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## Article

### Brexit : the Visegrad countries' perspective

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## Brexit – the Visegrad Countries' Perspective<sup>1</sup>

Gabriela DOVÁLOVÁ\* – Boris HOŠOFF\* – Erika MAJZLÍKOVÁ\*\*

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### Abstract

*The article deals with the possible implications of Brexit for the V4 countries from the perspective of foreign trade and labour market. Analysing Brexit from the perspective of the V4 countries is essential due to the importance of the UK as the Visegrad countries trade partner. By analysing direct and indirect effects on value added and employment generated by exports to the UK using the multi-regional input-output model, we were able to identify the exposure to Brexit in the V4 countries in terms of value added and employment. Results suggest that the V4 countries belong to the group of countries with a medium risk, particularly in mechanical engineering, automotive industry and electrical engineering. The importance of the UK as a trade partner for the V4 countries has been rising steadily throughout the years and therefore it is important to keep these economic relations as close as possible.*

**Keywords:** *Brexit, input-output analysis, labour market, value added, foreign trade*

**JEL Classification:** C67, F13, F14, F16

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### Introduction

The shape of the future arrangement of bilateral relations between the United Kingdom and the European Union will also depend on the ability of both partners to find a general agreement throughout the process of negotiations on the withdrawal of UK from the EU. The uncertainty concerning the possible consequences of the UK's withdrawal persists since both partners have agreed to

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postpone Brexit by 31 October 2019. In Slovakia, only a relatively small number of analytical studies deals with the economic impact of Brexit. According to the analytic commentary of the Institute of Financial Policy at the Ministry of Finance of the Slovak Republic (Melioris et al., 2016) a cumulative GDP loss in Slovakia is expected at 0.1 to 0.9% by 2019, depending on the scenario. Thus, in four years, the number of created jobs should be lower by around 7 thousand. However, Brexit should decrease the growth of the Slovak economy only to a relatively small extent. National Bank of Slovakia (2016) reported that Brexit could slow down the growth of the Slovak economy by around 0.3% by 2020, which would lead to a decreased job creation by roughly 5,300 jobs. The regional dimension of the UK's withdrawal from the EU and the possible disruption of the trade flows puts at the forefront of our interest not only Slovakia, but also other neighboring countries and important trading partners from the V4 group.

The main purpose of this paper is to draw attention to the possible implications of Brexit for the V4 countries from the perspective of foreign trade and labour market. The research question is whether the V4 countries belong to the group of countries with high (more than 5%), medium (between 2 and 5%) or low (less than 2%) impact and what specific industries would be affected the most. Using the data from the World Input-Output Database (WIOD), containing the world input-output tables and socio-economic accounts, we employ the multi-regional input-output model (MRIO model) in the analysis of the UK's importance as the V4's export partner from the perspective of value added and employment generated directly and indirectly by exports to the UK. More in-depth research in the field of foreign trade together with the analysis of value added and employment in the context of exports to the UK allow us to better document the similarities and differences for the V4 countries in selected areas and to identify the potential post-Brexit policy challenges.

The main results suggest that the Visegrad countries belong to the group of countries with a medium risk. In general, most of the employment interlinked with exports to the UK was created in services, with the exception of the Czech Republic, where the manufacturing sector was more dominant. In Hungary and Poland, a relatively high employment exposure developed in agriculture, while highest share of domestic value added and employment generated by exports to the UK among the V4 economies occurred in Slovakia.

The paper is structured as follows: first, we provide a literature review dealing with Brexit mainly from regional point of view with the main focus on the V4 countries. The methodology of the multi-regional input-output model (MRIO model) can be found in Section 2. Section 3 is focused on foreign trade between the V4 countries and the UK; it includes a more detailed analysis of foreign trade

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with an aim to identify the importance of the United Kingdom as V4 countries' trade partner. The areas for future possible post-Brexit coordination and cooperation among the V4 countries are considered in Section 4. Lastly, the final part investigates the findings in the area of the possible implications of Brexit for the V4 countries from the perspective of foreign trade and labour market and some recommendations for economic policy are discussed.

## 1. Review of Literature

The World Input-Output Database (WIOD) provides time series of world input-output tables merged with national accounts data and international trade statistics. It has been used to describe trends in global value chain trade analysing the domestic value-added content of gross exports for example by Wang et al. (2013) or Johnson (2014). Most of the economic studies on Brexit refer to implications for the whole EU-27. A majority of the existing scientific analysis showed that disruption of trade links between EU-27 and UK will impose economic costs on both sides with highlighting the higher negative impact for UK economy (e.g. Emerson et al., 2017). Although such studies are beneficial and important, they do reflect economic reality only partially, without capturing the interdependence of individual EU Member States on the regional level. Thus, the impact of the UK withdrawal can be regionally very different and spill over from one country to another.

Only a small number of scientific studies offer a disaggregated view on the impact of Brexit on individual member states or group of countries. Important study was conducted for the European Committee of the Regions in this regard (Levarlet et al., 2018). It assesses Brexit from the perspective of the most exposed countries and regions, by addressing their respective sectoral characteristics. Based on the exposure index calculations, the authors were able to identify economic sectors in particular countries and regions that could be most affected. They focused on six key economic sectors: transport vehicles; machinery; electronics; textile and furniture; vegetable, foodstuff; wood and chemicals and plastics. The results revealed the potentially asymmetric impact of Brexit on particular countries.

Another interesting study covering regional impacts of the UK withdrawal focusing on Central and Eastern Europe was done by Turner et al. (2018). In their article the authors analysed the Brexit impact through three channels: the disruption the trade; free movement of people and remittances from the UK and the loss of the UK's contribution to the EU budget. However, this study covered only 11 Central European states, not including Slovakia.

Even less attention of scientists is devoted to the impact of Brexit on the V4 countries. The study done by Szent-Iványi et al. (2018) can serve as a good example. This report examines V4 countries interests towards three aspects of Brexit and post-Brexit Europe: interests towards the EU-UK deal itself; interests related to Brexit induced changes in the UK; and interests manifested on the EU level. All three aspects are analysed from the economic, security and institutional point of view. Authors used data from qualitative interviews carried out in all four Visegrad countries. Interviewees have included senior civil servants, mainly in the Ministries of Foreign Affairs of the four countries, but also economic and political experts. One of main conclusions was that the V4 countries would like to see Britain remain a part of the single market, and if that is not possible, they would prefer a comprehensive free trade deal. It is necessary to mention a paper “Brexit Scenarios and the Economic Implications for Visegrad Four” (Nice, 2019) which is also examining effects of Brexit on the Visegrad Group. The author outlines the current state of withdrawal negotiations, the positions of particular parties as well as potential future scenarios in terms of export and trade, the EU budget, and migration. The impacts on the V4 countries are examined in terms of four channels: trade and exports; migration and remittances; the EU budget; and foreign direct investment. According to this study, only modest economic losses, and limited impact of changes to UK migration policy and contribution to the EU budget for the V4 countries can be expected from Brexit.

Recently, Dhingra et al. (2017) estimated the economic effects of Brexit using the standard quantitative general equilibrium trade model, focusing on the consequences of changes in trade and fiscal transfers between the UK and the EU. Authors estimate the effects of Brexit on welfare and find that UK experiences largest welfare losses, followed by two types of countries. First, countries for which the UK is an important trade partner (Ireland, Netherlands, Belgium, Denmark, Sweden, Germany) and countries that trade more with the UK in sectors with relatively low trade elasticity (Hungary, Czech Republic, Slovakia) and cannot easily substitute towards goods from other countries if trade costs rise. The paper by Chen et al. (2017) uses data from WIOD and combines them with regional data to estimate the degree to which EU regions and countries are exposed to negative trade-related consequences of Brexit. Results demonstrate that regions in the UK and Ireland are far more exposed than regions in other EU countries, while the next most affected regions are in Germany, the Netherlands, Belgium and France. Authors use global input-output tables to link trade to value added and estimate potential impact of Brexit on labour income and local GDP. Using similar methodology, our aim was to enrich these results and knowledge with possible consequences of Brexit on employment levels in selected industries, particularly in V4 countries.

However, as we have noted, some studies dealing with impact of Brexit on V4 countries already exist, but a comprehensive study on direct and indirect effects of the trade flows on sectoral employment combined with direct and indirect effects on value added in V4 countries using regional input-output model is still missing. Therefore, the motivation for this paper was to enrich the discussion by focusing on this particular issue.

## 2. Methodology

Our analysis is based on the World Input-Output Database (WIOD) specifically developed for the global input-output analysis. We used the 2016 release containing annual world input-output tables for 43 countries (28 EU countries and 15 other major economies) and the rest of the world (RoW) for the period 2000 to 2014. Data are available for 56 industries and products which are structured according to the recent industry and product classification ISIC Rev. 4 or equivalently NACE Rev. 2. All data are expressed in current prices and together cover the overall economy. The whole database together with data on employment, which are part of the Socio-economic Accounts, is freely available at [www.wiod.org](http://www.wiod.org).<sup>2</sup>

The advantage of using this database is its ability to capture the complex flows of intermediates and final products among countries in a detailed division by industry for the period of 15 years. In particular, for analyses of the relations between Visegrad countries and the UK from the perspective of employment and value added, we used the multi-regional input-output model (MRIO model). By capturing complex linkages among industries and countries, which arise from the use of intermediates in individual industries and from the international trade with intermediates, we can get also the indirect effects resulting from the international trade. This is considered a big advantage when compared to other macro-economic models.

The MRIO model is an extended version of an open static input-output model for one economy. While in the case of aggregate models, we examine the total production in an economy in the form of one product, the Leontief model is based on the assumption that the output of the production process includes different goods and services intended either for further processing or for final use. A detailed description of the model can be found e.g. in the monograph by Miller and Blair (2009) or Dietzenbacher et al. (2013). In this paper, we use the version of international input-output tables composed using the so-called model D for industry x industry. Before introducing the methodology in more detail, we would like to point out that our aim is not to calculate possible reduction in trade

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<sup>2</sup> Details about how the database is created are described e.g. in Timmer (2012), Dietzenbacher et al. (2013) or Timmer et al. (2015). The details about the newest 2016 release are presented in Timmer et al. (2016).

flows due to Brexit (or other scenarios) but rather to focus on the existing exposure. Moreover, we predominantly focus on the main trade channels, i.e. the effects generated by the final use in the UK. Results for additional, rather minor effects, can be found in the Technical Appendix.

The international input-output tables are composed of three basic sections – the intermediate consumption matrix ( $\mathbf{Z}$ ), the value added vector ( $\mathbf{p}$ ) and the matrix of final use ( $\mathbf{Y}$ ). Moreover, we will also work with the vector of total production  $\mathbf{x}$  and the employment vector  $\mathbf{e}$ . Matrix  $\mathbf{Z}$  captures the flows of intermediates among individual industries  $i$  and countries  $p$ . It can be expressed as  $\mathbf{Z} = \{z_{ij}^{pu}\}$ . The individual elements in matrix  $\mathbf{Z}$  indicate the production of industry  $i$  from the country of origin  $p$  intended for intermediate consumption in industry  $j$  in the target country  $u$ . Similarly, matrix  $\mathbf{Y}$  includes information about where the final products produced by industries in individual countries are used. This matrix also includes e.g. the exports of cars from Visegrad countries for the final use in the UK. The total production vector  $\mathbf{x} = \{x_i^p\}$  includes information about the production of industry  $i$  in country  $p$ . When deducing the MRIO model, we start from the input coefficients matrix  $\mathbf{A}$  which is calculated as  $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-1}$ . The elements of this matrix indicate the production of industry  $i$  in country  $p$  necessary for the production of one unit of production in industry  $j$  in country  $u$ . Moreover, the model assumes that the input coefficients are fixed, so the demand for input  $i$  changes proportionally with the output of sector  $j$ . In other words, Leontief production functions require inputs in fixed proportions, i.e. a fixed amount of each input is required to produce one unit of output and similar inputs originating in different countries also have this fixed proportion quality. Using vectors  $\mathbf{x}$  and  $\mathbf{y}$  and matrix  $\mathbf{A}$ , it is possible to construct a system of balance equations and deduce the Leontief model, in this case for several regions

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

where matrix  $\mathbf{L}$  is the basis of the model and includes complex linkages among industries and countries. The extension of the model by value added and employment vectors allows us to analyse the effects of final demand and its changes on these variables. The row vector  $\mathbf{p}'$  includes data from the MRIO model about value added created in industry  $i$  in country  $p$ . By dividing the individual elements of vector  $\mathbf{p}'$  by the respective production of an industry, we get the so-called direct value added coefficients  $\mathbf{p}_c = \mathbf{p}'\hat{\mathbf{x}}^{-1}$ . The main thing needed to link final use with the generated value added is the Leontief inverse matrix constructed for several countries. Then we get the cumulative value-added coefficients matrix, also known as the *matrix of global value chains*, formally written as:

$$\mathbf{G} = \hat{\mathbf{p}}_c \mathbf{L} \quad (2)$$

The typical elements of this matrix indicate value added in industry  $i$  and region  $r$  generated directly and indirectly by one unit of final use of the production of industry  $j$  in country  $u$ . By analysing multiple industries and regions, a dimension of such matrix grows quite significantly, since it is given by the product of the number of industries and countries, in our case 2464 x 2464. By multiplying matrix  $\mathbf{G}$  by the final demand vector, we calculate its effects on value added generated in individual countries and in corresponding industries. When examining the effects on V4 economies, it is necessary to select the relevant elements of this matrix indicating the value added created in individual industries of the economy. By analogy, we calculate the effects on employment generated by the final use of products in the UK, as well. We can express it as follows,

$$\begin{aligned} \mathbf{p}^{\text{gen}} &= \hat{\mathbf{p}}_c \mathbf{L} \mathbf{y}^{\text{ex}} \\ \mathbf{e}^{\text{gen}} &= \hat{\mathbf{e}}_c \mathbf{L} \mathbf{y}^{\text{ex}} \end{aligned} \quad (3)$$

where  $\mathbf{p}^{\text{gen}}$  captures the effects on value added and  $\mathbf{e}^{\text{gen}}$  the effects on employment. Besides, it is possible to calculate the overall value added and employment in individual countries generated by the final use of intermediates from these countries in the UK and get a more complex picture of the international trade. Moreover, using the hypothetical extraction method inspired by Los, Timmer and Vries in AER (2016),<sup>3</sup> we were able to also capture the effects in V4 generated by the use of inputs from a V4 country by British producers to produce intermediate exports which end up used as inputs in another country (e.g. Germany).<sup>4</sup> Even though these effects are only minor, they help to create a more precise description of trade flows among the V4 and the UK. We present them separately in the Technical Appendix.

### 3. Results and Discussion

#### 3.1. Foreign Trade between the V4 Countries and the UK

It is evident, that Brexit will have consequences for the V4 countries through three main channels: trade with goods and services, labour and capital. In general, much more attention is paid to the future of trade in goods after Brexit than to the post-Brexit trade in services. International trade with goods between the

<sup>3</sup> Published as a comment on Koopman, Wang and Wei (2014) providing an alternative approach for tracing value added and double counting in gross exports.

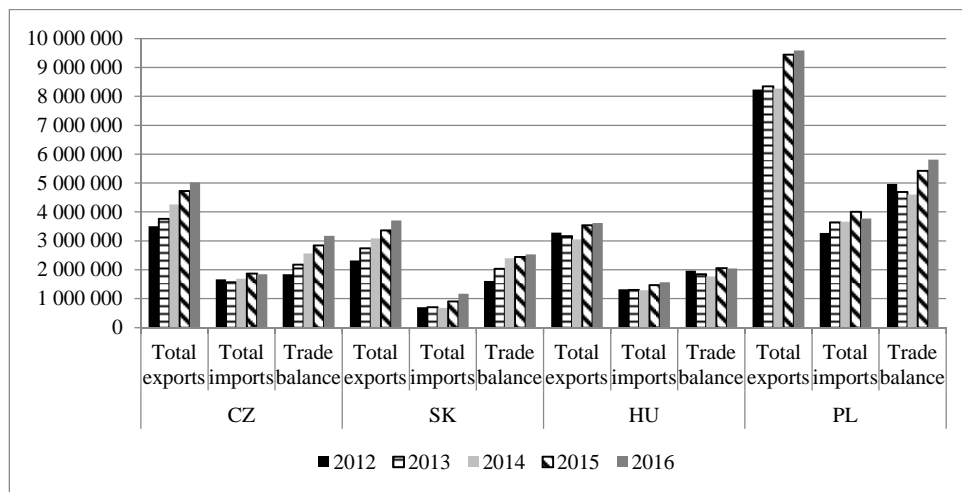
<sup>4</sup> For further details see Technical Appendix.



Visegrad countries and the UK (i.e. the sum of exports and imports) amounted to roughly EUR 30.3 billion in 2016 (Figure 1). By way of comparison, the foreign trade turnover of the V4 countries and the UK reached EUR 24.3 billion in 2012, thus it significantly increased in the last five years. As can be seen in Figure 1, during the last five years, all V4 countries maintained a balance of trade surplus with the UK. The annual balance of trade surplus with the UK amounted to roughly EUR 13.5 billion in 2016, while the balance of trade with the UK has been continually increasing since 2012.

Figure 1

**V4 Countries' Total Balance of Trade for Goods with the UK, in EUR Thousand**  
(Composed using data from Eurostat)



Source: Authors, based on data from Eurostat.

From the perspective of foreign trade, V4 countries are much more dependent on exports to the UK compared to imports from the UK (Table 1). In 2016, the United Kingdom with its 6.6% share ranked second in the importance of the Poland's export partners (after Germany). This makes Poland in comparison with other Visegrad countries much more vulnerable to any restrictions on access to the British market. The UK is the fourth largest export market for the Czech Republic (after Germany, Slovakia and Poland), accounting for 5.2% of total exports. According to the OECD data, around 5.9% of Slovakia's exports were delivered to the UK, which is its fifth largest export partner (after Germany, the Czech Republic, Poland and France). Hungarian exports to the UK increased very slightly during the last ten years, accounting for 3.9% of its total exports in 2016. It is important to emphasize that for all V4 countries, Germany represents the most important trade partner. Looking at the statistics, 21% to

33% of all exports of the Visegrad countries are transported to the German market, i.e. that the UK's withdrawal from the EU can have also significant indirect impact on the V4 countries.

Table 1

**Importance of the UK as Trade Partner for the V4 Countries, 2016**

	UK's share in total exports (%)	UK's importance as export partner (place)	UK's share in total import (%)	UK's importance as import partner (ranking)
CZ	5.2	4	2.7	8
HU	3.9	9	1.9	14
PL	6.6	2	2.6	10
SK	5.9	5	1.8	12

Source: Authors, based on data from the OECD and Syent-Iványi et al. (2018).

Table 2 shows four commodities that were predominantly exported from the V4 countries to the UK.

Table 2

**Top Products Exported to the UK (in EUR thousand), 2017**

Code	Product	Exports to the UK (value)	Exports to the UK (% of total exports to the UK)	Total exports to world (value)	Exports to the UK (% of total exports to world)
<i>Czech Republic</i>					
87	Vehicles other than railway....	2 469 503	30.9	33 834 134	7.3
84	Machinery, mechanical appliances...	1 706 012	21.4	30 385 999	5.6
85	Electrical machinery and equipment...	1 494 096	18.7	28 308 202	5.3
95	Toys, games and sports requisites...	204 152	2.6	2 896 706	7.0
	All products	7 990 086		161 309 678	5.0
<i>Slovak Republic</i>					
87	Vehicles other than railway...	1 749 448	39.1	19 751 659	8.9
85	Electrical machinery and equipment...	782 855	17.5	15 570 017	5.0
27	Mineral fuels, mineral oils...	1 012 765	22.6	3 315 130	30.5
84	Machinery, mechanical appliances,...	267 084	6.0	9 110 677	2.9
	All products	4 475 480		74 699 177	6.0
<i>Hungary</i>					
84	Machinery, mechanical appliances...	769 218	22.0	18 680 605	4.1
85	Electrical machinery and equipment...	851 621	24.3	21 067 836	4.0
87	Vehicles other than railway....	467 723	13.4	14 912 286	3.1
90	Optical, photographic, cinematographic,...	217 447	6.2	3719904	5.8
	All products	3 500 551		100 715 716	3.5
<i>Poland</i>					
84	Machinery, mechanical appliances...	1 951 648	14.6	27 047 550	7.2
87	Vehicles other than railway...	1 720 404	12.9	24 355 866	7.1
85	Electrical machinery and equipment...	1 572 753	11.8	22 422 573	7.0
94	Furniture; bedding, mattresses, mattress supports...	832 704	6.2	12 257 790	6.8
	All products	13 333 136		207 309 445	6.4

Source: Authors, based on data from Comtrade statistics.

As shown in the table below, close to 31% of the Czech Republic's and 40% of Slovakia's total exports to the UK involved "Vehicles other than railway or tramway rolling stock, and parts and accessories thereof" (category 34 according to ISIC Rev. 4). This means that exports of these two countries to the UK are dominated by automotive industry. In the mechanical engineering and electrical engineering sector, the main products exported to the UK are "Machinery, mechanical appliances, nuclear reactors, boilers..." (categories C28 and C29 according to ISIC Rev. 4) and "Electrical machinery and equipment..." (category C27 according to ISIC Rev. 4) in both countries. The Czech Republic is the EU's largest exporter of toys which is also reflected in export to the UK. Major contribution to the export volume is due to Lego Group which accounts for two-thirds of the total "Czech made" production (CzechTrade, 2019). For the Slovak Republic, exporting "Mineral fuels, oils and distillation products" (category C23 according to ISIC Rev. 4) to the UK is also significant. In 2017, exported products of this category to the UK were worth more than EUR 1 billion. In Poland and Hungary, the category C28 and C29 "Machinery, mechanical appliances, nuclear reactors, boilers..." dominated in overall exports to the UK. Poland belongs to the EU leaders in the production and also in the exports of furniture. More than 80% of the total production is exported to the EU market, mostly to Germany and the United Kingdom (6.8%).

In 2017, the Visegrad countries with more than 63 million customers became the UK's tenth largest export market and the share of exports going to the V4 countries reached 2.6% in the UK's total exports. Table 3 presented below suggests that the UK imports from the Visegrad group is more significant than its exports. Poland is becoming a more and more important trade partner for the UK mainly from the imports point of view, coming in eleventh place by import share at 2.1% (moving up from 25th place in 2005). The Czech Republic has a relatively modest share of the UK's trade, only 0.1% of total exports and 1.1% of total imports. Slovakia's share in the UK exports represented 0.6% in 2017, while only 0.1% of the UK's total imports originated from the Slovak republic. In recent years, the direct foreign trade between the UK and Hungary has been quite moderate. In the UK's export and import, Hungary ranked 32nd and 29th, respectively, with a share of 1.5% and 0.1%.

Trade in services is different than trade in goods mainly because services are not restricted by tariff barriers and border checks. In 2017, services represented 45% of the total UK exports with the EU as the main trading partner, which received 40% of British service exports (Lowe, 2018). Trade in services between the V4 countries and the UK tends to be economically less significant than the trade in goods. Unlike most EU countries, the V4 countries ran a total trade surplus in

services, which is lower than the surplus in goods (e.g. for Slovakia it is 46 times lower). Services exports to the UK accounts for 30%, 18%, 14% and 7% of the total Hungarian, Polish, Czech and Slovak exports to the UK. Services are more important on the import side, as services imports from the UK represented around 39%, 36%, 21% and 20% of total imports of the V4 countries from this country in 2017, respectively. The way in which the services trade between the V4 countries and the UK will be affected in the future depends on the form of Brexit. The services trade is much more important for the UK economy; therefore, increasing regulatory costs of trading services may have a significant effect on the UK services exports in the future as well as on the UK's surplus in services trade with the EU.

Table 3

**Importance of the V4 Countries as a Trade Partner for the UK, 2017**

	V4's share in total exports (%)	V4's importance as export partner (place)	V4's share in total import (%)	V4's importance as import partner (ranking)
CZ	0.1	26	1.1	19
HU	1.5	32	0.1	29
PL	0.4	18	2.1	11
SK	0.6	47	0.1	31
V4	2.6	10	4.5	7

Source: Authors, based on data from the ONS (2018).

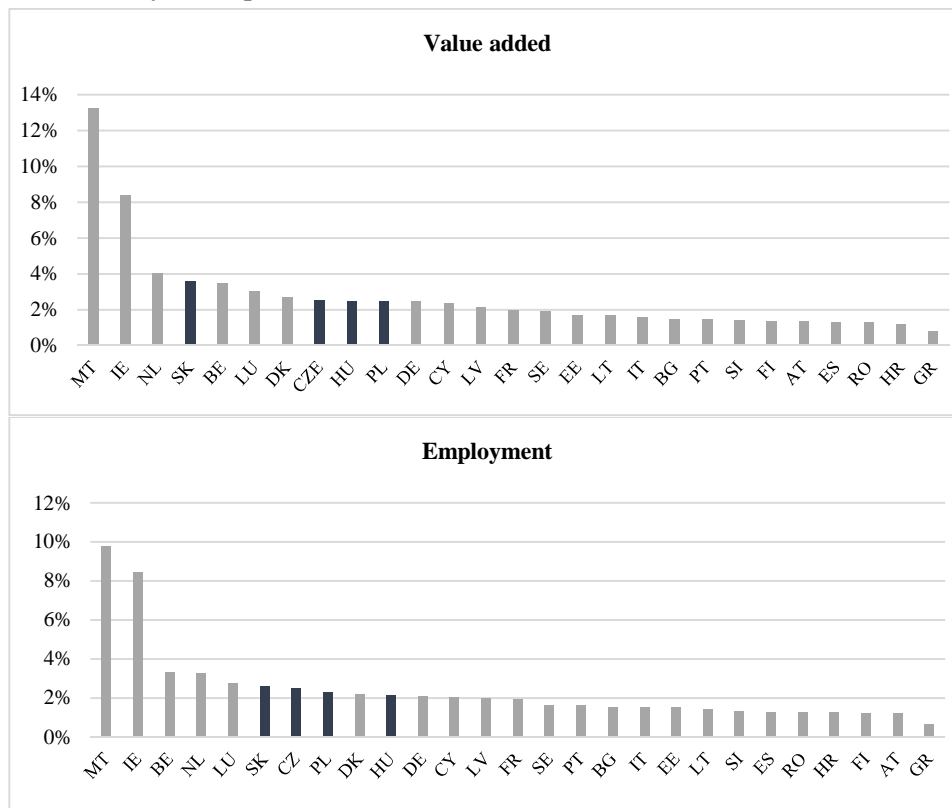
### 3.2. Effects on Value Added and Employment Generated Directly and Indirectly by Exports to the UK

In contrast to many studies on the impact of Brexit on both the UK and the remaining EU countries, we take into account the overall effects on employment and value added generated by exports to the UK. Thus, we are able to calculate value added or the number of jobs in individual countries directly or indirectly interlinked with exports to the UK. If we compare value added and employment in EU member states directly and indirectly linked to the exports to the UK, we find the strongest relations to this country in Malta and Ireland (see Figure 2). These results are in line with the findings of Aichele and Felbermayr (2015), who estimated that Ireland, Malta and Luxembourg should be affected the most, as they have strong economic relations with the UK in the financial sector. Whether looking at employment or value added, the Visegrad countries belong to the group of countries with a medium risk, where more than 2% of total value added/employment is linked in some way to the exports to the UK. Looking at value added, we can see that there is a gap between Slovakia and the rest of the V4 countries, which may suggest that the Slovak Republic has the strongest relation to the UK out of the V4 considering this indicator (3.6% versus 2.5% in the

rest of the V4). In case of employment, the Visegrad countries ranked similarly with a tiny difference between Hungary and the rest of the group. However, all values oscillate around 2.5% of the total employment. The other ends of the rankings are taken by countries with the lowest risk, i.e. Greece, Austria, Spain, Finland, Romania or Croatia.

Figure 2

**Share of Value Added/Employment in EU Member States Directly and Indirectly Generated by the Exports to the UK (2014)**



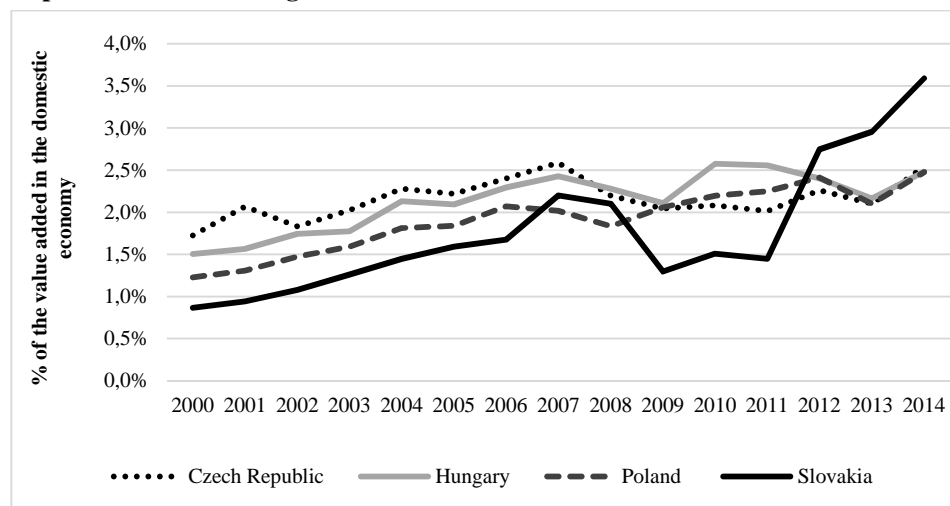
Source: Authors, based on data from WIOD.

As seen further in Figure 3, the importance of the UK as a trade partner in the V4 countries has been constantly increasing. Although the percentage of the value added connected directly or indirectly to exports to the UK on the total valued added created in individual V4 countries is relatively small, it has not fallen below 2% since 2013. We can observe a steadily increasing trend for the whole Visegrad country group, with a more visible deviation in case of Slovakia. Looking at Figure 3, we see that the Slovak Republic started from the lowest point of less than 1% but its connection to the UK final demand has increased

immensely since 2012. In 2014, exports to the UK generated roughly EUR 3 billion of value added directly and indirectly, which represents more than 3.5% of the value added in the domestic economy. This is Slovakia's highest share in the last 15 years and the highest value within the V4 group, as well. It can be stated that it was mainly final products that Slovakia exported to the UK throughout the examined period. For example, in 2000, it was 63%. Since 2012, this share has been decreasing, and in 2014, final products accounted only for 54% of the total value added generated by exports to the UK, or 1.64% of the gross value added created in Slovakia. We can observe a similar trend in Hungary and Poland, while in the Czech Republic, still up to 62% of the generated value added was interlinked with the exports of final products.

Figure 3

**Value Added Generated Directly and Indirectly in the V4 by Exports to the UK, Expressed as a Percentage of the Total Domestic Value Added**



Source: Authors, based on data from WIOD.

When looking at the effects *per one unit of final demand* in the UK, i.e. the global production chains linked to the final use of individual commodities in individual countries in the world, we observe that the highest effects are in manufacturing industries. This applies for the whole V4 group with the highest average values for Poland and the Czech Republic. Even though the generated effects per one unit (EUR 1 million) are small, we can get a better picture of the existing value chains. Looking at the upper 10% of the cumulative value-added coefficients in individual V4 countries, the highest value added is generated by the final use of one unit of these industries: the manufacture of motor vehicles,

trailers and semi-trailers, the manufacture of basic metals, the manufacture of machinery and equipment n.e.c., the manufacture of electrical equipment, the manufacture of computer, electronic and optical products and in Slovakia and Poland even the manufacture of wood and of products of wood and cork, i.e. mostly mechanical and electrical engineering. For instance, in Poland, in 2014, the final use of EUR 1 million of the manufacture of motor vehicles, trailers and semi-trailers in the UK created a value added in the Polish economy of almost EUR 8,400 compared to the average value of EUR 2,200 for Poland. In case of Slovakia, the final use of the manufacture of motor vehicles generated the total value added of nearly EUR 600. Again, this value is much higher than the calculated average cumulative coefficient of EUR 125. So, from this perspective, the most exposed industries belong to manufacturing. In addition, we see that some service industries may experience a major exposure to Brexit, as well.

Furthermore, in Table 4 we can observe the structure of value added generated directly and indirectly by exports to the UK by aggregated industries. Agriculture consists of crop and animal production, and hunting; forestry and logging; fishing and aquaculture and also mining and quarrying. Then, manufacturing represents all industries included in the C category of the ISIC Rev. 4 classification. Due to specific characteristics of the industries of energy supply and construction, these are stated individually. Services are the largest group which contains data for G to U categories of the ISIC Rev. 4 classification. Looking at the results in Table 4, the only country where a larger proportion of value added was generated by the final demand in the UK in manufacturing was the Czech Republic. Otherwise, most of the value added in the V4 countries was created in services, with the highest difference compared to other industries in Slovakia. Moreover, the Czech Republic and Hungary show similar patterns, as well as Poland and Slovakia. What is interesting, in Hungary and Poland, a substantial part of value added connected to exports to the UK was still linked to agriculture and in Slovakia to construction.

Table 4

**Structure of Value Added Generated Directly and Indirectly by Exports to the UK by Aggregated Industries, 2014 (in %)**

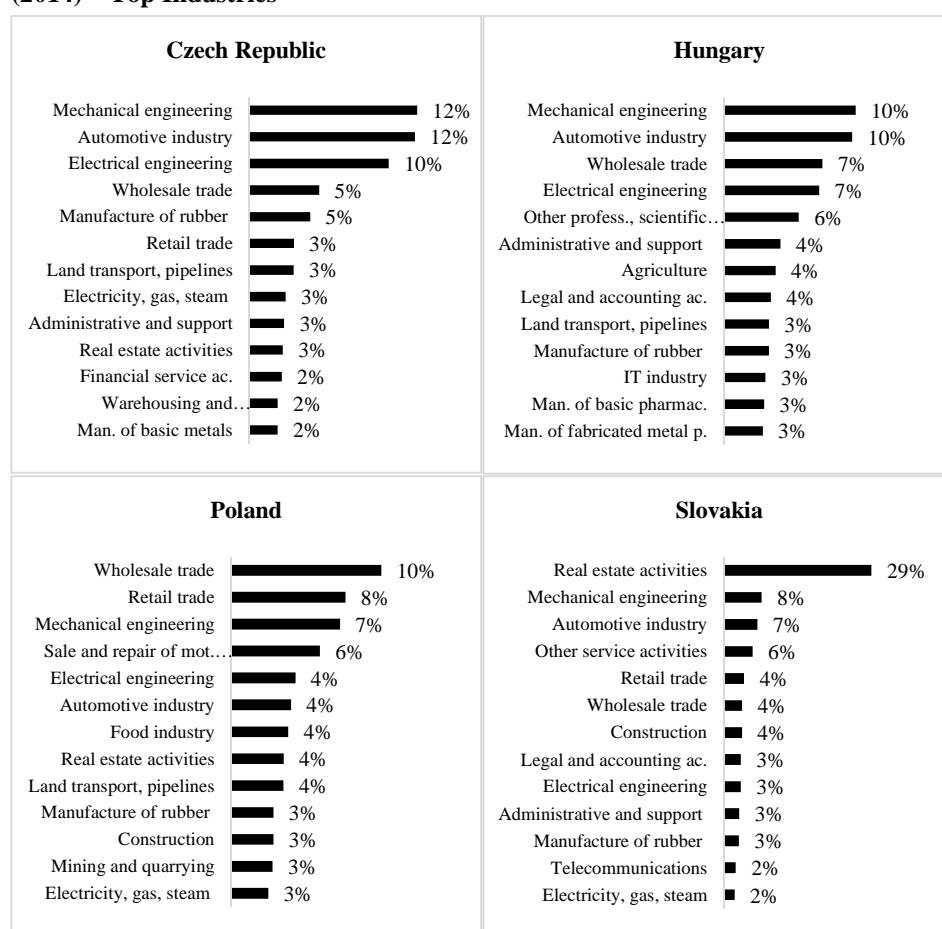
	<b>Czech Republic</b>	<b>Hungary</b>	<b>Poland</b>	<b>Slovakia</b>
Agriculture	2.87	4.26	5.61	2.40
Manufacturing	<b>54.63</b>	<b>45.21</b>	<b>35.99</b>	<b>27.26</b>
Energy supply	4.24	2.98	3.91	2.87
Construction	1.39	0.64	2.89	3.66
Services	<b>36.86</b>	<b>46.91</b>	<b>51.59</b>	<b>63.82</b>

Source: Authors, based on data from WIOD.

Furthermore, looking at industries individually (Figure 4), we can see that mechanical engineering<sup>5</sup> belongs to top 3 industries in all V4 countries. In the Czech Republic and Hungary, it represents more than 10% of the value added generated by exports to the UK. We can also observe a strong connection to the UK in automotive industry and electrical engineering.<sup>6</sup>

Figure 4

**Structure of Value Added Generated Directly and Indirectly by Exports to the UK (2014) – Top Industries**



Source: Authors, based on data from WIOD.

<sup>5</sup> Mechanical engineering includes the manufacture of fabricated metal products, except machinery and equipment, the manufacture of machinery and equipment n.e.c. and the manufacture of other transport equipment. It usually covers the manufacture of motor vehicles, trailers and semi-trailers as well, but we treated it separately because of its particular importance for the V4 countries.

<sup>6</sup> Electrical engineering includes the manufacture of computer, electronic and optical products and the manufacture of electrical equipment.



Automotive industry is usually a part of mechanical engineering but we treated it separately due its strong position in the Visegrad countries. Besides these industries, services represent quite a substantial part of the generated value added. The most relevant services include wholesale trade, retail trade, administrative and support service activities or other service activities. Interestingly, real estate activities represent almost 30% of the generated value added in Slovakia. In 2014, Slovakia recorded a negative balance of foreign direct investment inflows from the UK, which was caused, among other factors, by large acquisitions on the London real estate market. However, when looking at the employment shares, this industry contributes to the overall employment generated by exports to the UK only by 6% (Figure 5).

In terms of employment, we observe similar patterns as in case of value added (Table 5). Again, most of the employment interlinked with exports to the UK was created in services with the only exception of the Czech Republic. However, differences between aggregated industries are smaller compared to the results based on value added. In Hungary and Poland, a substantial part of the generated employment was again created in agriculture (crop and animal production, hunting and related service activities together with mining and quarrying), this time almost 7% and more than 13%, respectively.

Table 5

**Structure of Employment Generated Directly and Indirectly by Exports to the UK by Aggregated Industries, 2014 (in %)**

	<b>Czech Republic</b>	<b>Hungary</b>	<b>Poland</b>	<b>Slovakia</b>
Agriculture	3.11	6.99	13.02	2.48
Manufacturing	<b>52.55</b>	<b>42.28</b>	<b>39.19</b>	<b>35.95</b>
Energy supply	2.20	2.21	2.07	2.05
Construction	2.09	1.08	3.13	4.43
Services	<b>40.05</b>	<b>47.45</b>	<b>42.60</b>	<b>55.08</b>

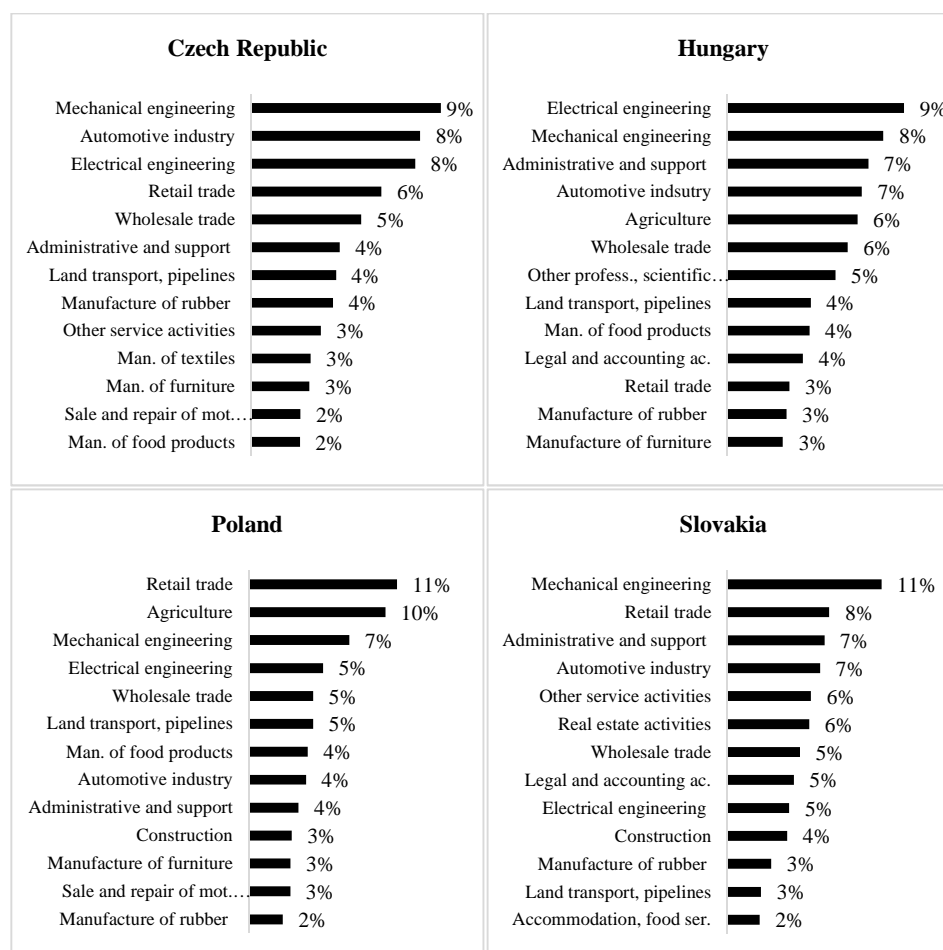
Source: Authors, based on data from WIOD.

A more detailed input-output analysis showed that in all V4 countries in 2014, from 2% to 3% of the overall employment was directly and indirectly generated by their exports to the UK. The highest share was generated in Slovakia, where out of 2.2 million working citizens; almost 58 thousand (2.57%) were somehow connected to exports to the UK. The lowest share of 2.08% was in this regard recorded in Hungary. In absolute terms, we can talk about more than 88 thousand jobs exposed to exports to the UK. In Poland and the Czech Republic, we talk about 351 thousand (2.26%) and 124 thousand jobs (2.44%), respectively.

In Figure 5, we can see the structure of employment generated by exports to the UK in top industries. Again, mechanical engineering, electrical engineering and automotive industry occupy the top places. In this case, the exception is Poland, where 11% of people worked directly or indirectly in retail trade and 10% of people were employed in agriculture. In case of employment in Slovakia, mechanical engineering outweighed the importance of real estate activities. In fact, the employment patterns are similar in all V4 countries with a slightly different situation only in Poland. In this country, we observe a higher dominance of services and agriculture.

Figure 5

**Structure of Employment Generated Directly and Indirectly by Exports to the UK (2014) – top Industries**



Source: Authors, based on data from WIOD.

### 3.3. Post-Brexit Policy Challenges

Understanding the interests of the V4 countries is important in getting insight how the future of the EU may evolve. Given the differences among the members of the Visegrad group, the organization has non-institutional character and mutual cooperation depends largely on the actual circumstances. The informal nature of the V4 cooperation limits the scope of the V4's potential joint impact on the EU's agenda.

However, the group is increasingly present as a separate agent in the European politics, e.g. migration or different quality of goods. Furthermore, Visegrad countries and their experiences play important role in the process of Euro-Atlantic integration of the western Balkan countries, the European Neighborhood Policy and the Eastern Partnership.

After the day of the UK's withdrawal, the distribution of political and economic power in the European Union will change. While this change is already taking place in the context of the broader crisis of European integration, Brexit can accelerate this process even further. Ensuing political and economic changes provide an opportunity for the Visegrad countries to further strengthen mutual trade ties and interests, since these are much less profound than it might seem.

After the UK's withdrawal from the EU, Germany will further strengthen its position within the EU and it is important how successfully the V4 countries will maintain economic relations with this country (Legiec, 2018). Compared to others, the V4 countries have a permanent competitive advantage in their geographical proximity to Germany and this fact is reflected in the position of Germany as the main export and import partner for all four Visegrad countries. Besides the impact of Brexit on the trade and labor flows, the Visegrad countries should be prepared also for closer political cooperation, which will ultimately affect economic reality on both sides.

The Visegrad countries have common interest to minimize the negative impact of expected shortfall in the funding of the European budget after the UK leaves the EU. The potential impact is even greater as the V4 countries are the net beneficiaries of European funds and these funds account for a substantial portion of their public investment.

While new challenges and policies emerge (e.g. migration, climate change), for the V4 countries it is generally desirable to promote budgetary priorities that address persistent problems such as social and economic convergence of less developed regions, or the reduction of income inequalities among the old and new EU Member States. In this context, it will be important to successfully replace possible funding shortfalls with financial resources from other central programs managed by the European Commission.

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## Conclusion

From the perspective of foreign trade, the V4 countries are much more dependent on exports to the UK than on imports from the UK. The United Kingdom with its 6.6% share ranked second in the importance of the Poland's export partners, which makes Poland much more exposed to any restrictions on access to the British market compared to other Visegrad countries. The Visegrad countries with more than 63 million customers became the UK's tenth largest export market.

Looking at how V4 countries could be affected by Brexit in terms of foreign trade, value added and employment, the analysis showed that the Visegrad countries belong to the group of countries with a medium risk. When looking at the value added and employment generated in the V4 countries by exports to the UK, we can observe that a larger proportion is created in services except for the Czech Republic with the highest shares in manufacturing. Even though the percentage of the value added connected directly or indirectly to exports to the UK on the total valued added created in the individual V4 countries is small, it has not fallen below 2% since 2013. This implies the importance of the UK as a trade partner in the Visegrad countries, which has been constantly increasing. The highest share of domestic value added and employment interlinked with exports to the UK among the V4 economies occurred in Slovakia. In 2014, it was 3.5% of gross value added and 2.57% of the overall employment (which means around 62 thousands jobs in absolute value).

In general, the most significant sectors from the perspective of the structure of generated employment in the V4 are mechanical engineering, automotive industry, electrical engineering, wholesale trade, retail trade and administrative and support service activities. In Slovakia and Poland, real estate activities play quite a significant role in terms of value added, as well. However, in the structure of employment in Slovakia, mechanical engineering outweighed the importance of real estate activities. In fact, the employment patterns are similar in all V4 countries with a slightly different situation only in Poland, where agriculture still has a strong position in the generated employment. As far as the structure of value added is concerned, the countries can be divided into two groups: we see similar developments in the Czech Republic and Hungary on the one hand and Slovakia and Poland on the other.

The Visegrad group agrees upon three main interests with regard to the Brexit. They run a balance of trade surplus with the UK and it is in their best interest to maintain barriers to trade as low as possible and to the greatest extent possible to protect and further develop the Single Market based on fundamental freedoms, including the free movement of goods, services, and capital. Then there is central

priority to protect their citizens, living, working and studying in the UK. Finally, the V4 countries have common interest to minimize the negative impact of short-fall in the funding of the European Budget.

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## Technical Appendix

### *Hypothetical Extraction Method*

According to Los, Timmer and Vries (2016), the approach based on hypothetical extraction provides a natural extension into decomposition of bilateral export flows and it can be used for further research of value-added flows in international trade. We compute value added in a hypothetical economy in the framework of input-output but with some trade flows equal to zero, i.e. some trade linkages between countries are ‘extracted’ or in other words ‘omitted’. Thus, comparing value added in the actual and the hypothetical economy, a country’s value added associated with these extracted linkages can be calculated. In this manner, we can also calculate the value-added effects in the V4 generated by using the inputs from a V4 country by a British producer which end up being used as inputs in other countries. To calculate these effects, we need to adjust matrix A so the linkages among the V4 countries and the UK are extracted. This can be expressed as follows:

$$A^* = \begin{pmatrix} A^{11} & & A^{1P} \\ & A^{V4,GBR} & \\ A^{P1} & & A^{PP} \end{pmatrix} = \begin{pmatrix} A^{11} & & A^{1P} \\ & 0 & \\ A^{P1} & & A^{PP} \end{pmatrix} \quad (4)$$

The blocks capturing the input coefficients for the V4 countries in rows and for the UK in a column are set to zero, while leaving the rest of the structure of the world economy unaffected. In order to capture the aforementioned flows, we work with the final demand in the rest of the countries/world (without the UK) called  $\mathbf{y}^{\text{Row}}$ . We calculate the additional trade flows by subtracting (6) from (5)

$$\mathbf{p}^{\text{Row}} = \hat{\mathbf{p}}_c \mathbf{L} \mathbf{y}^{\text{Row}} \quad (5)$$

$$\mathbf{p}^{\text{Row}*} = \hat{\mathbf{p}}_c \mathbf{L}^* \mathbf{y}^{\text{Row}} \quad (6)$$

while  $\mathbf{L}^* = (\mathbf{I} - \mathbf{A}^*)^{-1}$ . Equation (5) expresses value added in the V4 generated by the final demand in the Row ( $\mathbf{y}^{\text{Row}}$ ), while equation (6) indicates value added in the V4 generated by the final demand in the Row extracting the inputs from the V4 used in the UK to produce intermediate exports. By this subtraction we get value added in the V4 generated by the final use of the inputs from the V4 in the UK ending up as inputs in other countries, formally written as  $\mathbf{p}^{\text{Row}} - \mathbf{p}^{\text{Row}*}$ . These effects are not included in the vector of final demand in the UK in equation 3 ( $\mathbf{y}^{\text{ex}}$ ). The effects are rather minor, and we present them additionally in the following Table:

Table 6

**Value Added in the V4 Generated by the Final Use of the Inputs from the V4 in the UK to Produce Intermediate Exports** (percentage of the total domestic value added):

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
<b>Czech Republic</b>	0.18	0.21	0.18	0.22	0.25	0.26	0.28	0.32	0.27	0.27	0.28	0.31	0.33	0.29	0.34
<b>Hungary</b>	0.17	0.17	0.20	0.20	0.23	0.22	0.29	0.32	0.33	0.30	0.38	0.43	0.38	0.32	0.37
<b>Poland</b>	0.18	0.17	0.18	0.19	0.23	0.25	0.27	0.27	0.25	0.28	0.33	0.38	0.41	0.29	0.34
<b>Slovakia</b>	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.04	0.04	0.03	0.03

Source: Authors based on WIOD.

As seen in Table 6, the effects in all countries are lower than 0.5% of the total value added (on average, the highest in Hungary with 0.26% and the lowest in Slovakia with 0.03%), so in the analytical part, we predominantly focused our attention to main trade channels.