Charles University

Faculty of Social Sciences

Institute of Economic Studies

Bachelor Thesis

Value Added in the Global Value Chains in the Automotive Industry in Slovakia

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, July 31, 2019

Signature

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Abstract

The thesis provides a detailed decomposition of Slovak bilateral exports in the automotive industry and shows the development of global value chains participation in the scope of the Visegrad group. The first part, bilateral sectoral decomposition, examines shares of the domestic & foreign value added components as well as a double-counted term in Slovak exports to the global biggest economies. Moreover, it determines the origin of the foreign value added embodied in Slovak exports and final destinations, where the Slovak value added is absorbed. The second part determines to what extent is Slovakia participating in global value chains as well as Czechia, Poland and Hungary. The results obtained from this decomposition, showcased a decreasing share of the domestic value added, which is caused to some extent by integration into these value chains as well as the character of Slovak production specialisation. Data series provided proof of a long-term trend.

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Abstrakt

Táto bakalárska práca spracováva detailnú dekompozíciu slovenských bilaterálnych exportov v automobilovom priemysle a prezentuje tiež vývoj zapojenia sa Slovenska to globálnych hodnotových reťazcov v rámci Vyšehradskej skupiny. Práva časť, ktorá sa zameriava na bilaterálnu sektorovú dekompozíciu, skúma podiely domácej a zahraničnej pridanej hodnoty, ako aj zdvojenej časti slovenského exportu do najväčších svetových ekonomík. Navyše tiež určuje pôvod zahraničnej pridanej hodnoty, ktorá bola obsiahnutá v slovenských exportoch a tiež finálnu destináciu, kde bola slovenská pridaná hodnota absorbovaná. Druhá časť práce popisuje do akej miery bolo Slovensko zapojené do týchto hodnotových reťazcov, ako aj Česko, Poľsko a Maďarsko. Výsledky získané z tohto modelu poukazujú na znižujúci sa podiel domácej pridanej hodnoty, ktorá bola do určitej miery spôsobená práve participáciu v týchto hodnotových reťazcoch, ako aj charakter špecializácie slovenskej produkcie. Časový rad potvrdil dlhotrvajúci trend.

JEL Klasifikácia	*C67, L62, F47*
Kľúčové pojmy	*Input-output analýzy, Globálne hodnotové reťazce, Automobilový priemysel, Export, Pridaná hodnota*
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Acronyms

AutoSAP	Czech Automotive Industry Association
BM	Borin & Mancini
CEC	Central Europe Countries
CzechInvest	Czech Investment and Business Development Agency
DVA	Domestic Value Added
FVA	Foreign Value Added
GTAP	Global Trade Analysis Project
GVC	Global Value Chain
HIPA	Hungarian Investment Promotion Agency
IMF	International Monetary Fund
IO	Input-Output
JLR	Jaguar- Land Rover
KWW	Koopman, Wang & Wei
MAGE	Society of Hungarian Automotive Industry
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
PAIH	The Polish Investment and Trade Agency
PC	Passenger cars
SARIO	Slovak Investment and Trade Development Agency
SIEA	Slovak Innovation and Energy Agency
R&D	Research and Development
UN	United Nations
V4	Visegrad Group (Slovakia, Czechia, Hungary, Poland)
VS	Vertical Specialisation
WIOD	World Input-Output Database
WIOT	World Input-Output Tables
ZAP SR	Automotive Industry Association of the Slovak Republic

Bachelor's Thesis Proposal

Institute of Economic Studies
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Author	Matúš Pravda
Supervisor	Ing. Vilém Semerák M.A., Ph.D.
Proposed topic	Global value chains in automotive industry in V4 countries

Motivation

In my bachelor´s thesis I will focus on the added value of supply chains created by the automotive industry in the Central-European region. The most important question is: "Which factors have mostly affected the added value created by observed investors?" I will also analyse which countries have invested the most in this region. Finally, an important aspect of these investments are available work positions that were created.

Central-European countries grouped in the V4 are known for their highly-educated labour force and low wages compare to it. This combination has been one of the main reasons why companies have been investing in these economies. Particularly in the automotive industry, these investments have not only created new jobs in factories, but also in supply chains.

In 2015 Slovakia, for the first time in history, manufactured more than one million cars within one year. Slovakia is also the biggest car producer in the world in term of cars per inhabitant. Czechia with its long history of car producing belongs to one of the most important cars producers in Europe. In Hungary and Poland automotive industry also plays an important role in their economies.

Professor Pavlinek maps this area as one of the few authors in Central Europe. Therefore, his papers, e.g. Global Production Networks, Foreign Direct Investment, and Supplier Linkages in the Integrated Peripheries of the Automotive Industry (2017), are going to be be the main source of inspiration for me.

Expected Contribution

Jaguar-Land Rover is finishing its €1 billion factory in western Slovakia. It is the fourth car producer, which has decided to manufacture in that area. There are also existing rumours about a fifth producer, which is planning to build its factory in the Eastern part of Slovakia. Therefore, we can describe Slovakia as a country with a high degree of dependence on the automotive industry. Czechia also has a tight connection to the German economy and the automotive industry. In conclusion, the automotive industry determines development in mentioned countries. Since there do not exist many papers, which describes the added value in such an important industry, my thesis can help to explain linkages between producers and suppliers and quantify the concrete added value created by the automotive industry in these countries. I will use available data to determine, how should single governments deal with this industry. I will also be able to analyse certain risks of boss-eyed focus on this industry and show possible advantages or disadvantages of such a policy. Thanks to the Input-Output data I will be able to determine the biggest trade partners of V4 countries in the automotive industry. There also exist some studies, which describe the added value created in regions of the concrete country. Therefore, I plan to try to determine similar effects in regions of particular Central-European countries.

Methodology

I am going to use Input-Output tables, where I can find all trading volumes of each country in its industries. These data will allow me to analyse factor share in value added to global value chains. Precisely, I will focus on four factors: capital share in global value added, high-skilled; medium-skilled and low-skilled labour share in global value added. Thanks to these data I will be able to quantify the share of foreign value added in the output of a manufactures global value chain. I will also use data from the automotive supplier's associations in these countries to determine, from a more detailed perspective, how many jobs were created. Eurostat´s COMEXT data will allow me to analyse meta-data from these countries in terms of concrete products.

Outline

1) Introduction
2) Literature review
3) Hypotheses
4) Data and methodology
5) Results and discussion
6) Conclusion
7) Bibliography

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1 Introduction

Central European (CE) countries have experienced serious changes in their economies during the last three decades. A transformation from centrally planned to free-market economies in the 80s and related massive foreign capital inflows, a transition period between adopting the new economic model and the full implementation of it, applying and successfully becoming member states of the EU in 2004 with full access to the Single Market and afterward facing the Financial crisis in 2008.

Many companies have not been able to compete in a new environment and went bankrupt. In contrast, many firms have been able to use either domestic or foreign investments to build profitable businesses. The automotive industry is a great example of a strong, competitive sector, which profits from access to the Single Market and generates irreplaceable value added. Despite this fact, not a single economy in Europe is immune to changes in the global economy.

The automobile industry has been playing a key role in CE countries during this period. Only in Slovakia, 250,000 workers are employed directly or indirectly by the automotive industry (SARIO, 2018) and its production accounts for 40% of the total industrial export of Slovakia. The similar situation is in the rest of Visegrad 4 (V4). In Czechia, production of AutoSAP members creates 21.8% of the total export and companies employ more than 126,000 workers[1]. In Hungary, the automotive industry accounted for 28.7% of manufacturing output in 2017 and 175,000 people worked in Q4 2017 in the automotive industry (HIPA,2018). In Poland, directly, the automotive production sector employed 166,200 workers in 2014. This represents 8.1% of all employment in manufacturing (PAIH,2015).

However, none of the direct manufacturers of the Passenger cars (PC) is a domestically owned company. Only one of all companies within the automotive industry, across all V4 countries, is owned domestically. It is Solaris company, which is the second biggest bus producer in Poland. Generally, there is no evidence of national producers, except Škoda Auto (Škoda). The rest of the automotive industry consists of branches of multinational enterprises, which chose this region because of its strategic importance. Moreover, since 1991 Škoda is owned by the German Volkswagen (VW). In conclusion, even though CE countries have huge car production and for instance, taking into consideration the number of inhabitants, Slovakia

[1] AutoSap: Základní přehledy Automotive

is by far the global leader in car production per 1000 inhabitants (SARIO, 2018), these economies are completely dependent on the decision made by international automotive groups such as European Volkswagen group and PSA group or Japanese Suzuki and Toyota.

Within the scope of Europe, Germany is a key automotive superpower. Germany by itself produced more cars than Spain, the UK and Italy together in 2017. It also has the highest PCs registration in Europe (ACEA,2018). The automotive industry alone employs around 820,000 workers (VDA,2018) and its annual turnover accounted for € 423 bn in 2017, from which € 272 bn was from export[2]. In the last two decades, Germany has also been the world´s largest car exporter with around a 20% share in global export (Atlas, Harvard)[3]. The automotive industry has always had a unique position in German history and economy as well. The history of the automobile began in 1886 with Daimler's first motor carriage and Carl Benz's three-wheeled vehicle. Since then German producers have proven that they are leaders in the given industry. At present, the biggest enterprises are present not only in a homeland but also in all continents. With all, their suppliers create these companies such as BMW, VW or Daimler gigantic global value chains.

The production of cars belongs to the complex global value chains (GVCs) because the production of the final product requires components or intermediate products to cross the border at least twice. We live in a world, where more than two-thirds of the world trade occurs through GVCs, in which production crosses at least one border. The phenomenal growth in GVC-related trade has translated into significant economic growth in many countries across the globe over the last two decades, fuelled by reductions in transportation and communication costs and declining trade barriers. (WTO, 2019). All four Visegrad countries joined the EU in 2004 and since 21st December of 2007 are also members of the Schengen area. Moreover, all four countries are gaining from the Four freedoms of the Single Market. Thus, with skilled labour force, without trade barriers, with shrinking transportation costs and rising the level of infrastructure, V4 countries have become attractive for mainly German companies, but not only them. For instance, VW has its factories in all four countries and a tremendous network of suppliers. In such a complex scheme it is almost impossible to track origin of the value added.

Outsourcing is one of the many trends created by the globalisation. The main argument for outsourcing is becoming more competitive by gaining access to cheaper inputs with better

[2] VDA: Facts and figures overview

[3] Available at http://atlas.cid.harvard.edu/explore/?country=undefined&partner=undefined&product=1763&product Class=HS&startYear=undefined&target=Product&year=2017

quality. (OECD, 2013). Not many enterprises use their own manufacturing capacities exclusively, and even fewer corporations use only components made within their production network. Connections within the world's economy can be simply shown with example of iPod. Every product from Apple has the following label*:" Designed by Apple in California. Assembled in China."* Since Apple only owns the core software, the whole manufacturing process is outsourced to other countries. Some components come from the USA, however, the majority of them come from Japan, Korea or Taiwan and are assembled in China. On the other hand, the value added is distributed unevenly. Out of $194 of captured value only $4 fall on Manufacturing. Therefore, we can observe significant differences in distribution of value added. (Dedrick et al.,2010)

In the light of declared upcoming Brexit, the automotive industry in the UK is facing serious difficulties and tracking value added is one of them. For instance, the crankshaft crosses the Channel three times before the finished car rolls off the production line.[4] Domestic value added in gross exports is a macroeconomic estimation of value added in producing goods and services for export. It can be defined as the difference between gross output at basic prices and intermediate consumption at purchasers' prices. Slovakia, Czechia and Hungary are countries with one of the lowest values while Germany belongs to the top 4 with the highest value added. (OECD,2019).

This thesis aims to decompose Slovak exports into value added components together with the double-counted during the period from 2000 to 2014 in order to determine the position of Slovakia in GVCs. Moreover, it aims to compare GVC-participation rate with the rest of the Visegrad group in order to see the position of Slovakia within Central European cluster. The third goal is to investigate the power of Germany, V4 and other strong players in this GVC.

The text proceeds as follows. Chapter 2 summarises the most relevant literature sources on this topic, whereas history of the automotive industry and current stage of GVCs in Slovakia are described in Chapter 3. Dataset characteristics, methodology and model are presented in Chapter 4. Chapter 5 is devoted to the description of value added decomposition over the observed period and development of the GVC-participation. The implications for the Slovak economy and recommendations are included in Chapter 6.

[4] The Guardian (03.03.2017): "A Mini part's incredible journey shows how Brexit will hit the UK car industry"

2 Literature review

A topic of the automotive industry and its strategic importance for the Slovak economy are present in the media almost every day. Tight connections between V4 countries and Germany have also been widely discussed. The topic of input-output analysis has been present since 1936 when Leontief published his first paper about this macroeconomic analysis. This analysis is of growing importance in today´s interconnected economy.From the data side, the WIOD brought a more detailed macro-perspective and enabled researches to examine ties between countries and industry sectors more precisely.

This section is divided into three parts – Automobile industry, Value added and Global Value Chains and Input-output. Examination of these topics is vital to thoroughly understand and conduct a Sensitivity analysis of value added in the automotive industry.

2.1 Automotive industry

National associations of car producers and supply manufacturers publish up to date papers about state of the industry, changes and also trends. Among important associations in Visegrad countries belong ZAP SR, AutoSAP, MAGE and PZPM. There also exist many sectoral analyses made by national investment agencies such as SARIO, CzechInvest, HIPA and PAIH. ACEA is operating on the European level, which is an advocate for the automobile industry in Europe, representing manufacturers of passenger cars, vans, trucks and buses with production sites in the EU.

Since the automotive industry is a key component of exports and the economy as such, all Big4 accounting firms (EY, PwC, Deloitte, KPMG) regularly publish surveys, for instance, Automotive Innovation Slovakia Survey published by KPMG or PwC Automotive Supplier Survey, structural analyses such as Central Europe as a focal point of the automotive industry from Deloitte or future predictions from global perspective KPMG Global Automotive Executive Survey or The Future of the Automotive Value chain from Deloitte. Table 1 below is a detailed summary of available publications, where column “Macroeconomic indicators” represents three general indicators such as employment, production output and trade (imports & exports). Section “R&D and Innovations” indicates the total number of R&D centres, their location and also the level of Innovation. Section “Key players” indicates a list of key players either directly in manufacturing or in the supply chain.

Table 1 Automotive industry publications overview

General Information					Content Information		
Country / Region	**Agency / Company**	**Name of publication**	**Periodicity of publication**	**Years Available (Year published)**	**Macroeconomic indicators**	**R&D Innovatios**	**Key players**
EU	ACEA	Economic and Market Report	Quarterly / Yearly	2015/16/17/18	✓	X	X
Central Europe	Deloitte	Central Europe as a focal point of the automotive industry	N/A	2016	X	✓	X
Czechia	CzechInvest	Automotive Industry in the Czech Republic	N/A	2009	✓	✓	✓
Czechia	AutoSAP	Český autoprůmysl	5x per year	2015/16/17/18/19	✓	✓	✓
Slovakia	SARIO	Automotive Sector in SLOVAKIA	N/A	2018	✓	✓	✓
Slovakia	KPMG	Automotive Innovation Slovakia Survey	Yearly	2014/16	X	✓	✓
Slovakia	ZAP	Automotive Innovation	2x per year	2014/15/16	X	✓	X
Slovakia	ZAP/PWC	Automotive Suppliers Survey	Yearly	2015/16/17/18/19	X	✓	✓
Poland	PAIH	Automotive Sector in Poland	N/A	2015	✓	✓	✓
Poland	PZPM / KPMG	Automotive Industry	Quarterly	2008/9/10/11/12/13/ 14/15/16/17/18/19	✓	X	X
Hungary	HIPA	Automotive industry in Hungary	N/A	2018	✓	✓	✓
Hungary	PwC	Hungarian Automotive Supplier Survey 2018	N/A	2018	✓	✓	✓
N/A	Deloitte	The Future of the Automotive Value Chain 2025 and beyond	N/A	2017	X	✓	X

Source: Author´s elaboration. Macroeconomic indicators are Employment, Production and Trade (Import, Export).

2.2 Value Added and Global Value Chains

World

Seeing that the value added and GVCs are notably interrelated, review of current literature about these two expressions will be jointly covered in this part. Research papers about GVC and added value are focused mainly on macro perspective and global economy. However, the earliest paper specifically about the automotive industry was published in 2008 (Sturgeon et al., 2008). Moreover, one of the most cited paper about the complexity of GVC is about Apple´s iPod (Dedrick et al.,2010)

Even though the expression “value chain” was firstly used in 1986 (Porter,1986) and term “global value chain” in 2001 (Gereffi et. al., 2001) many working papers, articles and analysis have been published only in recent years. Among main institutional contributors were international organisations such as OECD, IMF, UN or World Bank.

The automotive industry is specific with its tight cluster-based production chain. The production tends to be organized regionally or nationally with components suppliers concentrated near to final assembly plants to assure time efficiency and use economies of scale. Moreover, R&D centres are concentrated in very few design centres, which are typically near the headquarter of the producer. Thus, the principal automotive design centres in the world are mainly in 4 countries – Germany, France, USA and Japan. (Sturgeon et al., 2008).

Manufacturing activity in the EU is increasingly concentrated in the Central European (CE) region centred in Germany, Austria and V4 countries. Structural shift out of manufacturing has not been visible or absent in the CE region contrary to quite strong in other parts of the EU. (Stollinger, Wiiw,2016).

The German automobile industry is considered to be one of the prominent examples of GVCs in Europe. Germany has been establishing itself as a leading automobile superpower and exporter for decades. On the other hand, there is a rising CE region, which thanks to the geographic proximity, relatively low unit labour costs, the favourable tax environment, and a highly qualified workforce with a history of expertise in the automobile industry, benefits from decision of German car producers to offshore production. The proof of the increasing importance of the V4 is the fact that 2009 is a first-year when foreign production of German producers overtook domestic production. The automotive industry has become an important part of V4 economies over time and has had an enormous impact on export growth. A decomposition of gross exports based on the origins of the added value illustrates the increased integration of the region with Germany. (IMF,2013, Germany)

According to the SIEA paper, there are outstanding differences in engagement of the automotive industry in GVCs in V4 countries and Germany, Despite the fact, that ratio of value added creation increases over time, the engagement of V4 countries is still lower than in case of Germany. However, Poland is an exception, because of its bigger national market. Slovakia has an extraordinarily high ratio of capital and a low ratio of labour on the value added creation. The ratio of high-skilled labour force on the creation of value added in the whole automotive industry accounted only for 1.6% in 2009, whereas in Germany it was 35.4%. This ration is among the lowest in the EU. This implies, that Slovakia was competitive only thanks to the high ration of mainly foreign capital and thanks to the medium-skilled labour force (Baláž et al., 2015).

The special treatment of the automotive industry from the governments perspective was visible during the 2008 Financial crisis. Countries like the USA, France, Germany or even Slovakia came up with programme “Cash-for-Clunkers” (CfC), which should have incentivised customers to buy new cars. However, the CfC programme in the USA – the Car Allowance Rebate System, was not fully successful. On the one hand, this incentive caused a short-term increase in production, GDP, and job creation. On the other hand, not only the implied cost per job created was much higher than alternative fiscal stimulus policies, and these small stimulus effects do not account for the depletion of the capital stock that resulted from the destruction of

used vehicles (Gayer,2013). But from the perspective of CO2, NOx and safety (ceteris paribus), the US scheme may have had benefits in line with its costs (OECD,2011). Contrary to the USA, a similar programme in France is considered to slow down losses and in Germany even boosted sales.[5] Moreover, Slovakia is considering the second wave of the CfC programme in order to boost sales of cars with an alternative fuel source.[6]

Automakers have been benefiting from this extraordinary political attention, however, from the GVC perspective, this approach has weakened the relative position of suppliers. On the other hand, there is a slight shift in the geography of design centres of lead firms. Some developing markets have grown sufficiently to warrant region-specific vehicles; thus, lead firms and suppliers have been setting up local design centres. Suppliers must fulfil three objectives in order to become successful. The main goal is to achieve worldwide quality standards. It is a necessary condition to start supplying globally competitive supply chains Secondly, improvement of productivity must happen at the same time as the average technological progress in the sector to match continuous price declines. Thirdly, new vehicles must be designed. (Sturgeon & Van Biesebroeck, 2011).

Main trends in the production of final manufacturing products were identified in later research. Primarily, the production had become increasingly internationally fragmented. This finding was supported by an empirical proof of rising shares of the foreign value added. Secondly, the factor distribution of the value added had shifted: for most products the shares of capital and high-skilled labour had increased, while the shares of medium- and low-skilled labour declined. Thirdly, VA in production giants such as the USA, the EU and Japan remained constant, predominately contributing to capital income. Lastly, advanced countries focused on GVC tasks made by high-skilled works. These four trends are fully represented in the case of the German car industry, where between 1995 and 2008 the domestic value added had been constantly decreasing. On the other hand, the foreign VA had been increasing because of intermediates imports from Eastern Europe. This drop was caused mainly because of the decline in the value added by less-skilled workers. (Timmer et. al., 2013).

In contrast, OECD concluded that after the Financial crises of 2008/2009 the growth of GVCs had slowed. Despite this fact, the expansion of complex GVCs had been growing faster than GDP growth in 2017. The significant conclusion also is that trade had not been the notable

[5] Forbes (07.07.2009): "Cash For Clunkers Works In Europe."
[6] Trend (28.05.2019): "Chystá sa Šrotovné 2.0. Vláda chce dotovať tretinu z ceny nových e-áut"

cause of declines in manufacturing jobs (WTO, OECD, 2019). From an international development perspective, GVCs play a key role for countries, because as the ability to prosper depends on their participation in the global trade, which is mainly about their participation in GVCs. (Gereffi, 2012).

Results of IMF shows that the GVC participation is positively related to income per capita. Moreover, conventional trade contributes to the income per capita less than the trade-in intermediates goods as well as the share of the GVC related trade flows. The GVC trade has an almost double share of nominal world GDP than traditional trade. Moreover, foreign direct investments are also positively linked to the GVC related trade flows. Better economic performance, rising productivity and income levels support the argument for participation. Despite this fact, there is a great degree of participation in GVC across countries and industries. Factors affecting a country´s participation in GVC are for instance business environment, good infrastructure and the rule of law. However, there exists a difference in participation between manufacturing and services. Plus, upstream sectors and services are more sensitive to trade barriers. (IMF, 2019)

Effect of participation in GVCs depends on the stage of development in a particular country. Results in a cross-industry, cross-country study from the IMF show that from the perspective of a low-income country, is participation harmful due to the reduced labour share. (IMF, WTO 2017) Increased GVC participation is performed mainly through the reallocation of production from high-labour share to low-labour share companies. Declining costs of offshoring support the substitution effect between imported intermediate goods and domestic labour. This leads to a reduction in the domestic wage bill as a share of gross output. (OECD, Employment Outlook 2018) Policymakers should implement sustainable educational changes which emerged from PIAAC skill data survey. Most important cognitive skills such as numeracy, literacy and problem solving, which are general, task- and industry independent set of skills strongly relate to labour productivity and support integration into GVCs. It is inevitable to synchronise educational systems with production and to carefully design skills policies in the long run. (Grundke et al., 2017)

Formation of international production in trade networks are increasingly driven by global buyers. Large retail corporations such as Walmart or Tesco have a powerful role in shaping GVCs and how they operate by requiring suppliers to meet certain standards. Large brand-name producers such as Apple or Nike also hold significant buyer power in GVCs.

Modern trends of growing consumer awareness of social and environmental issues together with quality standards requirements lead buyers. (Gereffi, 2012)

The digitalisation of production could be the biggest game-changer for the future of GVCs. Artificial intelligence and robotics will have disruptive effects on GVCs. On the other hand, IT will shift the trend of offshoring, thus the production of intermediates is expected to return to developed countries. Because of rising wages, emerging economies are not as attractive as they used to be. They are becoming less competitive, which implies that offshoring is even less attractive. Transportation costs could be the second breaking point. However, they are predicted not to raise, mainly because of the vacant maritime capacities, which account for more than 80% of world cargo transport. In contrast, only a slight increase in transportation cost could deeply affect GVCs. Also, changes in the structure of societies in emerging countries could deeply affect GVCs. With the rising middle class, the production would shift from developed to emerging countries. (OECD, 2017)

The automotive industry is among industries, where products can be broken down into discrete components that can be separately produced, transported, and assembled in another location. Thus, manufacture of motor vehicles, trailers and semi-trailers had the second-largest share of the foreign value added in exports among industries in 2010. There exist significant differences by country or region. Concretely, developing countries tend to use more foreign inputs to produce their exports than developed nations. One of the issues, which GVCs are responsible for, is the growing significance of "double counting" in global trade statistics. On the one hand, data shows that around 28% of the gross export of value added that is first imported by countries only to be incorporated in products or services that are then exported again. On the other hand, the domestic value added created from GVC trade can be very significant relative to the size of local economies in developing countries. (UNCTAD,2013) However, an intermediate good trade is more volatile than trade with final goods. It is documented that firms tend to be reluctant to hire new workers after recessions, slowdowns, and crisis until the economy recovers. Related to this, is also visible aggressive implementation of outsourcing and offshoring strategies. In contrast, it is likely that the motor vehicle industry has experienced strong production deepening in producing countries from expanded domestic production of intermediate inputs. This claim is also supported by the ranking of the top 50 countries according to total trade-in manufactured intermediate goods, wherein 2006 all V4 placed in it. (Sturgeon & Memedovic, 2011)

V4

In order to properly analyse the development of the value added, it is necessary to understand how value is created and captured in the automotive industry. The value creation is defined as firm-level activities that increase the value of the final goods or services compared to the value of raw materials, intermediate goods, services, and other expenses employed for their production. The value captured is defined as the amount (share) of the created value that is retained by firms or subsidiaries that originally created it and that has not been transferred outside the host country (region) of those firms or subsidiaries.

The capital intensity of production largely influences the economic effects of the automotive industry, especially in terms of wages and value added per employee, which tend to increase with the growing capital intensity of production. Tier 1 suppliers should have stronger economic effects than lower-tier suppliers because the highest capital intensity of production can be found exactly among Tier 1 suppliers and assemblers. However, the vast majority of these firms are foreign-owned. This implies that an increase in value creation by foreign firms does not necessarily has to result in increasing the value capture, because of capital outflow strategies. On the other hand, lower-tie suppliers have larger direct employment and wage effects per unit of production and investment capital than higher-tier suppliers. Since higher-tier companies generate greater value per employee, their share of the total value added has been increasing. Domestic suppliers import lower shares of inputs than foreign suppliers. The higher share of domestic sourcing by assemblers and Tier 1 suppliers supports evidence that higher-tier foreign companies create and capture greater value than lower-tier firms. (Pavlínek & Ženka, 2016)

At the same time, the value creation is a fundamental precondition for successful economic development and specifically, the role of transactional corporations (TNCs) is considered to be crucial since TNCs can create opportunities for the value created by their decisions to invest in concrete countries, regions or locations. Presence of TNCs also affects supply chains. In the case of Czechia, TNC´s centralized sourcing alongside with the unavailability of particular materials or parts and often low quality of supplies by domestic suppliers caused that Czech-based foreign firms source 86.5% of their total supplies from other foreign firms both from abroad and from Czechia and only 13.5% from domestic suppliers. However, because domestic firms are typically in a worse position in comparison with experienced foreign suppliers, which have management, quality expertise and capital to grow

rapidly in foreign locations, foreign lead firms often develop supplier networks consisting almost exclusively of their established foreign suppliers. (Pavlínek, Žížalová,2014)

However, the presence of foreign firms and their investments can lead to a success story. Case of successful integration of Škoda into VW also shows how can domestic firms benefit from a partnership with foreign TNCs. However, VW owns Škoda, it also has limited value capture capability. Foreign ownership typically involves the transfer of value (profit) from firms to their foreign owners in the form of dividends. In conclusion, Škoda has experienced a successful takeover by VW, which is supported by the current size of output, profitability or product portfolio. (Pavlínek, 2015)

Specifically, its Research & Development (R&D) activities have helped Czechia to have relatively strong automotive R&D compared to Central European countries. In other words, a significant R&D expansion in Czechia was largely limited to Škoda and to a small group of the first-tier suppliers. In terms of the whole country, the number of R&D centres increased by 67, both employment and expenditure grew twice as fast as in the core EU countries between 1998 and 2007. (Pavlínek,2011a) However, the vast majority of foreign investors did not develop any R&D functions in their Czech subsidiaries despite the government incentives. (Pavlínek, 2011b)

Slovakia represents an even more extreme case of foreign ownership. Foreign companies had almost completely controlled automotive industry by 2014. The foreign capital had accounted for 98% of production value, 97% of gross investment in tangible goods, 93% of persons employed, and 96% of value added at factor cost. These shares represent the highest level of foreign control of the automotive industry in East and Central Europe. (Pavlínek, 2018) Foreign companies have chosen Slovakia mainly because of sourcing, cheap labour force and investment incentives. In contrary to the R&D environment in Czechia, even though Slovakia is integrated into the global production networks (GPNs), is dependent on the transfer of R&D from core regions. Slovakia lacks skilled R&D labour, which turned out to be the biggest obstacle for establishing sizeable R&D activities. Moreover, the number of supply linkages between domestic and foreign companies are weakly developed. Foreign subsidiaries are dependent on imports; thus, majority of domestic suppliers cannot benefit from direct spillovers from foreign companies. (Pavlínek,2018)

2.3 Input-output analysis in Literature

Wassily Leontief is considered a father of input-output (IO) analysis. He was trying to elaborate an idea of general interdependence among the various parts of the economic system, which was at the time the very foundation of economic analysis. In his very first paper, he argues that each revenue item of an enterprise or household must reappear as an outlay item in the account of some other enterprise or household which follows from the obvious nature of economic transactions. He created a simple two-way table, which represented the whole system of interconnected accounts. (Leontief, 1936)

In his later paper, he defines input-output as a description and explanation of the level of output of each sector of a given national economy in terms of its relationships to the corresponding levels of activities in all the other sectors. In its more complicated multi-regional and dynamic versions the input-output approach permits to explain the spatial distribution of output and consumption of various goods and services and their growth or decline - as the case may be - over time. Structural coefficients can describe the technical interdependence between the levels of desirable and undesirable output. In this paper, he also included value added in the table. It represented the wages, depreciation charges, profits, taxes and other costs incurred by each producing sector in addition to payments for inputs purchased from other producing sectors. In that time, most of the value added represented the cost of labour, capital, and other primary factors of production, and depends on the physical amounts of such inputs and their price. (Leontief,1970)

In modern IO analysis, the second edition of Input-output analysis, a textbook from R.Miller and P.Blair, which summarizes the contribution of many other authors, develops a framework set forth by Leontief and explores the many extensions that have been developed over the last nearly 75 years. This textbook is an updated and expanded version of the 1985 edition. (Miller & Blair, 2009)

From an empirical perspective, construction of the World input-output tables (WIOTs) was specifically important. The WIOTs, which constitute the core of the World Input-Output Database, allowed detailed tracking of intersectoral linkages. In the time of creation, the WIOTs covered the value of transactions among 35 industries in 40 countries plus the ‘Rest of the World’ and from these industries to households, governments and users of capital goods in the same set of countries. In the first release, WIOTs were available for a period 1995-2009. (Dietzenbacher et. al. 2013)

3 Automotive industry in Slovakia

3.1 Brief history of the automotive industry in Slovakia

Socialism and the arrival of the first investor

In contrast to Czechia, the automotive industry had not had a strong position in Slovakia before the Velvet Revolution. Only Bratislava with its Automotive works (Bratislavské automobilové závody - BAZ), which were built in 1971, offered suitable infrastructure and skilled labour force. Despite this fact, Slovakia has become the global leader in car production per 1000 inhabitants. The automotive industry in Slovakia has begun to transform after VW´s investment in BAZ in 1991. In the beginning, it was a joint venture of VW and BAZ, where VW held 80% share. The transformation was finalized in 1998 when VW bought the remaining 20% of the company. As the only car producer in Slovakia, VW has been subsidised by the government several times mainly in the form of tax holidays (e.g.2008).[7] Among the government, support was also subsidizing the location of foreign suppliers in Slovakia, in particular through the construction of supplier parks. In 2004, VW had 17 direct suppliers, which were almost exclusively located in particular parks – Lozorno and Küster.[8] In 2017 came important change, when the plant in Bratislava started to complete Porsche's Cayenne SUV, which became first Porsche to be manufactured outside its homeland. Thus, cars would no longer be transported to Leipzig (Germany) for completion.[9]

Modern era

Next investment came in 2003 when PSA decided to build a plant next to Trnava. PSA gave priority to Slovakia before the rest of V4 because of better infrastructure, available skilled labour force and also possibility to build an industrial park for its suppliers nearby. This decision was also supported by the government subsidy, which accounted for €152m (land and infrastructure), €11.3m for training and €1,640 for every newly created job (Pavlínek,2016). In 2003 was the total amount of subsidy estimated on SKK 6.5bn (approx. €154m).[10] An initial investment of PSA was €700m, where 90% of construction works were made by Slovak companies.[11]

Kia was another example of Slovak successful incentive strategy. Slovakia won Kia´s investment because of massive compromises, which were negotiated personally by the Slovak

[7] SME (18.12.2008): "Volkswagenu schválili investičné stimuli."
[8] Trend (14.06.2005): "VW na Slovensku rozšíri sieť dodávateľov."
[9] Financial Times (13.09.2017): " Slovakia's worker shortage threatens growth of auto industry."
[10] Trend (15.01.2003): "Je rozhodnuté: PSA postaví nový závod v Trnave."
[11] PSA: Základné údaje

delegation in South Korea. The contract between Kia and Slovakia clearly favoured the company, because Kia was to receive all of the incentives, even if it did not complete all of the investments listed in the contract, and Slovakia had no right to demand any additional investment or return of any investment incentives. Czechia and Hungary complained that the size of incentives sought by Kia violated EU and national regulations and exceeded the expected benefits of the investment. In comparison to other government incentives, Slovakia paid more than in previous cases and as the result of overbidding, paid too much for the investment (Pavlínek,2016). A memorandum was signed in 2004 and production started in 2006. Kia officially claims total investment of €1.8bn.[12]

Table 2 Overview of the Slovaks car producers

Company \ Information	Foundation	Location	# of employees (in 2018)	Turnover (€ bn in 2018)	Exports (% of Turnover in 2018)
Volkswagen	1991	Bratislava	15,189	10.38	96.3
KIA Motors	2004	Žilina	3,785	5.19	98.5
PSA Peugeot Citroën	2003	Trnava	3,766	2.8	98.0
Jaguar Land Rover	2015	Nitra	1,400*	N/A	N/A

*Source: Author´s elaboration on Trend TOP 2018. * Based on an interview in Trend with JLR plant´s director Alexander Wortberg. Available on https://www.etrend.sk/trend-archiv/rok-2018/cislo-40/sef-slovenskeho-jaguaru-nedostatok-ludi-nas-prekvapil.html*

Jaguar Land Rover (JLR) made the latest big foreign investment into Slovakia. JLR claimed to invest €1.4bn and create 2,800 new jobs. One of the main reasons, why JLR had decided for Slovakia was also *"developed supply chain with more than 300 companies and also the presence of competitors."* [Original quote in Slovak *"Hlavnými dôvodmi bola rozvinutá sieť dodávateľov s viac ako tristo firmami v krajine a aj to, že prítomnosť konkurenčných závodov ukázala, že Slovensko je miesto, kde je možné vyrábať vysokokvalitné vozidlá*."] Since Slovak suppliers have had gained necessary skills while manufacturing for VW, which produces premium brands such as Porsche or Audi, they were already suitable for JLR production. However, Slovakia proved again how important is the government subsidy in negotiations. JLR firstly preferred Warsaw, but Slovakia gained the investment because of generous offer, which also included indirect support and complex services around the investment.[13] The current capacity of the plant is 150,000 vehicles, but according to the Financial Times, JLR is planning to make the next generation of Land Rover Defender in this

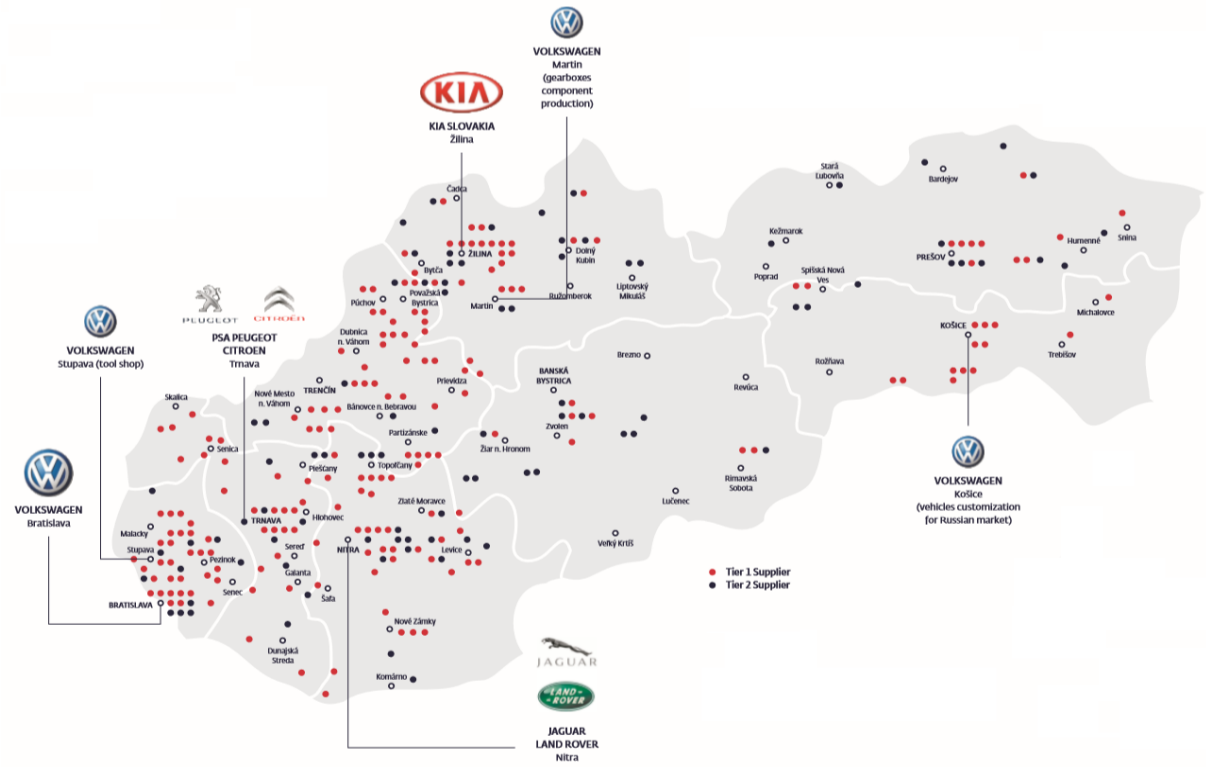
[12] Available at https://www.kia.sk/sk/o-nas/profil-spolocnosti
[13] Available at https://www.etrend.sk/trend-archiv/rok-2018/cislo-39/slovensko-je-aj-vdaka-jaguaru-dobrou-adresou-pre-automotive.html?split=all

plant and since the paint shop has been built accommodate 300,000 vehicles, this could be seen as a sign that the company plans to expand the facility.[14]

3.2 Automotive Global Value Chains in Slovakia

Car producers introduced in the previous section can be referred to as Original equipment manufacturers (OEMs) in the supply chain. However, the supply chain is composed not only from producers but mainly (in absolute terms) from suppliers. Suppliers can be divided into three groups based on their relationship with the OEM and type of their products. Tier 1 suppliers are companies that supply directly to OEMs and in many times, they also share joined partnership in R&D projects with OEMs. They are responsible for the assembly of components and just-in-time supply of modules and integration of systems. Tier 2 suppliers do not sell directly to OEMs. They are experts in their field and besides OEMs, they supply to other companies, not necessarily in the automotive industry. Usually, they produce sub-components. Tier 3 companies supply raw or close-to-raw materials like metals or plastic.

Figure 1 Car producers and selected automotive suppliers in Slovakia



Source: SARIO (2018)

Each one of OEMs has brought either its international supplying partners or domestic companies were established. Among the top VW´s suppliers are Bosch, Matador, Valeo, SAS

[14]Available at https://www.ft.com/content/0423543c-6b3d-11e9-a9a5-351eeaef6d84

Automotive or Johnson Controls. Suppliers such as Mobis, Hella, HEFRA Vráble or ZF Slovakia are important for KIA. PSA is supplied by Valeo, Visteon, Pilkington or Lear. Importance of suppliers is supported by fact, that in the period from 2008 to 2015 were established 339 new companies and closed 202. Thus, the net increase is 137 companies for over 8 years, where only in the year 2011 was net growth negative. Development of the growth of automotive suppliers in Slovakia can be found in the Appendix (Table 3). According to the OKBA portal, 268 suppliers are currently involved in the automotive industry, from which 70 are Tier 1, 105 are Tier 2 and 93 are Tier 3 suppliers. However, they are distributed disproportionately. They are mainly based in the west part of Slovakia, more precisely regions of Žilina, Trnava, Nitra. Trenčín and Bratislava, where OEMs are based as well. (see Appendix)

Table 5 Overview of the Slovaks TOP 10 automotive suppliers

Company \ Information	Foundation	Location	# of employees (in 2018)	Turnover (€ bn in 2018)	Exports (% of Turnover in 2018)
Mobis	2006	Gbeľany	1,980	1.4	N/A
Schaeffler	2000	Kysucké Nové Mesto	10,096	1.13	100
SAS Automotive	1996	Bratislava	596	0.9	0.2
Continental Matador Truck Tires	1998	Púchov	1,518	0.53	83.2
ZF Slovakia	1993	Trnava	3,215	0.58	97.4
Yura Corporation	2004	Lednické Rovne	1,630	0.38	50.3
Adient Slovakia	2005	Trenčín	2,578	0.35	65.2
ZKW Slovakia	2007	Krušovce	2,398	0.34	99
Lear Corporation Seating	2006	Prešov	1,698	0.33	N/A
Hella Slovakia Signal-Lighting	2003	Bánovce nad Bebravou	1,964	0.3	N/A

Source: Author´s elaboration on Trend TOP 2018

Suppliers based in Slovakia have been facing serious challenges in recent years, however, among the TOP 3 biggest concerns are rising labour costs, a potential decrease in orders from OEMs lack of skilled labour force. (PwC, 2019) Results in the 2019 PwC Suppliers survey also support the assumption that companies in Slovakia are mainly focusing on lower value added production phases in the GVC. Majority of companies (51%) answered that they do not have their R&D departments based in Slovakia. These are traditionally based in their foreign centres as many of them operate internationally. Thus, Slovakia is at the very bottom of the Smile curve (see Appendix), which represents value added along the GVC and where R&D together with marketing, design and services represent production phases with the highest value added and production the lowest. However, there can be found examples of successful R&D projects in Slovakia (e.g. Johnson Controls, ZKW Slovakia, Leoni, Continental Automotive, INA Schaeffler).

4 Input-Output Analyses

4.1 World Input-Output Tables

The WIOT is part of the WIOD project, which had its public inception in April 2012 and 11 international partners were involved. It belongs together with OECD/WTO Trade in Value Added database and Global Trade Analysis Project (GTAP)[15] among the most widely used IO databases. The WIOT have had 2 releases: 2013 and 2016.

WIOT Characteristics

The WIOT can be described as a set of national IO tables that relate to each other by bilateral international trade flows. The WIOT provides a detailed summary of all transactions within covered economies and between industries and final users across countries. The columns contain information on production processes. The rows contain information on a distribution of the output of industries over user categories. The gross output can be computed since its equal to the sum of all of the output uses from that industry. Schematic outline of the WIOT is in Table 6.

Table 6 Schematic Outline of the WIOT

			Use by country-industries							Final use by countries			Total Use
			Country 1			.....	Country M			Coutnry 1	.....	Country M	
			Industry 1	.....	Indutry N	.....	Industry 1	.....	Indutry N		.....		
Supply from country-industries	Country 1	Industry 1											
		.....											
		Indutry N											
	.....												
	Country M	Industry 1											
		.....											
		Indutry N											
Value added by labour and capital													
Gross output													

Source: Timmer et. al. (2015)

Construction of the WIOT – 2013 Release

The main reason why researchers had decided to create their own trade database had been the fact that official trade statistics had been collecting data with no information on the supplying industry nor on the use by the importers. Since the GTAP covered only specific benchmark years, it was not suitable for analyses of long-term trends. Thus, the World Input-Output Database was constructed as an alternative in 2012. Their very first release covered period from 1995 to 2007 and estimates for 2008 and 2009. (Dietzenbacher, 2013)

[15] Available at https://www.gtap.agecon.purdue.edu/databases/v9/default.asp

The 2013 Release has provided annual time-series of the WIOT from 1995 to 2011 and covered together 27 EU countries and 13 other world's major economies. Together, these countries covered 85% of the GDP in 2008. There is also an estimation for the non-covered part of the world called "Rest of the world" region. For each country, tables reflected how much is used and how much is produced in 35 industries mostly at the two-digit ISIC rev. 3 level or groups. (Timmer, 2015)

The WIOD contained three main data tables: IO tables, Socio-Economic Accounts and Environmental Accounts. The IO tables section is further divided into six subparts, which are described in Table 7 together with Socio-Economic and Environmental Accounts.

Table 7 WIOD main data tables

Main data table	Sub-table	Description
Input-output Tables	World IO Tables	2013 Release of the World Input-Output Tables
	World IO Tables PYP	Deflated WIOTs in Previous Years' Prices
	National IO Tables	National aggregations of the WIOTs
	Regional IO Tables	Regional aggregations of the WIOTs
	International SUTs	International Supply and Use Tables
	National SUTs	National Supply and Use Tables
	Input for SUTs	input files for National SUTs
Socio Economic Accounts	N/A	Data on employment (number of workers and educational attainment), capital stocks, gross output and value added at current and constant prices at the industry level
Environmental Accounts	N/A	Data on energy use, CO2 emissions and emissions to air at the industry level

Source: Author´s Elaboration on WIOD Data, 2013 Release

WIOT update – 2016 Release

The 2016 Release is the 3rd update of the WIOD project. This version of the database covers 28 EU countries and 15 other major economies – Croatia became part of the EU and Norway plus Switzerland were included – and "Rest of the world" region. The new release was expanded in terms of covered industries and includes data on 56 sectors and products mainly at the 2-digit ISIC revision 4 level or groups. The time period was also changed, and the 2016 Release provides an annual time-series of WIOT from 2000 to 2014. A structure of the WIOD was not changed and 2016 Release contains all three main data tables (in case of IO tables also all sub-tables) (Timmer,2016).

4.2 Methodology

The trade decomposition

Koopman, Wang & Wei (Koopman et.al, 2011) (hereafter KWW) proposed a framework for gross export decomposition, which breaks up a country´s gross export into various value added components and double-counted terms. They defined supply chains as a system of the value added sources and destinations, where each producer purchases inputs, then add value, which is included in the cost of the next stage of production. At each stage, the value added equals the value paid to the factors of production in the exporting country. However, since all official trade statistics are measured in gross terms, which into account intermediate inputs and final products as well, they double count the value of intermediate goods that cross borders more than once. This creates an inaccurate picture of global trade.

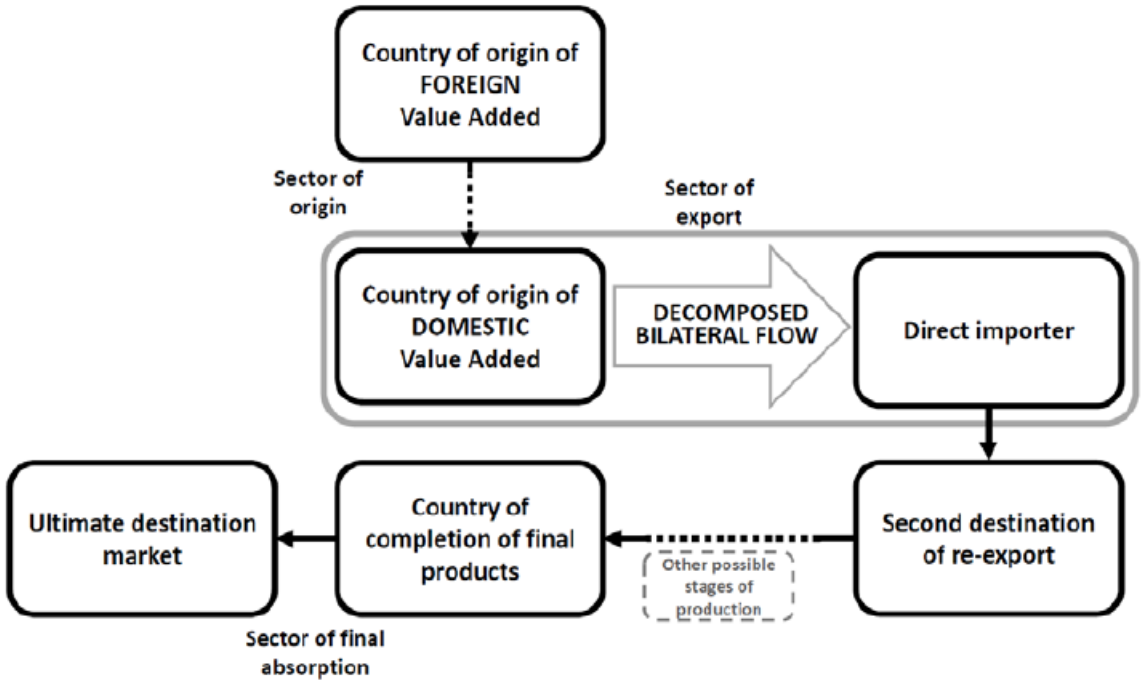
Double counted terms were specifically significant in their work because by identifying which terms are double counted and also identifying their source, they linked official trade (tracked in gross value) and national accounts statistics (tracked in value added). Double counted terms are also important in the determination of GVC-participation rate.

This paper provided not only detailed decomposition of the gross exports but also a framework for further and deeper analyses of value added. Indicators such as value added exports, domestic value added in exports, foreign value added in gross exports, domestic content and double-counted home and foreign intermediates exports can be obtained by summing its components. However, their paper had limitations for empirical applications since it cannot be applied to bilateral and sectoral dimensions of trade flows. Detailed KWW decomposition can be found in the Appendix of this thesis.

Borin and Mancini (BM) extended KWW´s methodology and in order to obtain consistent methodology of bilateral and sectoral trade flows. They overcame shortcoming and limitations that affected KWW export decomposition. BM provided proper definitions for components that were incorrectly defined for instance domestic value added (DVA) that is directly and indirectly absorbed by the final demand of importing country, foreign value added (FVA) in exports and double-counted terms produced abroad. Their work was also closely related to the Nagengast and Stehrer (from 2014) and Wang et al. (from 2013). However, as BM pointed out, Nagengast and Stohrer's methodologies could not properly account for all the domestic value added exported in the bilateral flow. Neither Wang et al.´s model was precise nor since they had used different approaches to single out domestic value added of the different components; their model suffered internal inconsistency. (Borin & Mancini, 2015)

BM did not only compiled a breakdown bilateral gross exports using a fully consistent sink-based approach, but also adopted a source-based perspective. Both their decompositions took correctly into account the DVA and double-counted components as they had been originally defined in the KWW framework and pointed out by Nagengast and Stehrer (in 2014). Difference between source and sink-based is in the perspective of value added. While the source-based approach accounts the value added the first time it is exported from the country of origin, the sink-based method accounts it the last time it crosses the national borders. In their early work (Borin & Mancini, 2015), they identified actors, which are involved in bilateral gross exports (Figure 3).

Figure 3 *The Actors involved in bilateral gross exports*



Source: BORIN, A. & M. MANCINI (2017a)

Later, they extended their working paper and described some components of the decomposition in greater detail. (Borin & Mancini, 2017a; 2017b). Since the aim of this thesis is to decompose gross exports in the automotive industry, thus the most important model is the BM´s sink-based decomposition of bilateral sectoral trade proposed in Borin, A. & M. Mancini (2017b). Its components will be used in the determination of trade indicators such as DVA, FVA, DC and its sub-parts between Slovakia and its trade partners. Detailed sink-based decomposition can be found in the Appendix.

The GVC participation

KWW defined a unified framework for vertical specialization measures using their bilateral gross export decomposition. They provided a detailed mathematical framework for Hummels,

Ishii and Yi Vertical Specialization (VS) indicator; VS1 indicator, Daudin´s VS1* indicator and Johnson and Noguera´s ratio of value added exports to gross exports. Detailed elaboration is in Figure 4 (see in Appendix).

They also described the reasons for the country´s exports of the value added to be different from its gross exports. Firstly, the export production may contain foreign value added or imported intermediate goods. Secondly, part of the domestic value added that is exported may return home after being incorporated in the imported foreign goods. The country´s position in global value chains can be obtained by analysing these two options. Specifically, the country, which specializes mainly in assembling imported components to manufacture final products tend to have a big share of foreign value added and a small share of domestic value added that returns to the initial economy.

BM also proposed the methodology on how to measure the weight of the GVC in bilateral trade based on their decomposition. Their goal was to single out the trade flows that were involved in GVC, which are defined as production processes that require at least two international shipments of intermediate inputs or final products. Thus, in order to obtain GVC-related trade, it was necessary to exclude only the share of DVA that never leaves the first importing country. In other words, it is possible to measure GVC-related trade flow simply by excluding the entire DVA of Slovakia absorbed directly by its direct importer from its total exports. Consequently, the GVC related trade share in total exports is expressed as GVC-related trade flow divided by the total exports. The source-based approach is more suitable for this model. Detailed source-based decomposition can be found in the Appendix. Thanks to this model it would possible to determine to what degree is Slovakia interconnected with the global economy.

4.3 Model

Bilateral sectoral decomposition of the Slovaks automotive industry

The WIOT data released in 2016 (3rd WIOT edition) were selected for the analyses. Borin and Mancini together with Belotti created Stata module for the analysis of Inter-Country Input-Output tables, which specifically covers BM bilateral and sectoral decomposition (Belotti et al., 2018) (ICIO module). As mentioned in WIOT section, the 2016 release covers the period from 2000 to 2014. This time series allows analysing shares of main indicators before Slovakia joined

the EU, after joining the EU and before 2009 crises and period after the crises. A detailed description of the periods is in Table 8 below.

Table 8 Period description

# Period	Name	Years	Total number of years
1	Before the EU	2000-2003	4
2	Before the Crisis	2004-2008	5
3	After the Crisis	2009-2014	6

Source: Author´s elaboration

This thesis aims to decompose bilateral gross exports from Slovakia to the biggest European economies such as Germany, France, Italy, Spain and the UK. Also covers Asian economies like China, Japan and Russia plus the USA. From a "bigger picture" perspective, there is also the decomposition for the whole EU (except Slovakia) and for the NAFTA (newly USMCA).

As mentioned in the Methodology section, BM (2017) sink-based bilateral sectoral decomposition is a key equation, from which all indicators will be calculated. For each direct importer will be three main indicators computed: DVA, FVA and Double-counted term. The DVA and the Double-counted term are further divided into sub-parts. The DVA contains three sub-parts: Direct Absorption (DA), Redirection (RED) and Reflection (REF). The Double-counted (DC) term is divided into two sub-parts: Domestic (DDC) and Foreign (FDC).

The domestic value added

The first main indicator is the Domestic value added. This indicator shows how much has concrete country contributed to the production process. Concretely, how much Slovakia contributed. In the BM (2017) model is represented by 12 components. Since gross exports consist of exports of final goods (products) and intermediate goods as well, thus, in order to obtain the complete DVA, it is necessary, to sum up, all components from 1 to 5. Components such as 2,3 and 4 have sub-components because they distinguish between the destination of the value added, where it is either the direct importer or a third country.

The DVA embedded in exports can be further broken down according to the country of final absorption. Firstly, the DA, which is defined as the DVA that serves a final demand for the direct importer. The DA is the sum of the components 1+2a+2b+3c. The DA covers final and intermediate goods. Secondly, the RED, which is defined as the DVA absorbed by the final demand in third countries. It means, that Slovaks exports are firstly imported to the direct

importer (direct trade partner) and then are re-exported to the final destination. Generally, the RED is computed as a sum of 4 components: 2c+3a+3b+3d. However, in order to track the final destination of the Slovak DVA, the RED is also decomposed into concrete countries. In this case, it is necessary to decompose 100% of the RED. Thus, it is divided into bigger economic blocks such as NAFTA, EU26 (respectively 27 in the case of the non-EU countries) then there are separately presented countries such as Russia, China and Japan. Lastly, the rest of the global economy is represented by the World. Detailed by-destination-redirection is obtained from the ICIO module. Thirdly, the REF, which represents the DVA that comes back to Slovakia to be consumed there. Generally, the REF is computed as the sum of 4 components: 4a+4b+4c+5[16]. Detailed overview of the DVA indicators can be found in Table 9.

The foreign value added

The second main indicator is FVA. In this case, the FVA represents value produced abroad, not in Slovakia. As in the previous indicator, intermediate and final goods are counted together. The FVA is sum up of 4 components: 7+8+9a+9b. To fully understand the GVC participation, it is also necessary to decompose the FVA into concrete countries or economic blocks. Since the V4 is an increasingly important region in terms of the automotive industry, each country is represented separately. Besides V4 countries, the biggest EU economies such as Germany, France, Spain, Italy and the UK are represented separately. The model also covers the rest of the EU, NAFTA members and China. Particular shares are computed from the ICIO module. However, this FVA decomposition covers only the FVA, which is absorbed by the direct importer. It means, that this decomposition does not cover the FVA share that was re-export to Slovakia or a different destination. The FVA overview is in Table 9.

Double-counted terms

Last main indicator is the DC term, which represents the items that cross the same border more than once. The DC can be obtained by summing up three terms: 6+9c+9d. It can be further distinguished into the domestic (DDC) and the foreign (FDC) components. The DDC is the term 6 and the FDC is the sum of 9c and 9d. These sub-terms also show the character of the country´s participation in the GVC. Since the DDC represents the intermediate goods, that

[16] Borin and Mancini defined the Reflection as one of three sub-components of the Domestic Value Added, which represents the DVA "that ultimately comes back to the country of origin to be consumed there." Based on their decomposition, they provided a formula for computing this sub-component: Reflection =4a+4b+4c. However, also item 5 represents the DVA that comes back to the country of origin. Thus, based on Borin and Mancini´s definition of the REF, the formula should be: Reflection = 4a+4b+4c+5. This approach is supported by empirical example provided in Borin and Mancini (2017a).

originated in Slovakia, then were used in production processes abroad and were imported back in Slovakia, the high value of the DDC would mean that Slovakia is where the production process starts. On the other hand, if the value of the FDC is high, it means that Slovakia imports already processed intermediate goods and only assembly them. The DC overview is in Table 9.

Table 9 Indicators overview

Shortcut	Indicator	Components
DVA	Domestic value added	1+2+3+4+5
DA	Dirrect absorption	1+2a+2b+3c
RED	Redirection	2c+3a+3b+3d
REF	Reflection	4a+4b+4c+5
FVA	Foreign Value added	4+8+9a+9b
DC	Double-counted term	6+9c+9d
DDC	Domestic double-counted term	6
FDC	Foreign double-counted term	9c+9d

Source: Author's elaboration on Borin and Mancini (2017a). Components in the DVA represent also sub-components, where 2=2a+2b+2c, 3=3a+3b+3c+3d and 4=4a+4b+4c.

The GVC indicator

The GVC indicator is computed from the source-based decomposition because this approach takes the perspective of the country, where the value added originated. Since by the definition the GVC indicator considers only components, which represent goods with at least two international shipments, it is necessary to exclude only two terms from the decomposition. Terms 1a* and 2a* represent absorption by the direct importer that has never left Slovakia or would be re-exported. For example, from the Slovak bilateral export to Germany, exports of final (1a*) and intermediate (2a*) goods, which are consumed directly in Germany, are excluded. The GVC indicator covers the same countries, which are covered in bilateral sectoral decomposition.

Generally, the GVC-related trade flow from Slovakia is

$$GVCX_{svk} = X_{svk} - 1a^* - 2a^*$$

where X_{svk} represents Slovak total export to 1 country. Consequently, the GVC-related trade share is

$$GVC_{svk} = \frac{GVCX_{svk}}{X_{svk}}$$

To fully understand Slovak participation in the automotive GVC, the aim of this thesis is to compare the GVC-related trade share on the regional level. Thus, a reader will be able to compare how much is Slovakia integrated into the GVCs and interconnected with the global economy. Consequently, the GVC-related trade shares of remaining V4 countries can be found in Table 10. These indicators follow the same logic as the Slovak one.

Table 10 GVC-related trade shares of Czechia, Hungary and Poland

Country	**GVC-related trade flow**	**GVC-related trade share**
Czechia	$GVCX_{cze} = X_{cze} - 1a^* - 2a^*$	$GVC_{cze} = \frac{GVCX_{cze}}{X_{cze}}$
Hungary	$GVCX_{hun} = X_{hun} - 1a^* - 2a^*$	$GVC_{hun} = \frac{GVCX_{hun}}{X_{hun}}$
Poland	$GVCX_{pol} = X_{pol} - 1a^* - 2a^*$	$GVC_{pol} = \frac{GVCX_{pol}}{X_{pol}}$

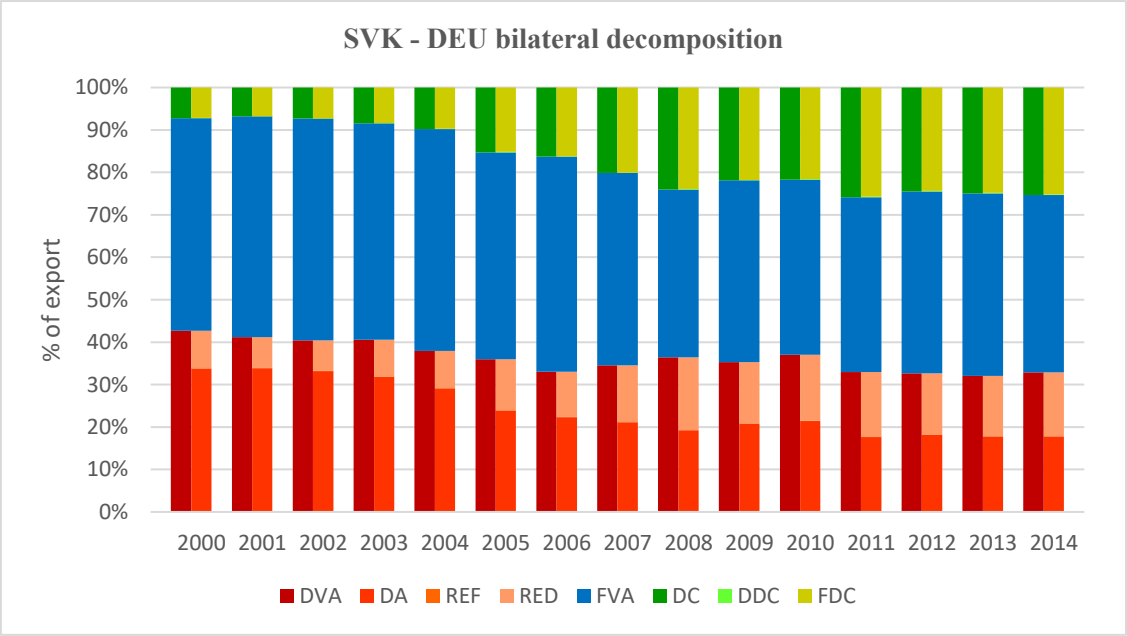
Source: Author´s elaboration. The X_{cze} represents Czech; X_{hun} represents Hungarian and X_{pol} represents Polish total export to its trade partner.

5 Results

5.1 Before the EU

This period is characterised by the production of only one car producer (VW) and several automotive suppliers. In this period, the DVA share of the Slovak exports is very similar not only across the EU members but also with the rest of observed countries. As visible in Figure 5, which represents bilateral trade with Germany, the DVA share is around 42.7%. However, two out of three of its sub-components differs across the observed sample. Differences are observed between the RED and the DA. Firstly, the consumption of direct importers was always greater than the re-export[17]. In the EU, countries like the UK or Spain were re-exporting around 15% of the Slovak exports. Germany had been re-exporting around 8% of exports from Slovakia. Contrary to that, direct consumption in Italy and France accounted for almost whole DVA. On the EU level, the RED accounted only for around 3.5% of Slovak exports. On the other hand, in the case of Russia, the RED differed across years, when it firstly accounted for around 3%, then increased to almost 9% and immediately dropped to 1%. China followed the same pattern as Russia, but Japan was constantly increasing its redirection, however, the biggest redirection share was only 2.2% (in 2003). The USA and NAFTA showed a constant decrease and in 2003 it accounted for around 0%. Secondly, the REF is around zero in all observed countries. The highest shares are in bilateral trade with Russia, where a peak was reached in 2002 (0.09%).

Figure 5 BM (2017) Decomposition of bilateral exports to Germany

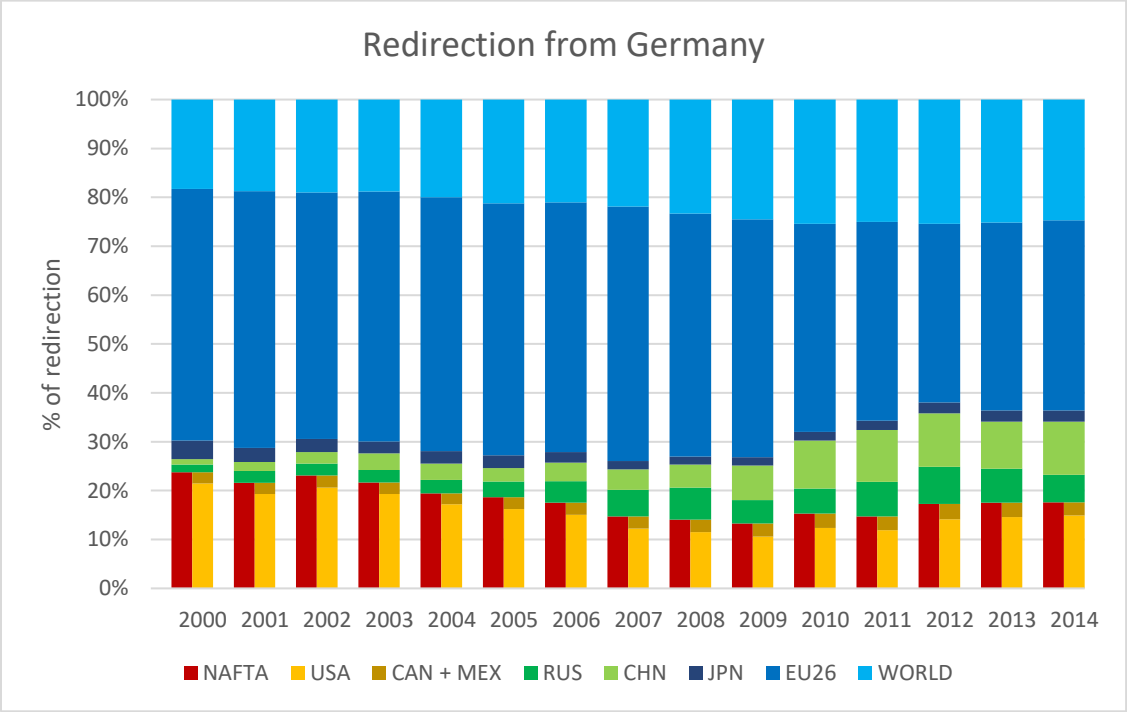


[17] In context of BM (2017) methodology, "re-export" means redirection of domestic value added, more precisely the RED sub-component of the DVA.

Source: Author´s computation

Also, the final destination of re-export differed across the sample. For all European countries was the EU ultimate destination when in all cases accounted for more than 50%. The highest share had in Spain, where it showed more than 80%. The same pattern was also observed in the rest of the shares, where World was the second most frequent destination (except Germany, where it was NAFTA or more precisely the USA). For Russia, the World was the primary destination and the EU was second. The USA was the primary destination of re-export for Japan and second for China. As for Russia, the World was the primary destination for the USA, however, the NAFTA switched place with the World in 2003 and became No.1 destination. Detailed overview of the destination of re-export from Germany can be found in Figure 6.

Figure 6 Destination of redirected Slovak export to Germany



Source: Author´s computations

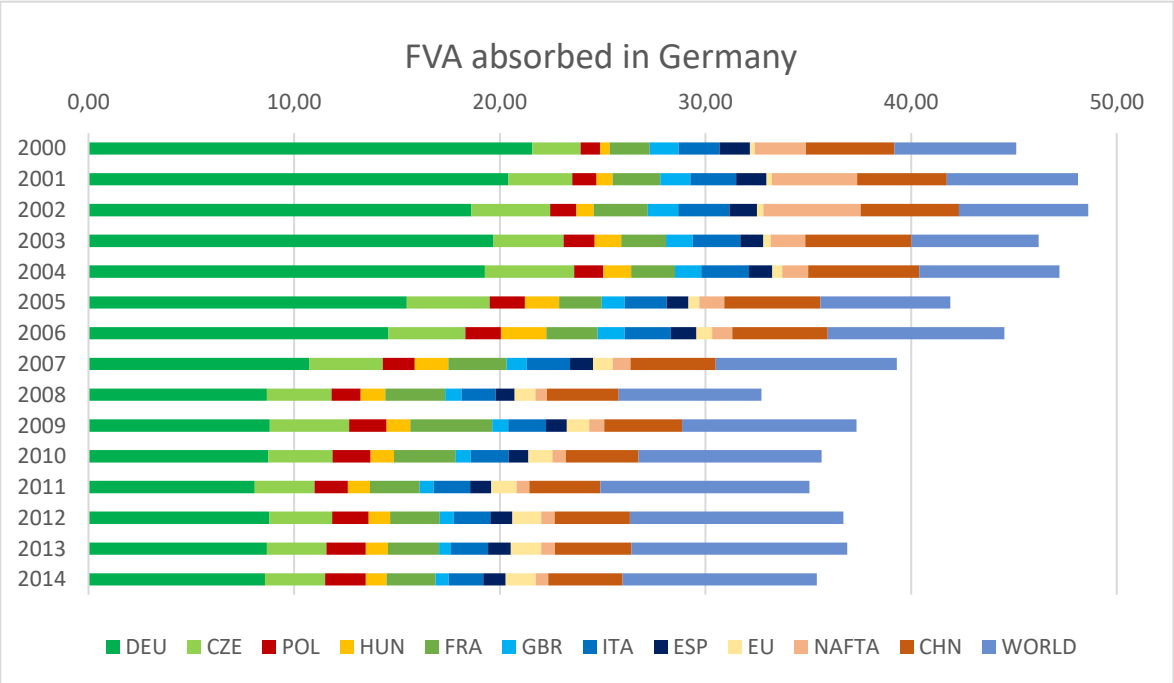
The FDA decomposition revealed that the origin of the biggest share of the FDA, which was absorbed directly by Slovak trade partners, belonged to Germany. This result supports the German status of the automotive superpower. In all observed countries, the German share of the directly absorbed FVA was almost 50%. Germany had the highest share of exports to Italy, where it accounted for 27.26% in 2000. However, its share was constantly decreasing. The second biggest contributor was World and China was third. The V4 automotive cluster was the fourth largest origin of the FVA.

The GVC-related trade accounted for more than 57% in bilateral exports with all observed trade partners. The constant increase in the GVC-related trade is observed in all countries. From the V4 perspective, only Hungary had a higher share. On the other hand, Poland and Czechia were exporters with the lowest share. However, it was always more than 35%. From the double-counting terms is visible that the FDC is always greater than the DDC. This supports the assumption that Slovakia does not create value added, but only import intermediate goods and assembles them.

5.2 Before the Crisis

This period is characterized by the V4 joining the EU and arrival of two car producers to Slovakia – KIA and PSA. In this period, the DVA immediately dropped by around 3% in the whole sample and continued in constant decline till 2007, where it slightly increased and in 2008 had the share on exports comparable to one in 2004. The REF was being steadily around zero, however, the difference between the RED and the DA was constantly widening in favour of the DA except for Germany, where the trend is opposite. In terms of the final destination of re-exported goods, the EU preserved the first place among European members, however, with a small decrease in favour of the World. In the case of Russia, the EU and the World was having similar shares of the RED. A similar trend can be observed in China and Japan, where the share of the NAFTA (more precisely the USA) and the share of the EU are declining in favour of the World. On the other hand, shares of the final destination of the US re-exports was not changing much.

Figure 7 The FVA decomposition



Source: Author's computations

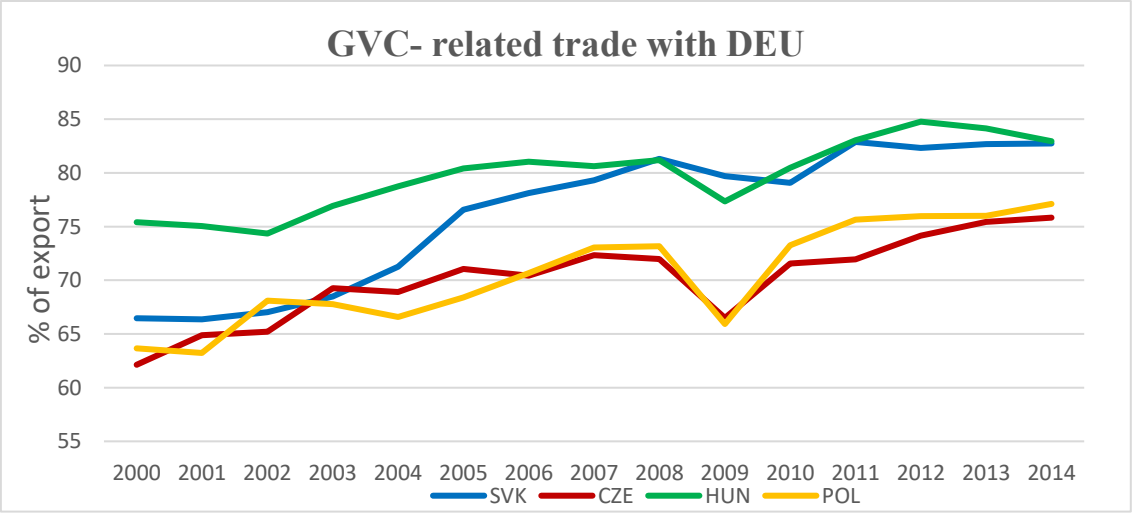
Also, the origin of the FVA absorbed by Slovak direct trade partners was changing over this period. German, Chinese and the UK shares were shrinking, whereas Visegrad countries together with the World, Italy and France were strengthening their positions. This supports the assumption that the importance of the V4 cluster has been increasing.

Hungary had the highest share of the GVC-related trade except for the UK and NAFTA, where Slovakia was No.1. Slovakia was No.2 in the rest of the cases except for Japan, where Czechia and Poland had similar shares only Slovakia had smaller. Slovakia had always shared more than 55% of exports in the whole sample. The double-counted terms had different involvements with different trade partners. The FDC rose in trade with Germany, France, Italy or Russia and falls in trade with China, the USA or the UK. In Spain was stagnating.

5.3 Post-crisis period

The increase of the DVA at the end of the previous period was immediately followed by the constant decrease, and in 2014 the DVA share of Slovak exports was around 10% lower than in 2000. In Germany, the RED had steadily grown and in 2014 the DA was only bigger only by 2.69% (17.76% vs 15.07%). In the rest of the sample, the DA, as the sub-component of the DVA, was shrinking as well, however, always outbalanced the RED and accounted for the greater part of the DA. The trend of diminishing EU share as the final destination of re-exports continued, whereas China, Russia and the World became a more frequent destination of the Slovak value added than they used to be in 2000.

Figure 8 *GVC-related trade in export to Germany*



Source: Author´s computations

At the expense of the DVA, the FVA was gaining a greater share of Slovak exports. This shift followed the trend established in the 2nd period. In many observed trade partners such

as the UK, France, Italy, China, Japan or the USA, the FDA accounted for more than 60% of exports. Even if the FDA was the greatest indicator in Germany and Spain, it did not account for more than 50% of exports, and in Russia, it was only around 55%. The DC or more precisely the FDC was also a significant indicator in these three countries.

Also, the composition of the origin of the FVA was following the trend from the 2nd period. Shares of Visegrad countries, the EU, China and the World were increasing at the expense of Germany, NAFTA and the UK.

In the last period, Slovakia became No.2 in terms of GVC participation except trade with Japan and Russia. Slovak exports to Russia was interconnected with other economies more than other Visegrad countries. On the other hand, Slovak exports to Japan were the second-lowest. Generally, GVC participation had increased in all countries except the UK, where the DA had increased over time.

All remaining tables and figures are in Appendix A. BM (2017) bilateral sectoral decompositions, detailed RED (re-exports) decomposition as well as detailed FVA decomposition are in section Tables. The GVC-participation development is in section Figures.

6 Implications

It is apparent that Slovakia is largely integrated into the automotive GVCs from the GVC indicator because of the EU membership, its geographical position (part of the V4 cluster), and the presence of large automotive groups, such as VW or PSA. However, an increasing share of the GVC participation means that lower and lower share of exports is produced in Slovakia and absorbed by the direct importer. A decreasing share of domestic value added and its supplementation with foreign value added during observed period supports the assumption that Slovakia is only a car factory, where a majority of components is imported and only the final assembly work is done in Slovakia. A recent investment by JLR would probably only worsen this disequilibrium.

Slovakia is interconnected not only with the EU but with the whole world. Considering the recent changes in global trade, shifting from globalism to trade policies based on national interests, Slovakia is mainly exposed to indirect threats caused by changes abroad. One of the biggest current macroeconomic threats are Brexit or the possibility of a trade war between the USA and EU. Slovak vulnerability to the consequences of international affairs has grown following the investment of JLR. However, Slovak automotive industry is facing serious challenges at home, as well. Lack of skilled labour force, insufficient infrastructure and rising labour costs are serious threats to the growth of the most important sector in the Slovak economy.

Moreover, the increasing importance of the Visegrad region shows that Slovakia will be even more under pressure from its neighbours and will eventually have to compete even harder for every single investment. However, these foreign investments should be mainly in production phases with higher added value than is production. Since it's unlikely that parent companies of international car groups will relocate their design studios from home states (Germany, France, South Korea, Japan), Slovakia should support local R&D programmes and incentivise foreign companies to not only build a new factory but to place R&D centres in here. In order to attract such investments, Slovakia has to change its educational system first, to raise a skilled labour force and also attract researchers from abroad. Slovakia should also focus on marketing and support collaboration between the creative and the automotive industry. We should follow the German example, where one-fourth of all R&D employees work in the automotive industry.

Since connections between the Visegrad members are tightening, Slovakia should also invest in infrastructure and increase the quality and net of high-speed roads not only in Western part, which has always been viewed as a heart of Slovak industry, but also in Eastern part of the country in order to increase attractivity for other suppliers, who want to invest in this region. The good connection will help to employ skilled labour force from this region, which had been previously unused. Thus, Slovakia should reconsider the maximal regional intensities of investment aid more precisely increase those for regions of Košice and Prešov.

Electromobility and car-sharing are trends that will shape not so distance future of the automotive industry. According to KPMG´s 2017 Global automotive executive survey, by 2025 more than half of all current car owners, will no longer want to own the car. Increasing production automation is also considered as a threat for employees. Moreover, with almost fully automated production and low level of R&D, Slovakia could stop benefit from the presence of automotive firms in terms of employment. Without doubt, Slovakia has been successfully attracting foreign investors in this sector, however, in order to not become second Detroit, Slovakia has to change its course.

7 Conclusion

This bachelor thesis provides insights into the composition of Slovak automotive exports on a bilateral level. The text constitutes detailed decomposition of origin and destination of value added in these exports. The main contribution of this thesis lies in presenting changing shares of value added components in exports for fourteen years. Moreover, it describes which countries do the foreign parts come from and what parts of the world are the final destination of Slovak value added.

In order to draw a complete conclusion and recommendation on the matter for Slovakia, the thesis starts with a brief description of the main actors in the automotive industry. It continues with a description of input-output tables, which were used in Borin and Mancini´s bilateral sectoral decomposition and in the determination of GVC participation. By using BM (2017) decomposition, more precise results were obtained for Slovak exports and new trends in the automotive GVCs were described. Results of this thesis support the assumption that Slovakia is fully integrated into GVCs and that Visegrad cluster is following the same pattern. From the bilateral perspective, Slovakia is constantly decreasing its share on exports, represented in the model by the Domestic value added indicator, partially because of participation in GVCs and partially because of focusing on production phases with a lower value added. In order to preserve its position and secure jobs, Slovakia should focus more on R&D and marketing.

Origin of the foreign value added component in exports has been changing over the observed period as well. Importance of Germany, the UK and the NAFTA have been decreasing, whereas the Visegrad group, France and China have been increasing their shares. This supports the assumption of shifting production capacities to Central Europe. Final destinations of redirected (re-exported) Slovak value added have been changing as well. For instance, even though the EU remained the biggest importer of re-exports from Germany, China and the rest of the World have been gaining its importance. However, the final destination of redirected final and intermediate goods has been heavily affected by the distance between direct importer of Slovak exports and the final destination.

This thesis could be further extended in terms of observed countries and years. Moreover, in order to better understand evolving GVCs in Middle Europe, the same BM (2017) bilateral sectoral decomposition could be based on exports from Czechia, Poland and Hungary.

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Appendix A

Tables

Table 3 Development of new businesses

	Employees	2008	2009	2010	2011	2012	2013	2014	2015
New businesses	SUM	27	34	31	44	27	35	74	67
	0 - 4	20	28	27	41	23	33	69	61
	5 - 9	1	0	1	2	2	1	3	1
	10+	6	6	3	1	2	1	2	5
Closed businesses	SUM	12	17	14	55	22	26	15	41
	0 - 4	11	11	11	52	20	26	15	40
	5 - 9	0	0	1	2	0	0	0	0
	10+	1	6	2	1	2	0	0	1
NET GROWTH	SUM	15	17	17	-11	5	9	59	26
	0 - 4	9	17	16	-11	3	7	54	21
	5 - 9	1	0	0	0	2	1	3	1
	10+	5	0	1	0	0	1	2	4

Source: Author´s elaboration on data from the Slovak Statistical Office. Table 3 describes New and Closed business in Divisions 29 and 30 classified in NACE Rev. 2

Table 4 Tier suppliers in Slovak regions

	Tier 1	Tier 2	Tier 3
Bratislava	19	12	16
Trnava	10	13	8
Nitra	7	18	12
Žilina	10	19	14
Trenčín	10	18	16
Banská Bystrica	4	7	8
Prešov	2	13	15
Košice	8	5	4

Source: Author´s elaboration on the OKBA database

Table 11 BM (2017) Decomposition of bilateral exports to Spain

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.68	27.89	0.03	14.76	38.18	19.16	0.04	19.12
2001	41.15	24.73	0.04	16.38	36.8	22.06	0.07	21.99
2002	40.37	21.34	0.07	18.96	33.44	26.2	0.12	26.08
2003	40.59	32.71	0.01	7.87	48.02	11.37	0.03	11.34
2004	37.97	32.38	0.01	5.58	52.95	9.06	0.01	9.05
2005	36.04	28.69	0.01	7.34	51.02	12.95	0.02	12.93
2006	33.14	25.79	0.01	7.34	52.12	14.75	0.02	14.73
2007	34.67	26.83	0.01	7.83	50.64	14.69	0.03	14.66
2008	36.54	26.07	0.01	10.46	45.32	18.14	0.03	18.11
2009	35.39	24.08	0.01	11.3	44.08	20.5	0.03	20.47
2010	37.15	29.15	0.01	7.99	49.35	13.48	0.02	13.46
2011	33.01	25.25	0.01	7.75	51.29	15.7	0.03	15.67
2012	32.72	25.15	0.01	7.56	51.77	15.51	0.04	15.47
2013	32.14	22.88	0.01	9.25	48.39	19.46	0.04	19.42
2014	32.99	23.88	0.01	9.1	48.58	18.43	0.03	18.4

Source: Author´s computation

Table 12 Destination of redirected Slovak export to Spain

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	4.35	3.38	0.24	0.26	0.98	82.25	12.18
2001	5.05	3.29	0.51	0.37	0.90	81.64	11.98
2002	5.84	3.54	0.38	0.48	0.62	81.37	11.93
2003	4.93	3.39	0.49	0.77	0.53	80.71	12.90
2004	4.80	3.33	0.78	0.82	0.82	78.34	14.69
2005	4.80	3.24	1.34	0.61	0.58	76.48	16.49
2006	4.54	3.03	2.03	0.80	0.49	76.92	15.49
2007	4.02	2.55	3.63	0.80	0.45	75.25	16.19
2008	3.49	2.23	5.33	0.87	0.45	73.33	16.78
2009	3.49	2.02	1.74	1.07	0.41	76.24	17.32
2010	4.09	2.39	2.36	1.66	0.48	72.41	19.31
2011	4.26	2.62	3.52	2.02	0.56	70.10	19.91
2012	5.64	3.64	4.42	2.42	0.71	64.21	23.08
2013	5.45	3.57	3.93	2.23	0.62	64.85	23.35
2014	7.64	5.68	1.97	2.01	0.66	67.25	20.85

Source: Author´s computation

Table 13 The FVA decomposition in export to Spain

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	17.79	1.94	0.77	0.4	1.6	1.16	1.64	1.23	0.19	2.04	3.55	4.9
2001	14.86	2.27	0.86	0.57	1.68	1.07	1.62	1.08	0.2	3.01	3.18	4.65
2002	11.9	2.45	0.81	0.53	1.68	0.95	1.59	0.87	0.19	3.03	3.05	4.02
2003	20.32	3.51	1.57	1.33	2.23	1.33	2.4	1.19	0.38	1.73	5.33	6.36
2004	21.52	4.85	1.6	1.5	2.39	1.43	2.59	1.28	0.53	1.42	6.02	7.62
2005	18.73	4.87	2.09	2.01	2.5	1.36	2.46	1.28	0.63	1.48	5.64	7.64
2006	16.96	4.36	2.02	2.57	2.91	1.52	2.61	1.47	0.89	1.13	5.42	9.99
2007	13.76	4.57	2	2.09	3.63	1.26	2.69	1.43	1.22	1.12	5.3	11.3
2008	11.93	4.34	1.93	1.66	4.02	1.08	2.31	1.25	1.39	0.78	4.79	9.57
2009	10.33	4.51	2.15	1.35	4.66	0.92	2.14	1.2	1.27	0.85	4.43	9.95
2010	12.04	4.33	2.53	1.57	4.14	1.02	2.52	1.33	1.61	0.9	4.87	12.28
2011	11.78	4.23	2.36	1.58	3.5	0.99	2.59	1.48	1.8	0.9	5.05	14.79
2012	12.35	4.28	2.5	1.45	3.39	0.97	2.49	1.51	1.96	0.93	5.13	14.56
2013	11.32	3.77	2.51	1.38	3.26	0.74	2.36	1.44	1.93	0.87	4.85	13.67
2014	11.7	3.98	2.71	1.39	3.24	0.88	2.29	1.47	2	0.82	4.94	12.88

Source: Author´s computation

Table 14 BM (2017) Decomposition of bilateral exports to France

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.7	41.66	0	1.04	55.9	1.39	0	1.39
2001	41.21	39.94	0	1.27	56.99	1.8	0	1.8
2002	40.49	38.78	0	1.71	57.06	2.47	0	2.47
2003	40.62	37.47	0.01	3.14	54.83	4.54	0	4.54
2004	37.98	32.14	0.01	5.83	52.55	9.46	0.01	9.45
2005	36.04	24.18	0.03	11.83	43.23	20.73	0.02	20.71
2006	33.15	31.05	0	2.1	62.69	4.16	0.01	4.15
2007	34.69	33.58	0	1.11	63.28	2.04	0.01	2.03
2008	36.57	35.53	0	1.04	61.68	1.75	0.01	1.74
2009	35.41	34.41	0	1	62.8	1.78	0.01	1.77
2010	37.15	35.52	0	1.63	60.11	2.72	0.02	2.7
2011	33.03	31.52	0	1.51	63.94	3.04	0.02	3.02
2012	32.74	31.64	0	1.1	65	2.27	0.02	2.25
2013	32.15	30.94	0	1.21	65.26	2.57	0.02	2.55
2014	32.98	31.17	0	1.81	63.29	3.7	0.03	3.67

Source: Author´s computation

Table 15 Destination of redirected Slovak export to France

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	8.64	7.61	0.45	1.01	1.44	69.34	19.15
2001	8.58	7.37	0.77	1.09	1.38	68.26	19.97
2002	8.36	6.95	0.99	1.18	1.37	68.41	19.77
2003	7.79	6.45	1.34	1.57	1.39	67.40	20.63
2004	7.01	5.82	1.71	1.65	1.32	67.33	21.11
2005	6.85	5.59	1.90	1.69	1.30	65.82	22.61
2006	6.78	5.48	2.78	2.26	1.21	64.27	23.01
2007	6.22	4.97	3.29	2.15	1.23	63.69	24.04
2008	6.44	5.20	3.97	2.52	1.26	59.60	27.18
2009	6.18	4.92	2.66	2.96	1.10	58.80	29.52
2010	6.55	5.20	3.31	3.74	1.38	56.51	29.62
2011	6.90	5.39	4.38	4.21	1.40	54.29	29.83
2012	6.79	5.36	4.96	4.42	1.53	52.84	30.71
2013	7.31	5.67	4.25	4.47	1.35	54.92	29.09
2014	7.65	6.04	4.57	4.63	1.28	55.89	27.34

Source: Author´s computation

Table 16 The FVA decomposition in export to France

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	26.7	2.91	1.16	0.6	2.4	1.73	2.47	1.84	0.28	3.07	5.33	7.35
2001	24.14	3.69	1.36	0.92	2.73	1.74	2.63	1.75	0.32	4.89	5.17	7.55
2002	21.81	4.49	1.48	0.98	3.08	1.75	2.9	1.59	0.35	5.55	5.58	7.37
2003	23.29	4.02	1.79	1.52	2.56	1.53	2.75	1.36	0.44	1.98	6.11	7.29
2004	21.3	4.8	1.58	1.48	2.36	1.41	2.56	1.26	0.53	1.4	5.96	7.55
2005	15.65	4.07	1.74	1.68	2.09	1.14	2.06	1.07	0.53	1.23	4.72	6.39
2006	20.45	5.26	2.43	3.1	3.51	1.83	3.15	1.77	1.07	1.36	6.53	12.05
2007	17.25	5.73	2.51	2.62	4.55	1.58	3.37	1.8	1.53	1.4	6.65	14.17
2008	16.3	5.92	2.64	2.27	5.49	1.48	3.16	1.7	1.9	1.07	6.55	13.08
2009	14.79	6.45	3.07	1.93	6.68	1.31	3.07	1.72	1.82	1.22	6.34	14.24
2010	14.68	5.28	3.09	1.91	5.05	1.25	3.08	1.63	1.96	1.1	5.94	14.97
2011	14.71	5.28	2.95	1.97	4.37	1.24	3.24	1.85	2.25	1.13	6.31	18.48
2012	15.55	5.39	3.15	1.83	4.27	1.22	3.13	1.9	2.46	1.17	6.46	18.33
2013	15.33	5.11	3.4	1.87	4.41	1	3.19	1.95	2.62	1.18	6.57	18.51
2014	15.29	5.2	3.55	1.81	4.23	1.15	2.99	1.92	2.62	1.07	6.46	16.83

Source: Author´s computation

Table 17 BM (2017) Decomposition of bilateral exports to the UK

% export	**DVA**	**DA**	**REF**	**RED**	**FVA**	**DC**	**DDC**	**FDC**
2000	42.68	27.89	0	14.79	37.52	19.78	0.01	19.77
2001	41.21	27.37	0.01	13.83	39.09	19.71	0.01	19.7
2002	40.48	26.04	0.01	14.43	38.36	21.15	0.01	21.14
2003	40.62	26.04	0.01	14.57	38.13	21.24	0.01	21.23
2004	37.97	28.32	0	9.65	46.29	15.73	0.01	15.72
2005	36.03	26.03	0	10	46.29	17.67	0.01	17.66
2006	33.13	23.85	0	9.28	48.25	18.63	0.02	18.61
2007	34.68	31.69	0	2.99	59.69	5.64	0.01	5.63
2008	36.57	32.24	0	4.33	55.94	7.49	0.01	7.48
2009	35.43	32.08	0	3.35	58.46	6.11	0.01	6.1
2010	37.18	34.06	0	3.12	57.54	5.28	0.01	5.27
2011	33.02	29.73	0	3.29	60.27	6.7	0.01	6.69
2012	32.76	30.51	0	2.25	62.63	4.61	0	4.61
2013	32.18	30.47	0	1.71	64.2	3.61	0	3.61
2014	33.01	31.2	0	1.81	63.31	3.67	0	3.67

Source: Author´s computation

Table 18 Destination of redirected Slovak export to the UK

% of Redirection	**NAFTA**	**USA**	**RUS**	**CHN**	**JPN**	**EU26**	**WORLD**
2000	21.29	18.96	0.46	0.97	2.61	53.39	21.32
2001	21.59	19.04	0.80	1.24	2.98	51.10	22.33
2002	24.19	21.44	1.05	1.19	2.67	49.51	21.45
2003	23.31	21.07	1.80	1.37	2.97	49.02	21.62
2004	20.58	18.36	3.47	1.59	3.07	49.50	21.90
2005	20.66	18.44	4.21	1.66	2.67	47.51	23.40
2006	18.52	16.18	5.05	2.00	2.13	48.59	23.89
2007	14.69	12.46	6.73	2.35	2.39	49.28	24.72
2008	14.53	12.10	9.47	3.15	1.70	45.02	26.32
2009	14.52	11.94	5.62	3.86	1.60	47.12	27.48
2010	16.06	13.20	5.64	5.83	1.75	41.93	28.96
2011	14.67	12.14	7.50	6.80	1.60	40.11	29.47
2012	15.32	12.66	10.37	8.12	1.77	33.53	31.03
2013	17.49	14.55	8.18	11.19	1.81	24.98	36.45
2014	17.26	14.72	6.19	11.82	1.56	33.26	30.03

Source: Author´s computation

Table 19 The FVA decomposition in export to the UK

% of exports	**DEU**	**CZE**	**POL**	**HUN**	**FRA**	**GBR**	**ITA**	**ESP**	**EU**	**NAFTA**	**CHN**	**WORLD**
2000	17.7	1.93	0.77	0.4	1.59	1.15	1.64	1.22	0.19	2.03	3.53	4.87
2001	16.37	2.5	0.95	0.62	1.85	1.18	1.78	1.19	0.22	3.31	3.5	5.12
2002	14.49	2.98	0.98	0.65	2.05	1.16	1.93	1.05	0.23	3.69	3.71	4.9
2003	16.05	2.77	1.24	1.05	1.76	1.05	1.89	0.94	0.3	1.37	4.21	5.02
2004	18.75	4.22	1.39	1.3	2.08	1.24	2.25	1.11	0.46	1.24	5.24	6.64
2005	16.95	4.4	1.89	1.82	2.26	1.23	2.23	1.16	0.57	1.34	5.11	6.92
2006	15.64	4.02	1.86	2.37	2.68	1.4	2.41	1.35	0.82	1.04	4.99	9.21
2007	16.28	5.41	2.37	2.47	4.29	1.49	3.18	1.7	1.44	1.32	6.27	13.37
2008	14.77	5.37	2.4	2.05	4.98	1.34	2.86	1.54	1.72	0.97	5.94	11.85
2009	13.77	6.01	2.86	1.8	6.22	1.22	2.86	1.6	1.7	1.13	5.9	13.27
2010	14.07	5.06	2.96	1.83	4.84	1.19	2.95	1.56	1.88	1.05	5.69	14.35
2011	13.88	4.98	2.79	1.86	4.12	1.17	3.06	1.74	2.12	1.06	5.95	17.43
2012	14.99	5.2	3.04	1.76	4.12	1.18	3.02	1.84	2.38	1.13	6.23	17.68
2013	15.1	5.03	3.35	1.84	4.35	0.99	3.14	1.92	2.58	1.16	6.47	18.23
2014	15.32	5.21	3.55	1.81	4.24	1.16	2.99	1.93	2.62	1.07	6.47	16.87

Source: Author´s computation

Table 20 BM (2017) Decomposition of bilateral exports to Italy

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.71	42.5	0	0.21	57.02	0.27	0	0.27
2001	41.21	40.75	0	0.46	58.15	0.64	0	0.64
2002	40.48	38.51	0	1.97	56.68	2.84	0	2.84
2003	40.62	38.39	0	2.23	56.17	3.21	0	3.21
2004	37.98	37	0	0.98	60.42	1.58	0	1.58
2005	36.05	34.91	0	1.14	61.96	1.99	0	1.99
2006	33.14	32.65	0	0.49	65.89	0.96	0	0.96
2007	34.67	34.23	0	0.44	64.48	0.83	0	0.83
2008	36.58	35.98	0	0.6	62.39	1.02	0	1.02
2009	35.44	34.23	0	1.21	62.4	2.17	0.01	2.16
2010	37.17	34.17	0.01	2.99	57.85	4.97	0.01	4.96
2011	33.03	29.88	0.01	3.14	60.71	6.27	0.02	6.25
2012	32.73	30.21	0	2.52	62.14	5.11	0.01	5.1
2013	32.15	29.99	0	2.16	63.34	4.5	0.01	4.49
2014	33	30.52	0	2.48	62.03	4.95	0.01	4.94

Source: Author´s computation

Table 21 Destination of redirected Slovak export to Italy

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	14.27	12.32	1.03	1.66	2.09	57.98	23.04
2001	13.24	11.37	1.26	1.91	1.87	58.92	22.86
2002	13.14	11.16	1.42	2.02	1.87	59.20	22.47
2003	12.18	10.28	1.56	2.56	1.80	59.73	22.34
2004	12.04	10.23	2.09	2.99	1.86	56.42	24.78
2005	12.25	10.39	2.28	2.59	1.76	56.23	25.11
2006	11.91	9.85	2.64	3.48	1.52	54.79	26.07
2007	10.32	8.34	3.35	3.42	1.32	54.59	27.39
2008	9.50	7.60	4.28	3.50	1.36	52.51	29.25
2009	8.49	6.75	3.19	4.56	1.40	50.75	32.01
2010	9.47	7.37	4.13	5.48	1.37	48.52	31.47
2011	10.15	7.78	4.77	6.17	1.46	45.74	32.20
2012	11.90	9.44	4.44	5.02	1.76	44.46	32.92
2013	12.60	10.10	4.51	5.37	1.62	44.24	32.18
2014	14.23	11.90	3.46	5.65	1.66	43.85	31.63

Source: Author´s computation

Table 22 The FVA decomposition in export to Italy

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	27.26	2.98	1.18	0.61	2.45	1.77	2.52	1.88	0.29	3.13	5.44	7.5
2001	24.65	3.77	1.42	0.94	2.79	1.78	2.68	1.79	0.32	4.99	5.28	7.71
2002	21.67	4.46	1.47	0.97	3.06	1.74	2.89	1.58	0.35	5.52	5.54	7.32
2003	23.88	4.12	1.84	1.56	2.63	1.57	2.82	1.4	0.45	2.03	6.26	7.47
2004	24.63	5.55	1.83	1.71	2.73	1.64	2.96	1.46	0.61	1.62	6.89	8.73
2005	22.86	5.94	2.55	2.46	3.05	1.66	3.01	1.56	0.77	1.8	6.89	9.33
2006	21.54	5.54	2.56	3.26	3.69	1.93	3.32	1.86	1.13	1.44	6.88	12.7
2007	17.61	5.85	2.56	2.67	4.64	1.61	3.44	1.83	1.56	1.43	6.78	14.46
2008	16.51	6	2.68	2.3	5.56	1.5	3.2	1.73	1.92	1.08	6.64	13.25
2009	14.71	6.42	3.06	1.92	6.65	1.3	3.05	1.71	1.81	1.21	6.3	14.17
2010	14.12	5.08	2.97	1.84	4.85	1.2	2.96	1.57	1.89	1.05	5.71	14.4
2011	13.95	5.01	2.8	1.87	4.15	1.18	3.07	1.75	2.13	1.07	5.98	17.51
2012	14.85	5.15	3.01	1.75	4.08	1.17	2.99	1.82	2.35	1.12	6.17	17.51
2013	14.86	4.95	3.29	1.81	4.28	0.97	3.1	1.89	2.54	1.14	6.37	17.95
2014	14.98	5.1	3.48	1.77	4.15	1.13	2.93	1.88	2.56	1.05	6.33	16.5

Source: Author´s computation

Table 23 BM (2017) Decomposition of bilateral exports to Russia

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.69	39.64	0.02	3.03	53.25	4.06	0.02	4.04
2001	41.2	37.74	0.03	3.43	53.92	4.89	0.02	4.87
2002	40.43	31.53	0.09	8.81	46.66	12.91	0.06	12.85
2003	40.63	39.71	0.01	0.91	58.05	1.33	0.01	1.32
2004	37.98	36.8	0.01	1.17	60.09	1.92	0.01	1.91
2005	36.04	35.23	0.01	0.8	62.52	1.44	0.01	1.43
2006	33.14	32.95	0	0.19	66.45	0.4	0	0.4
2007	34.63	29.52	0.03	5.08	55.73	9.62	0.04	9.58
2008	36.5	28.85	0.06	7.59	50.24	13.25	0.07	13.18
2009	35.42	29.78	0.04	5.6	54.34	10.25	0.03	10.22
2010	37.13	31.06	0.04	6.03	52.61	10.24	0.05	10.19
2011	32.98	27.45	0.04	5.49	55.81	11.22	0.06	11.16
2012	32.69	27.3	0.03	5.36	56.21	11.08	0.05	11.03
2013	32.12	26.5	0.04	5.58	56.03	11.83	0.05	11.78
2014	32.99	27.05	0.01	5.93	54.95	12.05	0.02	12.03

Source: Author´s computation

Table 24 Destination of redirected Slovak export to Russia

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	10.01	8.99	0.00	3.56	4.21	35.40	47.34
2001	8.20	7.33	0.00	4.66	3.55	41.44	42.75
2002	8.24	7.40	0.00	5.06	3.05	39.35	44.92
2003	8.94	7.96	0.00	6.23	3.21	43.34	38.98
2004	8.79	7.70	0.00	4.67	2.99	43.23	41.04
2005	9.03	7.90	0.00	4.53	2.94	42.63	41.62
2006	9.37	8.13	0.00	4.64	2.64	43.88	40.33
2007	7.86	6.67	0.00	4.20	2.94	36.89	48.93
2008	7.96	6.73	0.00	4.67	2.96	41.71	43.52
2009	7.42	6.29	0.00	6.43	3.37	38.71	44.62
2010	8.36	7.09	0.00	6.85	4.24	37.98	43.32
2011	7.77	7.00	0.00	8.64	4.34	37.22	42.57
2012	7.20	6.09	0.00	8.49	4.64	31.00	49.50
2013	6.75	5.57	0.00	7.93	4.23	23.12	58.74
2014	7.16	5.91	0.00	8.43	4.43	22.42	57.89

Source: Author´s computation

Table 25 The FVA decomposition in export to Russia

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	25.41	2.77	1.1	0.57	2.28	1.65	2.35	1.75	0.27	2.92	5.07	4.99
2001	22.81	3.48	1.32	0.87	2.58	1.65	2.48	1.65	0.3	4.62	4.88	5.19
2002	17.73	3.65	1.21	0.8	2.51	1.42	2.36	1.29	0.29	4.52	4.54	4.16
2003	24.73	4.27	1.9	1.61	2.72	1.62	2.92	1.45	0.47	2.1	6.48	5.45
2004	24.51	5.52	1.82	1.7	2.72	1.63	2.94	1.45	0.61	1.62	6.85	6.71
2005	23.08	6	2.57	2.48	3.08	1.68	3.04	1.58	0.78	1.82	6.95	7.27
2006	21.74	5.59	2.58	3.29	3.73	1.95	3.35	1.88	1.14	1.45	6.94	10.27
2007	15.16	5.04	2.21	2.3	4	1.38	2.96	1.58	1.35	1.23	5.84	10.5
2008	13.22	4.8	2.14	1.84	4.45	1.2	2.56	1.38	1.54	0.86	5.31	8.7
2009	12.78	5.58	2.66	1.67	5.77	1.13	2.65	1.48	1.57	1.05	5.48	10.85
2010	12.83	4.61	2.7	1.67	4.41	1.09	2.69	1.42	1.72	0.96	5.19	11.13
2011	12.81	4.6	2.57	1.72	3.81	1.08	2.82	1.61	1.95	0.98	5.49	13.91
2012	13.4	4.65	2.71	1.58	3.68	1.06	2.7	1.64	2.12	1.01	5.57	13.68
2013	13.12	4.37	2.91	1.6	3.78	0.86	2.73	1.67	2.24	1.01	5.62	13.94
2014	13.26	4.51	3.08	1.57	3.67	1	2.59	1.67	2.27	0.93	5.6	13.36

Source: Author´s computation

Table 26 BM (2017) Decomposition of bilateral exports to China

% export	**DVA**	**DA**	**REF**	**RED**	**FVA**	**DC**	**DDC**	**FDC**
2000	42.71	36.56	0	6.15	48.97	8.31	0	8.31
2001	41.22	36.01	0	5.21	51.28	7.5	0	7.5
2002	40.49	39.5	0	0.99	58.03	1.48	0	1.48
2003	40.62	39.44	0	1.18	57.61	1.75	0	1.75
2004	37.99	35.69	0	2.3	58.2	3.8	0	3.8
2005	36.04	35.9	0	0.14	63.67	0.27	0	0.27
2006	33.15	33.03	0	0.12	66.6	0.25	0	0.25
2007	34.68	34.39	0	0.29	64.78	0.53	0	0.53
2008	36.58	36.42	0	0.16	63.14	0.27	0	0.27
2009	35.45	35.26	0	0.19	64.23	0.33	0	0.33
2010	37.18	36.96	0	0.22	62.43	0.38	0	0.38
2011	33.04	32.82	0	0.22	66.52	0.45	0	0.45
2012	32.75	32.5	0	0.25	66.71	0.52	0	0.52
2013	32.18	32.07	0	0.11	67.57	0.24	0	0.24
2014	33.02	32.88	0	0.14	66.69	0.28	0	0.28

Source: Author´s computation

Table 27 Destination of redirected Slovak export to China

% of Redirection	**NAFTA**	**USA**	**RUS**	**CHN**	**JPN**	**EU26**	**WORLD**
2000	25.86	23.12	0.72	0.00	12.99	17.64	42.79
2001	24.96	22.28	0.94	0.00	12.72	17.14	44.24
2002	26.97	23.92	1.03	0.00	11.51	16.85	43.67
2003	28.73	25.40	1.03	0.00	12.11	19.51	38.63
2004	27.80	24.32	1.19	0.00	10.90	19.35	40.79
2005	28.38	24.74	1.58	0.00	10.21	18.99	40.88
2006	27.28	23.51	2.06	0.00	8.61	18.63	43.48
2007	24.53	20.88	3.81	0.00	6.99	19.14	45.66
2008	22.55	18.82	3.84	0.00	6.76	20.23	46.78
2009	22.64	18.90	2.30	0.00	6.63	19.41	49.16
2010	22.95	19.09	2.89	0.00	6.21	18.71	49.37
2011	21.91	18.02	3.97	0.00	5.82	17.23	51.19
2012	22.31	18.33	4.61	0.00	5.60	15.19	52.43
2013	22.09	18.02	4.35	0.00	5.47	16.45	51.78
2014	22.81	18.93	3.60	0.00	5.43	16.16	52.11

Source: Author´s computation

Table 28 The FVA decomposition in export to China

% of exports	**DEU**	**CZE**	**POL**	**HUN**	**FRA**	**GBR**	**ITA**	**ESP**	**EU**	**NAFTA**	**CHN**	**WORLD**
2000	23.4	2.55	1.02	0.53	2.1	1.52	2.16	1.62	0.25	2.69	4.67	6.44
2001	21.74	3.32	1.26	0.83	2.46	1.57	2.37	1.57	0.29	4.4	4.65	6.8
2002	22.23	4.57	1.51	1	3.14	1.78	2.96	1.62	0.36	5.66	5.69	7.51
2003	24.55	4.24	1.89	1.6	2.7	1.61	2.9	1.44	0.46	2.09	6.44	7.68
2004	23.74	5.35	1.76	1.65	2.63	1.58	2.58	1.41	0.59	1.57	6.64	8.41
2005	23.52	6.11	2.62	2.53	3.14	1.71	3.09	1.61	0.8	1.86	7.09	9.6
2006	21.79	5.6	2.59	3.3	3.74	1.95	3.35	1.88	1.14	1.45	6.96	12.84
2007	17.69	5.88	2.57	2.69	4.67	1.62	3.45	1.84	1.57	1.44	6.81	14.53
2008	16.72	6.08	2.71	2.32	5.63	1.51	3.24	1.75	1.95	1.09	6.72	13.41
2009	15.16	6.62	3.15	1.98	6.85	1.34	3.15	1.76	1.87	1.25	6.5	14.6
2010	15.29	5.5	3.22	1.99	5.26	1.3	3.2	1.7	2.05	1.14	6.19	15.6
2011	15.34	5.5	3.08	2.05	4.56	1.3	3.38	1.93	2.34	1.18	6.57	19.26
2012	15.98	5.54	3.24	1.88	4.39	1.26	3.22	1.96	2.53	1.2	6.64	18.85
2013	15.9	5.3	3.52	1.94	4.58	1.04	3.31	2.03	2.71	1.22	6.1	19.2
2014	16.15	5.49	3.75	1.91	4.47	1.22	3.16	2.03	2.76	1.13	6.82	17.78

Source: Author´s computation

Table 29 BM (2017) Decomposition of bilateral exports to Japan

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.71	42.68	0	0.03	57.25	0.03	0	0.03
2001	41.21	41.20	0	0.01	58.75	0.03	0	0.03
2002	40.48	40.42	0	0.06	59.42	0.09	0	0.09
2003	40.63	40.38	0	0.25	59.02	0.36	0	0.36
2004	38.00	37.70	0	0.3	61.53	0.47	0	0.47
2005	36.05	35.14	0	0.91	62.36	1.59	0	1.59
2006	33.15	32.15	0	1	64.86	1.99	0	1.99
2007	34.67	27.62	0	7.05	52.25	13.08	0.01	13.07
2008	36.58	27.62	0	8.96	48.07	15.34	0	15.34
2009	35.43	24.72	0	10.71	45.28	19.28	0.01	19.27
2010	37.18	30.07	0	7.11	51.00	11.82	0.01	11.81
2011	33.04	28.88	0	4.16	58.61	8.34	0	8.34
2012	32.75	31.76	0	0.99	65.22	2.02	0	2.02
2013	32.17	31.12	0	1.05	65.62	2.2	0	2.2
2014	33.02	30.81	0	2.21	62.55	4.43	0	4.43

Source: Author´s computation

Table 30 Destination of redirected Slovak export to Japan

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	53.05	49.04	0.36	2.55	0.00	15.10	26.76
2001	51.34	47.32	0.59	3.78	0.00	15.02	29.28
2002	52.86	48.45	0.77	4.02	0.00	13.73	28.66
2003	43.97	39.70	1.69	6.32	0.00	16.52	31.54
2004	40.14	35.84	4.07	5.94	0.00	16.67	33.23
2005	41.22	35.87	6.25	4.39	0.00	14.47	33.92
2006	43.50	37.94	7.82	5.20	0.00	14.07	29.44
2007	37.99	32.07	10.16	5.35	0.00	14.35	32.22
2008	32.62	27.48	13.61	6.13	0.00	12.62	35.07
2009	34.31	28.10	4.92	10.33	0.00	12.64	37.87
2010	34.19	28.68	6.63	10.58	0.00	10.33	38.35
2011	33.95	28.56	9.39	10.90	0.00	10.94	34.88
2012	36.90	31.63	9.22	9.19	0.00	8.24	36.53
2013	38.47	33.44	8.95	8.86	0.00	8.88	34.93
2014	37.59	32.88	7.37	9.65	0.00	9.05	36.42

Source: Author´s computation

Table 31 The FVA decomposition in export to Japan

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	27.38	2.99	1.19	0.61	2.46	1.78	2.53	3.14	5.46	1.89	0.29	6.45
2001	24.92	3.81	1.44	0.95	2.82	1.80	2.71	5.04	5.33	1.81	0.33	6.86
2002	22.76	4.68	1.55	1.02	3.22	1.82	3.03	5.80	5.83	1.65	0.37	6.55
2003	25.15	4.34	1.94	1.64	2.76	1.65	2.97	2.14	6.60	1.47	0.48	6.54
2004	25.11	5.65	1.86	1.75	2.79	1.67	3.02	1.66	7.02	1.49	0.62	7.48
2005	23.02	5.98	2.56	2.47	3.08	1.68	3.03	1.82	6.94	1.57	0.78	8.23
2006	21.21	5.45	2.52	3.21	3.64	1.90	3.26	1.41	6.77	1.83	1.11	11.29
2007	14.20	4.72	2.07	2.16	3.75	1.30	2.77	1.15	5.47	1.48	1.26	10.52
2008	12.67	4.60	2.06	1.76	4.27	1.15	2.45	0.83	5.09	1.32	1.48	9.38
2009	10.61	4.63	2.20	1.39	4.79	0.94	2.20	0.87	4.55	1.23	1.31	9.40
2010	12.43	4.47	2.61	1.62	4.27	1.05	2.60	0.93	5.03	1.38	1.66	11.46
2011	13.49	4.84	2.71	1.81	4.01	1.14	2.97	1.04	5.78	1.69	2.06	15.88
2012	15.62	5.42	3.16	1.84	4.29	1.23	3.15	1.18	6.49	1.91	2.47	17.18
2013	15.43	5.14	3.42	1.88	4.44	1.01	3.21	1.19	6.61	1.97	2.63	17.49
2014	15.14	5.15	3.51	1.79	4.19	1.14	2.96	1.06	6.39	1.90	2.59	15.67

Source: Author´s computation

Table 32 BM (2017) Decomposition of bilateral exports to the USA

% export	DVA	DA	REF	RED	FVA	DC	DDC	FDC
2000	42.70	38.58	0	4.12	50.73	6.56	0	6.56
2001	41.23	37.95	0	3.28	53.23	5.56	0	5.56
2002	40.49	37.25	0	3.24	53.85	5.67	0	5.67
2003	40.62	40.57	0	0.05	59.26	0.1	0	0.1
2004	38	37.91	0	0.09	61.82	0.18	0	0.18
2005	36.05	35.91	0	0.14	63.63	0.31	0	0.31
2006	33.15	33.04	0	0.11	66.57	0.27	0	0.27
2007	34.69	34.46	0	0.23	64.81	0.5	0	0.5
2008	36.58	36.33	0	0.25	62.95	0.47	0	0.47
2009	35.44	35.03	0	0.41	63.73	0.84	0	0.84
2010	37.19	36.89	0	0.3	62.23	0.57	0	0.57
2011	33.05	32.68	0	0.37	66.1	0.85	0	0.85
2012	32.76	32.39	0	0.37	66.36	0.89	0	0.89
2013	32.18	31.83	0	0.35	66.98	0.85	0	0.85
2014	33.01	32.59	0	0.42	66	0.98	0	0.98

Source: Author´s computation

Table 33 Destination of redirected Slovak export to the USA

% of Redirection	NAFTA	USA	RUS	CHN	JPN	EU26	WORLD
2000	34.59	0.00	0.42	2.08	6.48	19.90	36.54
2001	34.30	0.00	0.52	2.76	5.53	20.76	36.15
2002	34.22	0.00	0.54	3.01	5.04	19.99	37.22
2003	37.68	0.00	0.69	3.36	4.75	20.85	32.68
2004	37.76	0.00	0.97	3.99	4.32	19.78	33.20
2005	40.56	0.00	1.27	3.90	3.90	18.60	31.79
2006	42.44	0.00	1.59	4.23	3.34	18.07	30.36
2007	41.14	0.00	2.37	4.18	2.84	20.07	29.43
2008	38.51	0.00	3.21	4.57	2.81	19.04	31.90
2009	42.20	0.00	1.27	5.99	2.45	16.64	31.50
2010	41.95	0.00	1.47	6.95	2.34	14.82	32.51
2011	40.56	0.00	1.90	7.74	2.34	15.48	32.02
2012	39.19	0.00	2.22	8.28	2.72	13.95	33.68
2013	39.13	0.00	2.80	9.30	2.37	14.28	32.17
2014	38.44	0.00	1.82	10.32	2.35	15.74	31.37

Source: Author´s computation

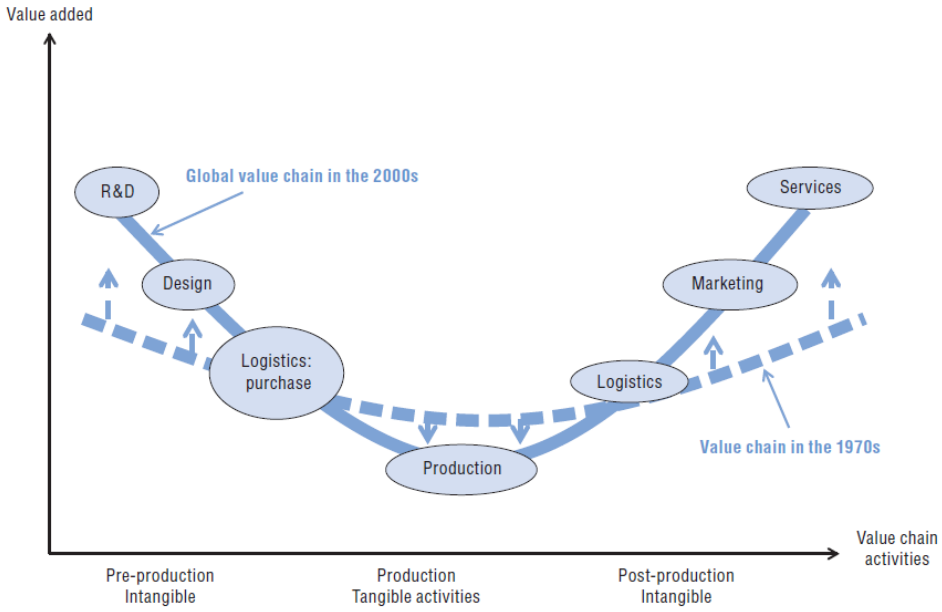
Table 34 The FVA decomposition in export to the USA

% of exports	DEU	CZE	POL	HUN	FRA	GBR	ITA	ESP	EU	NAFTA	CHN	WORLD
2000	24.19	2.64	1.05	0.54	2.17	1.57	2.24	0.19	0.26	2.78	4.83	6.66
2001	22.53	3.44	1.3	0.86	2.55	1.63	2.45	0.18	0.3	4.56	4.82	7.04
2002	20.59	4.24	1.4	0.92	2.91	1.65	2.74	0.17	0.33	5.24	5.27	6.95
2003	25.26	4.36	1.95	1.65	2.78	1.66	2.98	0.2	0.48	2.15	6.62	7.91
2004	25.23	5.68	1.87	1.76	2.8	1.68	3.03	0.2	0.62	1.66	7.06	8.94
2005	23.51	6.11	2.62	2.53	3.14	1.71	3.09	0.25	0.8	1.85	7.08	9.59
2006	21.78	5.6	2.59	3.3	3.73	1.95	3.35	0.3	1.14	1.45	6.96	12.84
2007	17.7	5.88	2.58	2.69	4.67	1.62	3.46	0.34	1.57	1.44	6.82	14.54
2008	16.67	6.06	2.7	2.32	5.61	1.51	3.23	0.29	1.94	1.09	6.7	13.37
2009	15.04	6.56	3.12	1.97	6.79	1.33	3.12	0.29	1.85	1.24	6.44	14.49
2010	15.24	5.48	3.21	1.98	5.24	1.29	3.19	0.3	2.04	1.14	6.17	15.55
2011	15.25	5.47	3.06	2.04	4.53	1.29	3.36	0.37	2.33	1.17	6.53	19.15
2012	15.9	5.51	3.22	1.87	4.37	1.25	3.21	0.35	2.52	1.2	6.6	18.75
2013	15.76	5.25	3.49	1.92	4.54	1.03	3.28	0.35	2.69	1.21	6.75	19.02
2014	15.98	5.44	3.71	1.89	4.42	1.21	3.12	0.33	2.74	1.12	6.75	17.6

Source: Author´s computation

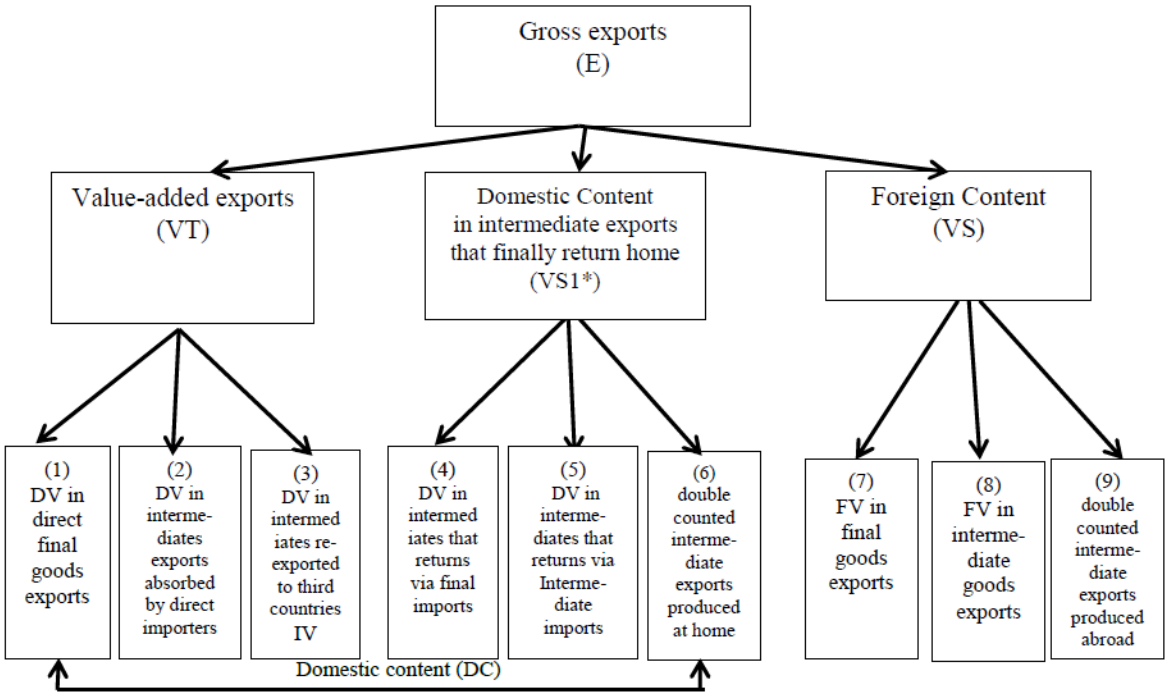
Figures

Figure 2 The Smile curve



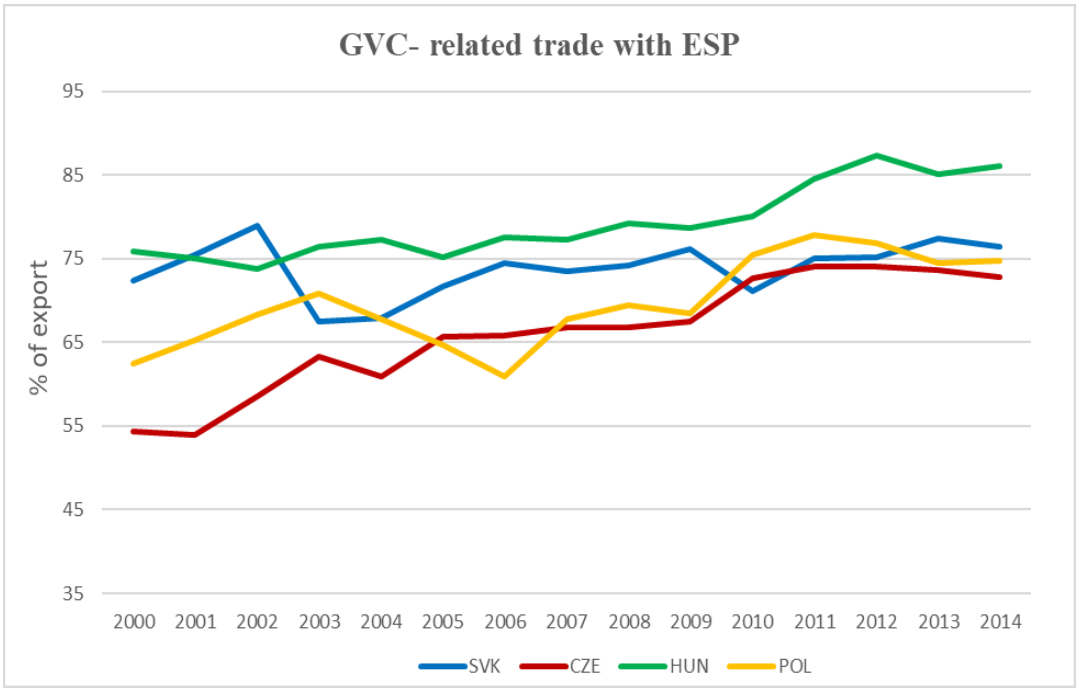
Source: OECD (2013)

Figure 4 Accounting of gross exports



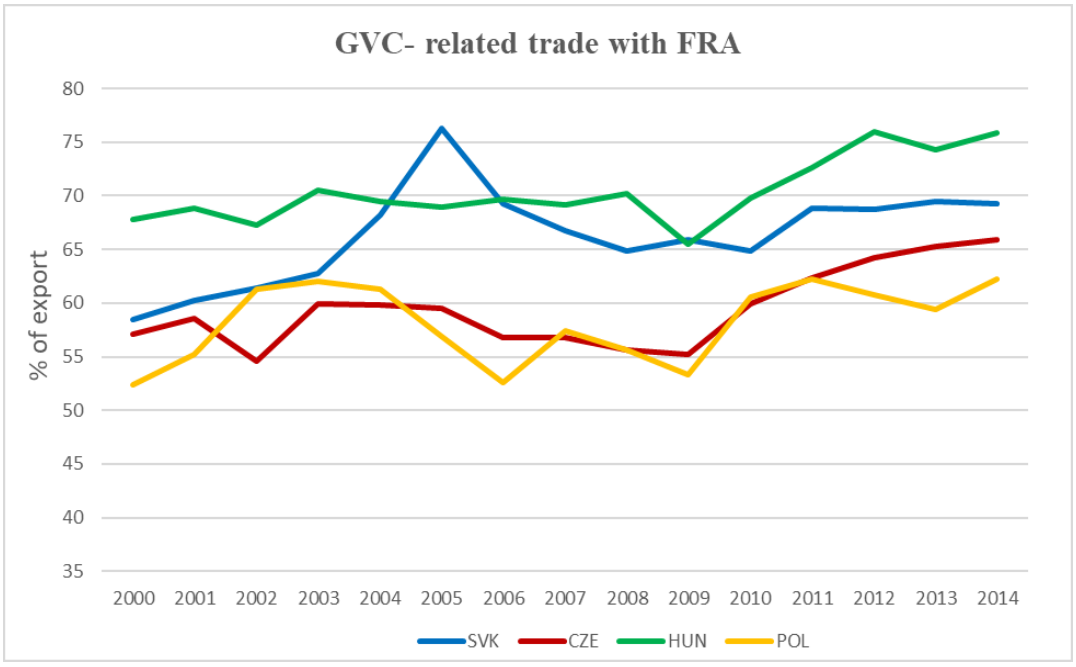
Source: Koopman et al. (2014)

Figure 9 GVC-related trade in export to Spain



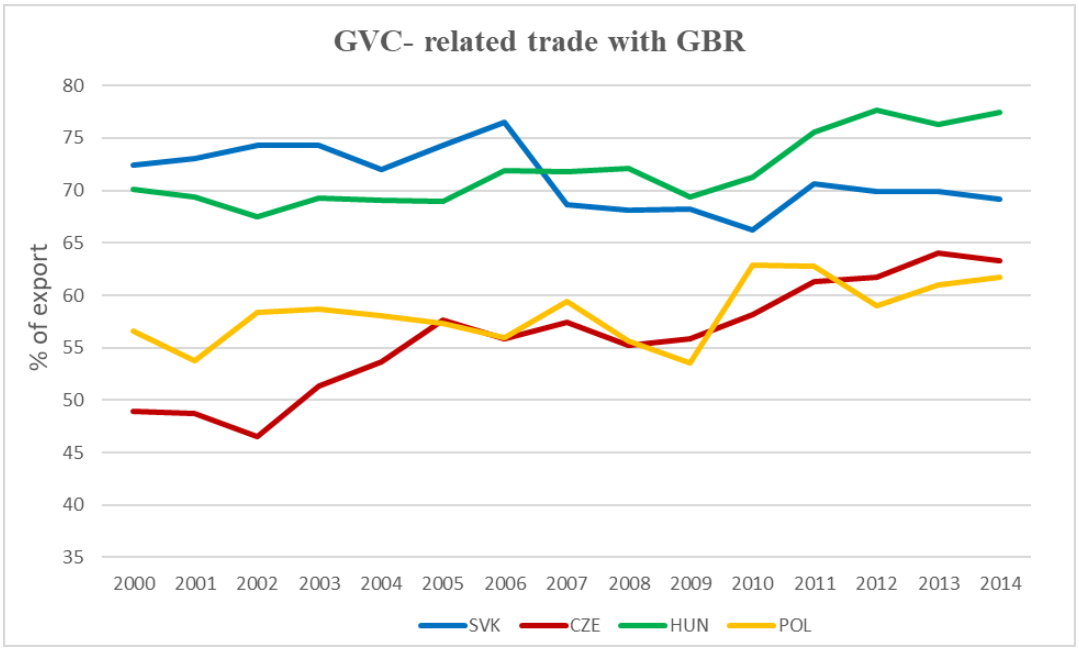
Source: Author´s computation

Figure 10 GVC-related trade in export to France



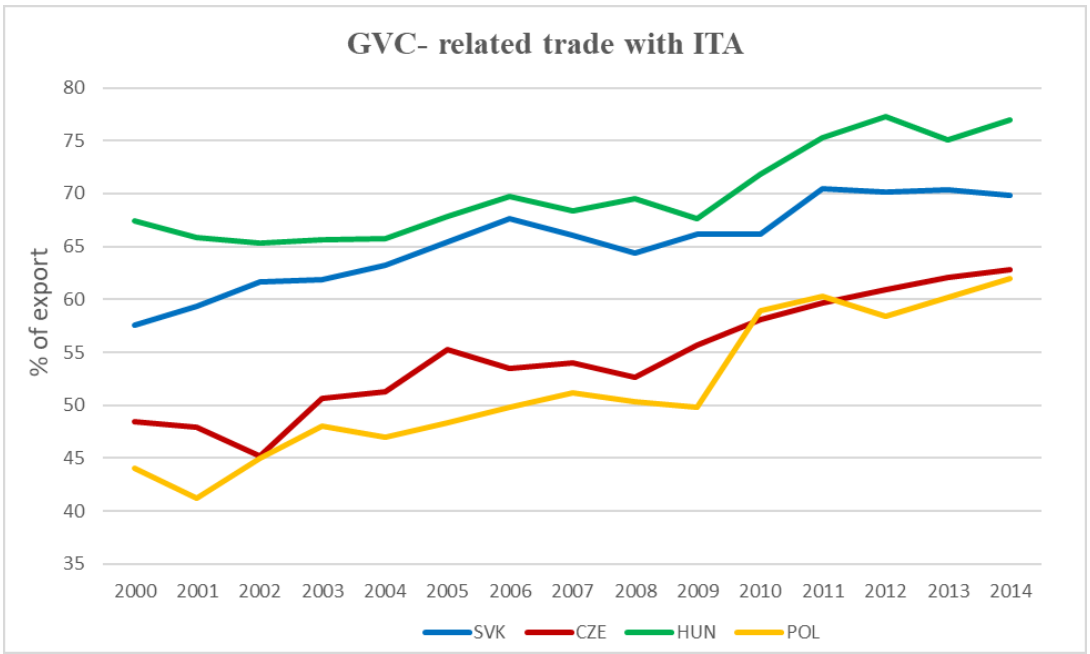
Source: Author´s computation

Figure 11 GVC-related trade in export to the UK



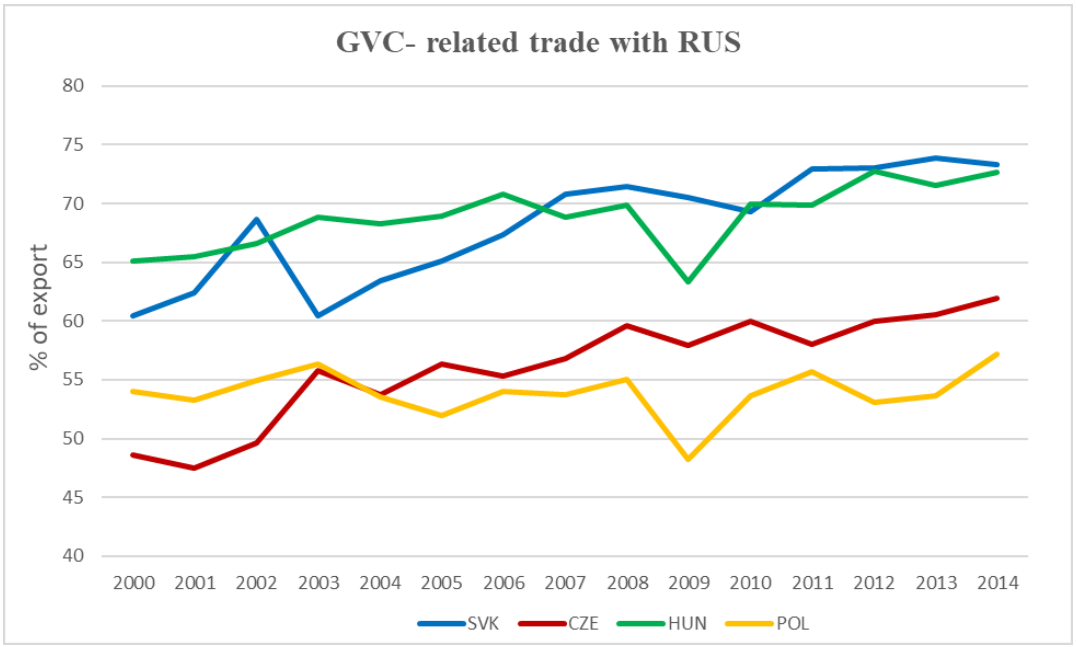
Source: Author´s computation

Figure 12 GVC-related trade in export to Italy



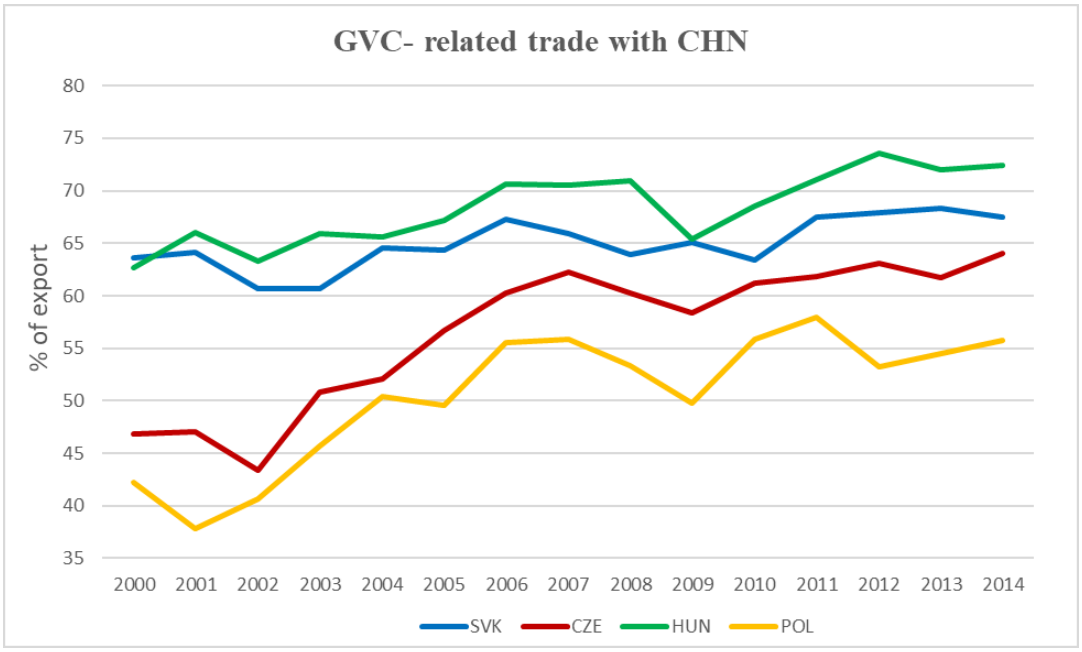
Source: Author´s computation

Figure 13 GVC-related trade in export to Russia



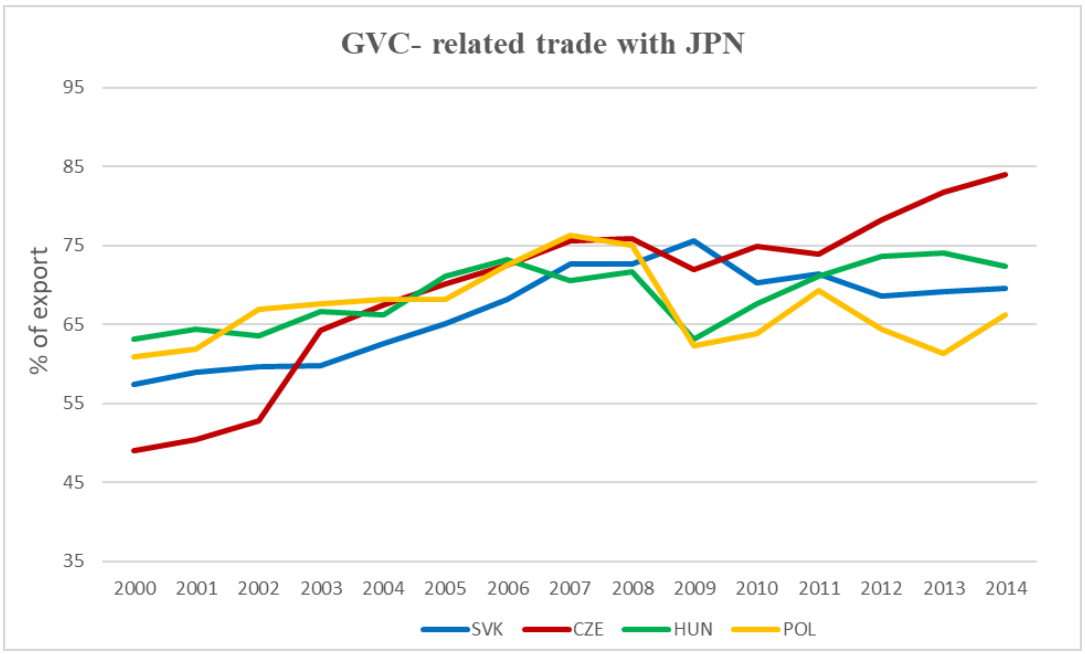
Source: Author´s computation

Figure 14 GVC-related trade in export to China



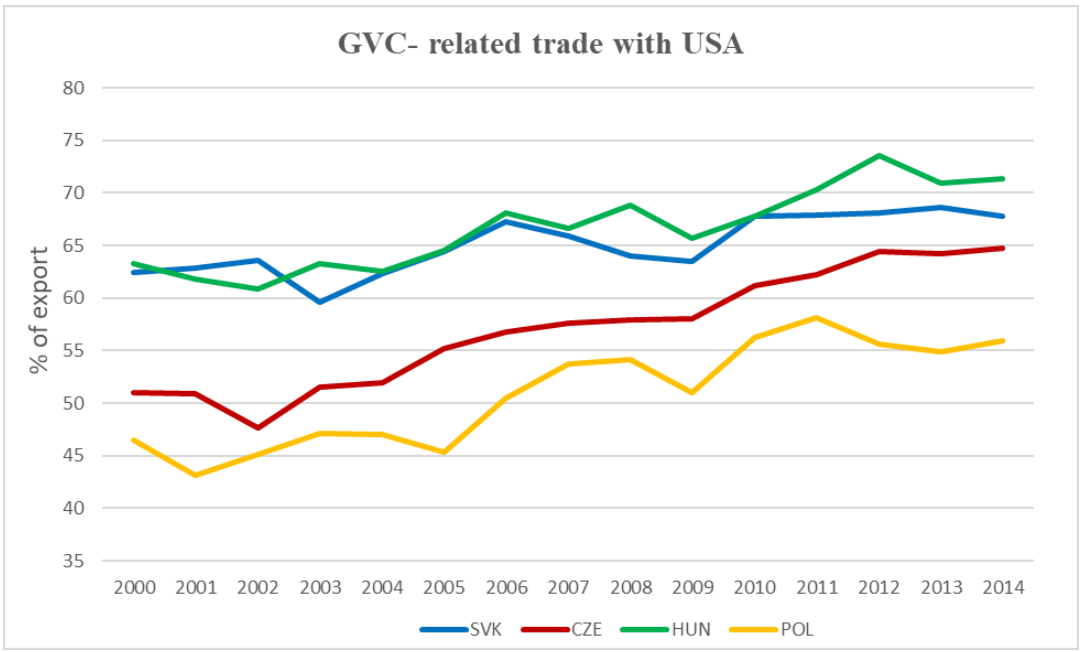
Source: Author´s computation

Figure 15 GVC-related trade in export to Japan



Source: Author´s computation

Figure 16 GVC-related trade in export to the USA



Source: Author´s computation

Appendix B

Models

KWW Total exports decomposition

The essential decomposition of total exports of country s ($u_N E_{s*}$) in KWW is summarized by the following accounting relationship. (Borin & Mancini, 2017b)

$$
\begin{aligned}
\mathbf{u}_N\mathbf{E}_{s*} &= \left\{\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{ss}\mathbf{Y}_{sr}+\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rr}+\mathbf{V}_s\sum_{r\neq s}^{G}\sum_{t\neq s,r}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rt}\right\} \\
&+ \left\{\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rs}+\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{A}_{rs}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{Y}_{ss}\right\} \\
&+ \mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{A}_{rs}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{E}_{s*} \\
&+ \left\{\sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{Y}_{sr}+\sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\mathbf{Y}_{rr}\right\} \\
&+ \sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\mathbf{E}_{r*}
\end{aligned}
$$

KWW defines the nine items in equation as follows:

1. $\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{ss}\mathbf{Y}_{sr}$: domestic value added in direct final goods exports;
2. $\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rr}$: domestic value added in intermediate exports absorbed by direct importers;
3. $\mathbf{V}_s\sum_{r\neq s}^{G}\sum_{t\neq s,r}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rt}$: domestic value added in intermediate goods re-exported to third countries;
4. $\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{Y}_{rs}$: domestic value added in intermediate exports reimported as final goods;
5. $\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{A}_{rs}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{Y}_{ss}$: domestic value added in intermediate inputs reimported as intermediate goods and finally absorbed at home;
6. $\mathbf{V}_s\sum_{r\neq s}^{G}\mathbf{B}_{sr}\mathbf{A}_{rs}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{E}_{s*}$: double-counted intermediate exports originally produced at home;
7. $\sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{Y}_{sr}$: foreign value added in exports of final goods;
8. $\sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\mathbf{Y}_{rr}$: foreign value added in exports of intermediate goods;
9. $\sum_{t\neq s}^{G}\sum_{r\neq s}^{G}\mathbf{V}_t\mathbf{B}_{ts}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\mathbf{E}_{r*}$: double-counted intermediate exports originally produced abroad.

BM (2017) Sink-based bilateral decomposition

The sink-based decomposition of bilateral exports from country s to country r. (Borin & Mancini, 2017b)

$$
\begin{aligned}
\mathbf{u}_N \mathbf{E}_{sr} = {} & \underset{1}{\mathbf{V}_s \mathbf{B}_{ss} \mathbf{Y}_{sr}} \\
& + \mathbf{V}_s \mathbf{B}_{ss} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\underset{2a}{\mathbf{Y}_{rr}} + \underset{2b}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \widehat{\mathbf{B}}^{\not s}_{jr} \mathbf{Y}_{rr}} + \underset{2c}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \sum_{k \neq s,r}^{G} \widehat{\mathbf{B}}^{\not s}_{jk} \mathbf{Y}_{kk}} \right] \\
& + \mathbf{V}_s \mathbf{B}_{ss} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\underset{3a}{\sum_{j \neq r,s}^{G} \mathbf{Y}_{rj}} + \underset{3b}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \sum_{l \neq s,r}^{G} \widehat{\mathbf{B}}^{\not s}_{jr} \mathbf{Y}_{rl}} \right. \\
& \qquad \left. + \underset{3c}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \sum_{k \neq s,r}^{G} \widehat{\mathbf{B}}^{\not s}_{jk} \mathbf{Y}_{kr}} + \underset{3d}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \sum_{k \neq s,r,l}^{G} \sum_{l \neq s,r}^{G} \widehat{\mathbf{B}}^{\not s}_{jk} \mathbf{Y}_{kl}} \right] \\
& + \mathbf{V}_s \mathbf{B}_{ss} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\underset{4a}{\mathbf{Y}_{rs}} + \underset{4b}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \widehat{\mathbf{B}}^{\not s}_{jr} \mathbf{Y}_{rs}} + \underset{4c}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \sum_{k \neq s,r}^{G} \widehat{\mathbf{B}}^{\not s}_{jk} \mathbf{Y}_{ks}} \right] \\
& + \mathbf{V}_s \mathbf{B}_{ss} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \underset{5}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \widehat{\mathbf{B}}^{\not s}_{js} \mathbf{Y}_{ss}} \\
& + \mathbf{V}_s \mathbf{B}_{ss} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \underset{6}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} \widehat{\mathbf{B}}^{\not s}_{js} \mathbf{E}_{s*}} \\
& + \underset{7}{\sum_{t \neq s}^{G} \mathbf{V}_t \mathbf{B}_{ts} \mathbf{Y}_{sr}} + \underset{8}{\sum_{t \neq s}^{G} \mathbf{V}_t \mathbf{B}_{ts} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \mathbf{Y}_{rr}} \\
& + \mathbf{V}_r \mathbf{B}_{rs} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\underset{9a}{\sum_{j \neq r}^{G} \mathbf{Y}_{rj}} + \underset{9b}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} (\mathbf{I} - \mathbf{A}_{jj})^{-1} \mathbf{Y}_{jj}} \right] \\
& + \underset{9c}{\sum_{t \neq s,r}^{G} \mathbf{V}_t \mathbf{B}_{ts} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \mathbf{E}_{r*}} \\
& + \mathbf{V}_r \mathbf{B}_{rs} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \underset{9d}{\sum_{j \neq r}^{G} \mathbf{A}_{rj} (\mathbf{I} - \mathbf{A}_{jj})^{-1} \mathbf{E}_{j*}}
\end{aligned}
$$

We can define the items that form the bilateral decomposition of gross exports as follows:

1 domestic value added (VA) in direct final good exports;

2a domestic VA in intermediate exports absorbed by direct importers as local final goods;

2b domestic VA in intermediate exports absorbed by direct importers as local final goods only after additional processing stages abroad;

2c domestic VA in intermediate exports absorbed by third countries as local final goods;

3a domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers;

3b domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers only after further processing stages abroad;

3c domestic VA in intermediate exports absorbed by direct importers as final goods from third countries;

3d domestic VA in intermediate exports absorbed by third countries as final goods from other third countries;

4a domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers;

4b domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers after additional processing stages abroad;

4c domestic VA in intermediate exports absorbed at home as final goods of a third country;

5 domestic VA in intermediate exports absorbed at home as domestic final goods;

6 double-counted intermediate exports originally produced at home;

7 foreign VA in exports of final goods;

8 foreign VA in exports of intermediate goods directly absorbed by the importing country r;

9a and 9b foreign VA in exports of intermediate goods re-exported by r directly to the country of final absorption.

9c and 9d double-counted intermediate exports originally produced abroad.

BM (2017) Source-based bilateral decomposition

The source-based decomposition of bilateral exports from country s to country r. (Borin & Mancini, 2017b)

$$
\begin{aligned}
\mathbf{u}_N\mathbf{E}_{sr} = {} & \overset{1a^*}{\mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{Y}_{sr}} \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\left[\overset{1b^*}{\sum_{j\neq r}^{G}\mathbf{A}_{rj}\mathbf{B}_{js}\mathbf{Y}_{sr}} + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{1c^*}{\sum_{k\neq s,r}^{G}\mathbf{B}_{js}\mathbf{Y}_{sk}}\right] \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\left[\overset{2a^*}{\mathbf{Y}_{rr}} + \overset{2b^*}{\sum_{j\neq r}^{G}\mathbf{A}_{rj}\mathbf{B}_{jr}\mathbf{Y}_{rr}} + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{2c^*}{\sum_{k\neq s,r}^{G}\mathbf{B}_{jk}\mathbf{Y}_{kk}}\right] \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\left[\overset{3a^*}{\sum_{j\neq r,s}^{G}\mathbf{Y}_{rj}} + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{3b^*}{\sum_{l\neq s,r}^{G}\mathbf{B}_{jr}\mathbf{Y}_{rl}}\right. \\
& \qquad \left. + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{3c^*}{\sum_{k\neq s,r}^{G}\mathbf{B}_{jk}\mathbf{Y}_{kr}} + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{3d^*}{\sum_{k\neq s,r,l}^{G}\sum_{l\neq s,r}^{G}\mathbf{B}_{jk}\mathbf{Y}_{kl}}\right] \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\left[\overset{4a^*}{\mathbf{Y}_{rs}} + \overset{4b^*}{\sum_{j\neq r}^{G}\mathbf{A}_{rj}\mathbf{B}_{jr}\mathbf{Y}_{rs}} + \sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{4c^*}{\sum_{k\neq s,r}^{G}\mathbf{B}_{jk}\mathbf{Y}_{ks}}\right] \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\overset{5^*}{\sum_{j\neq r}^{G}\mathbf{A}_{rj}\mathbf{B}_{js}\mathbf{Y}_{ss}} \\
& + \mathbf{V}_s(\mathbf{I}-\mathbf{A}_{ss})^{-1}\overset{6^*}{\sum_{t\neq s}^{G}\mathbf{A}_{st}\mathbf{B}_{ts}\mathbf{E}_{sr}} \\
& + \sum_{t\neq s}^{G}\mathbf{V}_t(\mathbf{I}-\mathbf{A}_{tt})^{-1}\mathbf{A}_{ts}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\left[\overset{7^*}{\mathbf{Y}_{sr}} + \overset{8^*}{\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\mathbf{Y}_{rr}}\right] \\
& + \sum_{t\neq s}^{G}\mathbf{V}_t(\mathbf{I}-\mathbf{A}_{tt})^{-1}\mathbf{A}_{ts}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\overset{9a^*}{\sum_{j\neq r}^{G}\mathbf{Y}_{rj}} \\
& + \sum_{t\neq s}^{G}\mathbf{V}_t(\mathbf{I}-\mathbf{A}_{tt})^{-1}\mathbf{A}_{ts}(\mathbf{I}-\mathbf{A}_{ss})^{-1}\mathbf{A}_{sr}(\mathbf{I}-\mathbf{A}_{rr})^{-1}\sum_{j\neq r}^{G}\mathbf{A}_{rj}\overset{9b^*}{\sum_{k}^{G}\sum_{l}^{G}\mathbf{B}_{jk}\mathbf{Y}_{kl}} \\
& + \sum_{t\neq s}^{G}\mathbf{V}_t(\mathbf{I}-\mathbf{A}_{tt})^{-1}\left[\overset{9c^*}{\sum_{j\neq t,s}^{G}\mathbf{A}_{tj}\mathbf{B}_{js}\mathbf{E}_{sr}} + \mathbf{A}_{ts}(\mathbf{I}-\mathbf{A}_{ss})\overset{9d^*}{\sum_{t\neq s}^{G}\mathbf{A}_{st}\mathbf{B}_{ts}\mathbf{E}_{sr}}\right]
\end{aligned}
$$

1a* domestic value added (VA) in final good exports directly absorbed by bilateral importers;

1b* domestic VA in intermediate exports absorbed by bilateral importers as domestic final goods after additional processing stages;

1c* domestic VA in intermediate exports absorbed by third countries as domestic final goods after additional processing stages;

2a* domestic VA in intermediate exports absorbed by direct importers as local final goods;

2b* domestic VA in intermediate exports absorbed by direct importers as local final goods only after further processing stages;

2c* domestic VA in intermediate exports absorbed by third countries as local final goods;

3a* domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers;

3b* domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers only after further processing stages;

3c* domestic VA in intermediate exports absorbed by direct importers as final goods from third countries;

3d* domestic VA in intermediate exports absorbed by third countries as final goods from other third countries;

4a* domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers;

4b* domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers after further processing stages;

4c* domestic VA in intermediate exports absorbed at home as final goods of a third country;

5* domestic VA in intermediate exports absorbed at home as domestic final goods;

6* double-counted intermediate exports originally produced at home;

7* foreign VA in exports of final goods;

8* foreign VA in exports of intermediate goods directly absorbed by the importing country r;

9a* and 9b* foreign VA in exports of intermediate goods re-exported by r;

9c* and 9d* double-counted intermediate exports originally produced abroad.