}_c$ is a vector of labor imputs per one unit of prodution in industry j. We can rewrite equation (3) in such a way that we will see the link between matrix $\mathbf{R}^l$ and $\mathbf{N}$ explicitly as follows. $\mathbf{N} = \hat{\mathbf{l}}\mathbf{B} = \hat{\mathbf{l}}\hat{\mathbf{x}}^{-1}(\mathbf{I}-\mathbf{A})^{-1}\hat{\mathbf{y}} = \mathbf{R}_l\hat{\mathbf{y}}$. Thus, the matrix $\mathbf{N}$ is the product of matrix of cummulative employment coefficients multiplied by diagonalized vector of final demand.

The share of employment generated under different subsystems can be calculated in the same way as for the one-country model in equation (4) but the matrix $\mathbf{C}$ now takes the following form

$$\mathbf{C} = \begin{bmatrix} \mathbf{C}_{ss} & \mathbf{C}_{sr} \\ \mathbf{C}_{rs} & \mathbf{C}_{rr} \end{bmatrix} \tag{8}$$

Changes in the matrix $\mathbf{C}$ over time can reveal the drivers of deindustrialization processes in particular countries (regions) across the globe.

Data

The analysis is based on data from World Input-Output Database. The version released in 2013 covers the period from 1995–2011 including the socio-economic accounts with employment data. The new release from 2016 features data up to 2014 in a more detailed structure but socio-economic indicators linked to the data have not been published yet. So far, we can use the new release for the analysis of deindustrialization in terms of value added effects.

IV. EMPIRICAL RESULTS

First, we analyze the deindustrialization trends base on the national input-output tables. Then we focus our attention to the change in the structure of value added generation within particular subsystems between 2000 and 2014 based on world input-output tables.

Subsystem analysis of deindustrialization trends based on national input-output tables

As mentioned before, one of the main drivers of deindustrialization is outsourcing. In this paper it is represented by the share of value added generated by the final demand for manufacturing products in market services. The complete overview of the level of outsourcing and its development throughout the observation period 2000–2014 can be seen in Appendix B. The process of outsourcing is mainly present at the developing countries (G7 – CAN, DEU, FRA, GBR, ITA, JPN, USA)[6] with the average value of 20% and the highest value of 28% in Italy in 2014. The average value for the group of developed countries (a majority of countries belongs to this group) gained the value of about 15%. This implies that the difference between the level of outsourcing in the major developed and developed countries is notable. Furthermore, on average 13% of value added was generated by the final demand for manufacturing products in market services in countries belonging to the developing ones (CHN, IDN, IND, MEX, RUS, TUR, TWN). The lowest share of only 6.7% in 2014 was identified in Luxembourg. Apparently, there is a quite significant difference in the extent of outsourcing among these aggregated groups of countries and there is also a considerable difference in the average rate of change in outsourcing in manufacturing which is further analyzed in this paper.

Figure 1 shows countries organized based on two criteria: share of value added generated by the final demand for manufacturing products in market services in 2000 (the original level of outsourcing), and the average rate of change of outsourcing between 2014 and 2000. The effects of outsourcing on value added are represented by the horizontal axis. The average value accounts for 16%. Figure 1 can be also vertically divided into two parts by the average rate of change equal to one. The countries lying under this value are those where the level of outsourcing decreased during the observation period and vice versa.

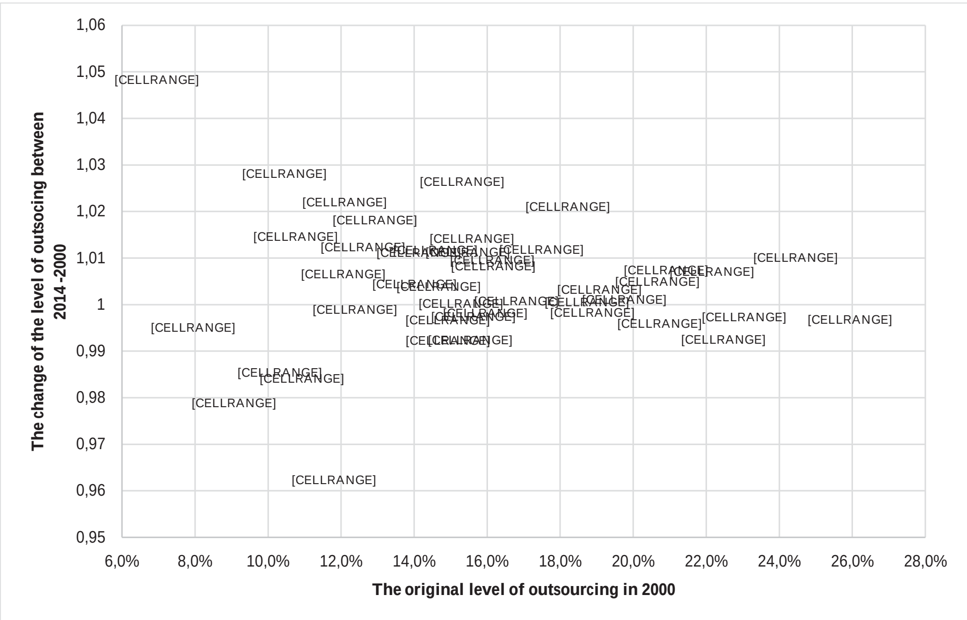
As can be seen, the countries with a lower original level of outsourcing converged to the level of the most developed countries in a higher pace, which is represented by the notional main diagonal. The countries considered to be a frontier in manufacturing, i.e. the major developed ones, are located mostly in the bottom right-hand corner. This means that the level of outsourcing in manufacturing is higher in these countries but it experienced no change or even a decrease in the observation period

[6] For a detailed aggregation of countries into regions see Appendix A.

2000 – 2014. A good example of that are France and Germany, both of which are a part of the major developed world and trend setters in industrial policies. In Germany, 23% of the whole value added generated by the final demand for manufacturing products is generated in the market service sectors in 2000. The share is even higher in France, 26% in particular. However, there has been a decreasing trend in outsourcing in both countries, 0.25% and 0.3% respectively on average. The converging trend in outsourcing is visible in the upper left-hand corner. The countries located in this quadrant belong to those with a lower original level of outsourcing but with a higher average rate of change. The best example of that is the Russian Federation where the share of value added generated by the final demand for manufacturing products in market services accounted for less than 7% in 2000. In 2014, this share almost doubled with the average rate of change of 4.85%. During the last 15 years, another well-known industrialized country, China, experienced the same development.

Looking at the bottom left-hand corner, there are two groups of countries, which can be interpreted separately. The first one consists of Slovakia, Hungary, Slovenia and Lithuania where the rate of change in time is similar to developed countries but the magnitude of outsourcing is much lower. The shift of value added from manufacturing to services is also present in these economies, but more likely across the country's boundaries. A good example is the Slovak automotive industry where many high value added service activities have stayed in the countries of origin (e.g. design, marketing and R&D or financial activities). The second group of countries including Indonesia, Taiwan, Luxembourg, Malta and Ireland is quite different from the rest of the economies in this quadrant. First, in Luxembourg, the manufacturing accounts for less than 10% of the whole value added. This implies that the manufacturing sector in Luxembourg does not play a major role in the country's economy.

Figure 1: The sample organized based on two criteria: the original level of outsourcing on the horizontal axis and change of outsourcing in time on the vertical axis.



Source: Authors' calculations based on NIOT from WIOD.org.

In Malta, there has been a significant decrease of the relative importance of manufacturing during the last 15 years. However, this process has not been caused by domestic outsourcing, since its level decreased quite significantly as well. The development of manufacturing in the rest of the countries in this group, i.e. Indonesia, Taiwan and Ireland, is not clear and a deeper research would be needed.

Deindustrialization processes in the context of internationally fragmented subsystems

The main results from the subsystem analysis are presented in Appendix C. We compare the shares of particular subsystems in 4 major regions of the world economy. The analysis is based on aggregation into three sectors, primary, secondary and tertiary.

In Table 1 focus on the subsystems of secondary sector in these four regions. These subsystems correspond to the shares of value added creation in different sectors in various regions that come under the final use of manufacturing products originated in these regions.

Table 1: The difference between matrices C in 2014 and 2000 for 3 sectors and 4 regions in the world economy, in p. p. (chosen sectors and aggregation) *

<table>
<tr><th colspan="2" rowspan="2"></th><th>G7</th><th>Developed</th><th>Developing</th><th>RoW</th><th></th></tr>
<tr><th>Secondary</th><th>Secondary</th><th>Secondary</th><th>Secondary</th><th>TOTAL</th></tr>
<tr><td rowspan="3">G7</td><td>Primary</td><td>0,48</td><td rowspan="3">-2,10</td><td rowspan="6">-5,34</td><td rowspan="6">-5,70</td><td>-5,08</td></tr>
<tr><td>Secondary</td><td>-6,85</td><td>-23,37</td></tr>
<tr><td>Tertiary</td><td>-0,32</td><td>-5,65</td></tr>
<tr><td rowspan="3">Developed</td><td>Primary</td><td rowspan="9">6,70</td><td>-0,68</td><td>0,36</td></tr>
<tr><td>Secondary</td><td>-3,93</td><td>-6,76</td></tr>
<tr><td>Tertiary</td><td>0,50</td><td>5,25</td></tr>
<tr><td rowspan="3">Developing</td><td>Primary</td><td rowspan="6">6,22</td><td>3,53</td><td rowspan="3">4,83</td><td>4,69</td></tr>
<tr><td>Secondary</td><td>-2,71</td><td>8,50</td></tr>
<tr><td>Tertiary</td><td>3,35</td><td>12,38</td></tr>
<tr><td rowspan="3">RoW</td><td>Primary</td><td rowspan="3">1,16</td><td>7,59</td><td>15,99</td></tr>
<tr><td>Secondary</td><td>-6,49</td><td>-5,58</td></tr>
<tr><td>Tertiary</td><td>-0,23</td><td>-0,72</td></tr>
</table>

** Note: The sum of rows in last column (Total) corresponds to total some over all sectors, not only secondary sector.*
Source: Authors' calculations based on WIOT from WIOD.org.

The sum of columns in matrix **C** (8) equals to 1. Thus, the sum of the percentage changes in these matrices over time must be 0. This holds in Table 1 as well, where we present the results for secondary sector subsystems. The last column in Table 1 clearly indicates the shift of value added creation that goes under the final use of manufacturing products from G7 and Developed countries to Developing countries. The fastest decline is recorded in manufacturing production in G7 countries (–23,37 p.p.). Final use of manufacturing products originated in G7 and Developed countries generated lower shares of value added within domestic manufacturing sector. This decline was only partially compensated by an increase in value added creation in tertiary sector in Developed countries. The value-added creation was offshored from G7 countries to the rest of the world. Similarly, there was a clear offshoring trend in Developed countries that offshored the production activities to Developing countries and to RoW. The decrease of manufacturing activities within the subsystem in Developing countries was more than compensated by an increase in domestic activities in Primary and Tertiary sector.

V. CONCLUSION

Deindustrialization as a new phenomenon is present more significantly in the major developed countries when compared to developing economies. However, the fact that deindustrialization is an issue also for developing countries creates the hypothesis of premature deindustrialization. Moreover, outsourcing as one of the main drivers of deindustrialization, based on the findings of the paper, plays a major role mostly in developing countries. It is well documented on the example of China where one third of the whole value added is generated directly by manufacturing. However, even such a newly industrialized country faces a decrease in the relative importance of manufacturing. The change in the share of value added generated by the final demand for manufacturing products in market services has increased notably during the last 15 years. Such a conclusion suggests that the emerging industry is connecting with market services in a much faster pace.

Moreover, there is a higher level of outsourcing in the major developed economies, but its average rate of change in time is constant or even slightly decreasing. This means that deindustrialization in the most developed economies cannot be very well described by outsourcing. There are other factors like offshoring, re-shoring or a rapid growth of productivity in manufacturing which can influence the development of manufacturing in these countries.

The effects of offshoring where documented in the analysis based on internationally fragmented subsystems. There is a clear shift of value added activities that come from manufacturing subsystems from G7 and Developed countries to the rest of the world. There are no significant signs of re-shoring when we compare the manufacturing subsystems in 2000 and 2014.

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Appendix

Appendix A – The aggregation of countries into three regions

Major developed countries – G7

CAN, DEU, FRA, GBR, ITA, JPN, USA

Developed countries

AUS, AUT, BEL, BGR, BRA, CHE, CYP, CZE, DNK, ESP, EST, FIN, GRC, HRV, HUN, IRL, KOR, LTU, LUX, LVA, MLT, NLD, NOR, POL, PRT, ROU, SVK, SVN, SWE

Developing countries

CHN, IDN, IND, MEX, RUS, TUR, TWN

Appendix B – The share of value added generated by the final demand for manufacturing products in market services (in %) by countries and years

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AUS	22.1	21.8	22.5	22.7	22.5	21.7	22.7	22.6	22.3	23.6	22.9	23.4	23.6	23.7	24.5
AUT	14.6	14.7	15.7	15.7	16.0	16.2	16.3	16.6	17.6	16.8	16.9	17.0	16.7	17.1	17.2
BEL	20.7	20.8	19.9	19.9	20.1	20.0	21.3	21.2	21.5	21.6	21.2	23.1	22.4	22.5	22.2
BGR	15.6	16.1	16.8	16.2	17.2	17.0	17.1	19.1	18.0	18.6	20.9	19.5	19.1	19.3	19.0
BRA	20.9	21.8	21.6	20.8	19.2	21.8	22.6	22.2	21.9	20.8	21.1	20.9	21.9	22.3	23.2
CAN	18.7	19.9	19.8	19.5	19.3	19.5	19.7	20.0	20.4	19.0	18.4	18.4	18.4	18.5	18.9
CHE	12.4	11.3	11.6	11.7	11.7	11.3	11.0	11.2	11.1	12.0	11.9	11.8	11.9	12.0	12.2
CHN	12.9	13.3	13.5	13.2	13.3	14.0	14.3	14.7	14.2	15.1	14.6	14.3	15.0	15.8	16.7
CYP	12.6	13.3	12.8	12.1	11.0	11.5	13.1	12.7	13.0	14.1	13.0	13.9	13.4	14.1	15.0
CZE	10.8	11.2	12.7	13.9	13.8	13.8	13.7	14.3	14.6	14.6	14.5	14.1	13.6	13.9	13.2
DEU	23.0	23.4	23.8	23.8	23.6	24.0	23.9	24.4	24.8	24.0	22.4	22.3	22.0	22.3	22.2
DNK	14.0	14.7	14.7	14.9	15.1	16.0	14.9	15.0	16.1	17.9	16.1	15.8	14.8	14.8	14.9
ESP	15.3	16.1	16.5	16.8	17.2	17.5	18.0	18.8	19.2	20.5	21.2	21.5	22.0	21.8	22.1
EST	18.9	18.7	18.5	17.7	18.0	17.5	17.2	16.6	17.5	18.6	18.6	18.5	18.0	18.5	18.5
FIN	19.1	18.9	18.8	18.5	18.7	19.0	18.6	18.2	18.7	20.1	18.7	19.5	20.9	19.7	20.0
FRA	25.9	26.5	26.4	26.4	26.9	27.6	28.8	29.0	29.6	26.1	25.6	25.3	24.8	24.7	24.8
GBR	16.1	16.7	17.4	17.6	17.9	17.6	18.0	18.6	18.1	18.8	18.3	18.4	18.4	18.1	18.5
GRC	18.2	17.9	18.6	18.1	19.2	22.2	23.1	22.2	21.8	24.5	26.1	24.8	25.7	24.6	24.6
HRV	12.1	11.8	11.2	11.9	12.6	13.6	14.6	15.3	15.2	16.0	16.3	16.9	16.7	16.6	16.4
HUN	14.9	15.1	16.4	16.6	16.9	18.1	17.7	17.9	18.7	17.6	16.7	16.1	15.4	14.7	14.3
IDN	7.9%	8.7%	9.5%	11.0	10.4	10.3	9.7%	8.2%	7.4%	7.2%	6.8%	6.5%	6.7%	7.0%	7.4%
IND	15.5	16.5	17.0	18.2	18.4	17.8	16.9	16.2	16.5	17.7	16.6	17.1	16.8	17.2	18.1
IRL	10.9	9.3%	8.1%	8.9%	9.8%	12.4	12.4	13.3	13.3	12.7	11.6	8.2%	7.6%	8.9%	8.8%
ITA	24.4	25.0	25.5	26.4	26.5	27.0	27.0	27.4	28.1	27.9	27.1	27.2	28.1	28.3	28.2
JPN	16.8	18.1	17.8	17.4	17.0	16.6	17.2	17.7	18.4	19.1	17.8	18.0	17.5	17.1	17.0
KOR	15.3	16.2	17.2	17.9	17.4	17.6	16.8	16.3	16.6	16.7	15.9	15.9	15.6	15.3	15.4
LTU	15.5	14.5	14.1	13.4	12.9	13.2	13.5	14.4	15.2	16.4	15.6	14.9	13.7	14.4	14.0
LUX	9.1%	9.3%	9.8%	8.3%	8.8%	8.6%	8.7%	6.9%	7.4%	10.8	9.7%	9.6%	7.2%	6.7%	6.7%
LVA	16.2	16.0	16.7	19.0	17.8	18.3	17.5	16.9	17.4	16.8	16.2	17.5	18.0	18.3	18.2
MEX	12.1	12.2	12.9	13.6	12.9	13.6	12.9	13.2	13.1	14.2	13.4	12.7	12.6	13.3	13.2
MLT	10.3	11.3	9.9%	9.3%	10.6	9.6%	8.5%	8.3%	6.0%	6.6%	6.5%	6.2%	6.8%	7.5%	8.4%
NLD	20.7	20.2	18.9	19.2	20.5	20.8	20.9	21.7	21.5	20.9	20.7	20.8	21.3	20.3	19.6
NOR	15.9	16.4	16.4	16.2	16.3	16.3	16.1	17.3	17.0	17.4	16.0	15.6	15.3	15.8	15.6
POL	14.7	15.7	16.0	16.1	15.2	15.8	15.6	15.9	15.9	15.0	15.4	15.5	15.9	15.2	15.5
PRT	14.1	14.2	14.2	15.0	15.3	15.7	16.2	17.0	17.7	17.0	17.1	17.7	17.8	17.0	16.5
ROU	10.4	9.0%	9.5%	9.1%	9.2%	9.6%	9.9%	11.0	10.2	11.5	12.1	12.2	13.8	16.0	15.4
RUS	7.0%	8.6%	9.1%	10.6	10.2	10.0	10.1	11.2	10.7	12.0	12.3	11.2	11.5	12.2	13.5
SVK	14.9	14.3	16.0	16.0	14.2	13.5	12.6	13.8	13.9	16.4	15.8	13.7	14.2	14.3	13.4
SVN	15.6	15.4	15.5	15.6	15.7	15.6	16.2	16.0	16.0	16.4	17.2	16.8	15.8	15.3	15.1
SWE	22.5	23.0	22.6	22.2	22.2	22.9	22.7	22.7	23.5	21.8	19.0	19.9	20.4	20.4	20.3
TUR	17.5	20.2	18.1	16.9	16.6	16.2	17.0	17.6	18.9	20.3	19.1	18.8	20.3	20.0	20.7
TWN	11.8	12.2	10.9	10.5	10.2	10.3	10.7	10.2	10.1	8.6%	8.0%	7.9%	8.0%	7.3%	6.9%
USA	19.8	21.4	21.5	20.4	19.4	20.2	19.4	19.3	18.8	18.5	18.6	18.4	19.4	19.4	20.1

Source: Authors' calculations based on NIOT from WIOD.org.

Appendix C – The difference between matrices C in 2014 and 2000 for 3 sectors and 4 regions in the world economy, in p. p.

		G7			Developed			Developing			RoW			
		Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	TOTAL
G7	Primary	-1,12	0,48	-0,23	-0,15	-0,08	-0,09	-0,17	-0,74	-0,13	-0,94	-1,46	-0,45	**-5,08**
	Secondary	-2,80	-6,85	-1,05	-0,93	-1,55	-0,44	-0,93	-3,50	-0,69	-1,17	-2,68	-0,77	**-23,37**
	Tertiary	1,20	-0,32	-0,20	-0,24	-0,47	-0,13	-0,47	-1,41	-0,50	-1,11	-1,66	-0,32	**-5,65**
Developed	Primary	0,34	0,82	0,12	-1,30	-0,68	-0,58	0,42	0,44	0,16	0,16	0,32	0,13	**0,36**
	Secondary	0,15	0,50	0,10	-2,00	-3,93	-0,94	0,01	-0,19	-0,02	-0,06	-0,35	-0,03	**-6,76**
	Tertiary	0,39	0,78	0,23	1,79	0,50	0,68	0,12	0,05	-0,02	0,08	0,13	0,51	**5,25**
Developing	Primary	0,41	1,08	0,23	0,53	1,18	0,26	-8,58	3,53	1,42	1,42	2,28	0,93	**4,69**
	Secondary	0,44	1,16	0,28	0,61	1,51	0,29	3,60	-2,71	0,20	1,12	1,40	0,60	**8,50**
	Tertiary	0,25	0,59	0,15	0,38	0,78	0,20	4,51	3,35	-0,45	0,80	1,15	0,68	**12,38**
RoW	Primary	0,54	1,31	0,24	0,85	1,85	0,40	1,34	1,36	0,30	-1,40	7,59	1,60	**15,99**
	Secondary	0,08	0,18	0,05	0,14	0,38	0,07	0,13	-0,16	-0,07	0,18	-6,49	-0,06	**-5,58**
	Tertiary	0,14	0,26	0,11	0,31	0,52	0,27	0,02	-0,04	-0,21	0,93	-0,23	-2,81	**-0,72**

Source: Authors' calculations based on WIOT from WIOD.org.