Tracing Value Added and Job Creation across Industries in the Slovak Republic

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Abstract

Increasing participation of the Slovak republic in the global value chains (GVCs) represents one of the key implications of the steadily growing position of important Slovak industries in both domestic and international terms. Slovak Republic is mainly positioned in the downstream activities of GVCs. However, his fact contributes to the relatively limited domestic value added creation. The aim of this article is to analyze whether the changes and the increasing participation of the Slovak republic in the GVCs influenced the position of important industries in term of value added creation and employment. We analyze the multipliers of production and value added using input-output model. The factors of skill structure of labor demand will be estimated using the system of cost share equations derived from translog cost function. The data covers period 2000-2014 and 1995-2009 for socio-economic analyses and come from World Input-Output Database (WIOD). The results for two analyzed industries show that their impact on total industrial production has decreased during the analyzed period. The results for employment analysis clearly revealed the differences between domestic and foreign orientated industry.

Keywords: value added, employment, multipliers, GVCs, offshoring, labor demand, input-output model, translog cost function

JEL Classification: J31, F14, F16

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1. Introduction

Over the past decade, there has been a significant change in the organization of world trade and production. The share of regions in world added value has considerably changed. The share of the value added EU27 was 29% by 2003, while in 2011 it was only 24% (Lábaj, 2014). World exports of value added are around 70% - 75% of gross exports while in the 1970s and 1980s it varied around 85%. However, there are large differences in this indicator between countries (Johnson, 2014). EU countries from Central and Eastern Europe (CEE) generate about 5% lower domestic value added compared to old EU (EU15) countries. Foreign value added represents a larger share of CEE exports than the EU-15. Although the CEE countries have become major suppliers of intermediates and components, semi-final products and final products, they are shown to have an increasing share of imports included in their exports. In the CEE, the share in global value chains (GVCs) is higher than the EU-15 average, so they can improve their positions in the long run and increase domestic added value in exports (Vrh, 2015). Therefore, this article will be interested in the question whether the changes and the increasing participation of the Slovak republic in the GVCs were influenced the position of important industries in term of value added creation and employment. We will analyze the multipliers of production and value added using input-output analysis. The factors influencing the skill structure of labor demand will be estimated using the system of cost share equations derived from translog cost function. The data covers period 2000-2014 and 1995-2009 for socio-economic analyses and come from World Input–Output Database (WIOD).

This paper is divided into five sections. Following the introduction, the relevant empirical literature is reviewed in Section 1. In Section 2 we provide a description of characteristics regarding analyzed industries and skill upgrading. In Section 3 we provide main results of input-output analysis of selected industries with a brief overview of input-output model that we employ to calculate the values of multipliers. In Section 4 we discuss the effects of GVCs on employment particularly on the skill structure of labor demand. In this section we provide a brief overview of model that we employ to examine the impact of offshoring on labor demand as well. Finally, concluding remarks are made in Section 5.

2. Literature Review

International fragmentation of production draws increasing attention in both theoretical literature in the area of foreign trade (i.e. Grossman and Rossi-Hansberg, 2008; Costinot, Vogel, and Wang, 2013) and empirical literature (i.e. Feenstra and Hong 2007; Johnson and Noguera, 2012; Baldwin and Lopez-Gonzalez, 2013; Los, Timmer and De Vries, 2015). The process of fragmentation is often analyzed in literature under the names such as vertical specialization, outsourcing, offshoring or trade in task. Due to international fragmentation of production in world economy we may observe changes in understanding of international competitiveness. Intention of countries to participate in new international division of labor based on participation of country in the global value chains reveals lot of opened questions for industrial policy framework. Traditional measures of export performance provide biased information for policy decisions (Labaj, 2014; Habrman, 2013).

As a result, many authors focus on estimations of domestic value added shares in unit of exports that is used as a measure of vertical specialization in foreign trade. Examination of relative importance of individual sectors of the economy in the international production chains naturally corresponds with a requirement to use appropriate methodology (Lábaj, 2014). In order to examine structural and intra-industrial linkages, empirical literature tend to implement input-output analysis that is based on the use of multiregional input-output tables that provide crucial information not only on value added within individual segments of production chains but also on quantitative and qualitative features of inputs (labor and capital) (Backer and Miroudot, 2014). Empirical literature on input-output analysis concentrates on examination of equilibrium in the individual country. Such studies are based on the use of input-output tables due to their precise ability to monitor not only value added in export industries but also on the individual levels of a production chain.

Several empirical studies for the Slovak economy focused on analyzing the position and importance of individual industries for the national economy or analyzed the importance of selected sectors for the individual regions of Slovakia. Kubala, Lábaj and Silanič (2015) made an overview of this issue in the context of structural links in the Slovak economy in 2010 and the identification of key sectors. Hečková and Chapčáková (2011) analyzed the competitiveness of the manufacturing industry during period 1998-2008. They concluded that the manufacturing industries produced a low value added and provide a limited space for the use of skilled workers in production processes contrary to high import demand. Lábaj, Luptáčik a Rumpelová (2008), Dujava, Lábaj a Workie (2011), Habrman, Kočišová a Lábaj (2013), Lábaj (2013) analyzed complex cross-sectorial links in the economy of Slovakia, focusing on total production, added value, employment and imports for the years 2000, 2005 and 2008. These studies bring important information on multiplier effects of final-use of individual commodities for Slovakia's economy and the importance of each final-use category for value added and employment creation. An approach that explores key sector based on the analysis of comparative advantages, has been investigated, for example by Balog et al. (2013). This approach does not take into account the importance of domestic demand and the complex linkages between industries.

Differentiation of the employment in individual regions of Slovakia in terms of high-tech and low-tech manufacturing industries and services was studied by Gašparíková, Nemcová and Páleník (2006). The sector of information and communication technologies (ICT) within the regions of Slovakia was analyzed by Hudec and Šebová (2012). Their results confirm that the ICT sector has become important in the sectorial structure of Bratislava and Košice regions over the last two decades.

Luptáčik et al. (2013) analyzed the importance of the automotive industry for the economy of the Slovak Republic. They stated that in 2012, 9% of total employment in the Slovak economy, direct and indirect depends on the automotive industry. The share of value added generated by the automotive industry in total national value added was over 11%. The value added generated directly by automotive industry was 4%. The main results of the study suggest that the automobile industry generates directly and indirectly 17% of the Slovak economy gross production and create more than 200,000 jobs.

Creation of value added in the Slovak economy was also examined by Habrman (2013) who notes that exports generate lesser effects than domestic demand. Despite the great openness of the Slovak economy, most of the value added (even GDP) is still generated by domestic demand (58-63% of the added value) while exports generate the remaining part (37-42% of value added). Production for the domestic market generates higher effects than output for export. A deeper look at the sectorial structure of the economy shows that the three most exporting sectors - Automotive, Electrical and Optical Equipment and basic metal and fabricated metal account for up to 50% of the economy's exports, but only 40% of the effects of all exporting sectors on value added and employment. This is mainly caused by the automotive industry, whose production is highly fragmented, and therefore domestic value added of the export generated in Slovakia represents only 26%. On the basis of these studies, further analysis will concentrate on automotive sector and construction as the most important sectors in term of production, export and value added creation.

3. Stylized Facts

The type of competitiveness selected by Slovakia was based on low taxes and salaries instead of investments in research and development and quality factors (e.g. quality of institutions, education system or national innovation system). The growth of labor productivity has been achieved mainly by transfers of technologies and organizational innovations in the framework of multinational companies. The Slovak economy achieves a strong position, both in comparison with the Central European economies and with the innovation leaders, only in the area of foreign direct investments and transfer of technologies. Increased arrival of foreign investments into the economy is demonstrated by the high level of a production process. In the 1997-2011, a clear trend towards specialization in certain product types could be seen in the Slovak export of goods. In 2011, more than a half of the Slovak export was made by only three product classes (MHSR, 2013).

The next tables illustrate the main characteristic of the most important industries in terms of production, export and value added creation in Slovakia such as automotive - manufacture of motor vehicles, trailers and semi-trailers (that includes the manufacture of motor vehicles for transporting passengers or freight) as well as construction (including general construction and specialized construction activities for buildings and civil engineering works). The construction sector is included mainly for comparison of typically domestic sector with high level of domestic value added and employment creation. The source of data is WIOD database that provides annual time-series of world input-output tables from 2000 to 2014 and provides data on the factor inputs used in production, low, medium and high-skilled workers and capital (for period 1995-2011).

From the data in Table 1 a slight change in the share of value added in total output, but in particular a significant increase in export, can be noticed. This growth of exports, as already mentioned, can be associated with the production of the automotive sector, whose share in the total production of Slovakia increased from 4.6% to 12.2% (in connection with the current foreign direct investment of another car manufacturer in Slovakia it can be expected that this share will increase). This is also supported by the growing share of automotive exports in total exports, which in 2014 accounted for up to 25.7% of whole export.

Table 1. Main Characteristics of Selected Slovak Sectors

	2000	2008	2009	2011	2014
GO (millions of USD)	47,953.6	22,2650.9	19,3954.5	22,8356.7	22,9289.1
VA / GO (%) total	38.4	39.5	41.8	38.9	39.7
EXP / GO (%) total	15.7	31.1	27.6	31.9	35.8
GO automotive / GO (%)	4.6	8.7	7.0	10.2	12.2
GO construction / GO (%)	7.7	9.4	10.0	8.4	7.1
VA automotive / VA (%)	1.9	3.2	2.3	3.6	3.8
VA construction / VA (%)	7.2	9.5	9.7	8.9	8.4
EXP automotive / EXP (%)	18.3	22.4	20.7	25.5	25.7
EXP construction / EXP (%)	0.6	0.8	1.0	0.7	0.7

Source: data from WIOD

Note: Automotive = manufacture of motor vehicles, trailers and semi-trailers. GO = gross output, VA = gross value added, EXP=export

On the other hand, the share of construction in the total output is almost unchanged (growth was mainly in the pre-crisis period). Similarly, the share of exports is small, but the significant difference can be seen in the share of value added that is more than 8% for construction, but less than 4% for automotive. Construction is among the sectors that produce the largest share of value added in the Slovak economy.

In the Slovak Republic, the share of capital and labor in value added creation has unusual unbalanced ratio (capital has unusual high share and labor low share). This development is related to the massive inflow of foreign capital. In Germany and France, the share of capital in the value added creation declined in favor of labor. The high share of high skilled labor on the value added creation is due to the high contribution of the service sector in production of vehicles in France and Germany and conversely, with low share of input from services in the Slovak Republic and other CEE countries.

Table 2. Share (%) of Labor and Capital in Value Added Creation for Individual Industries in Slovakia in 1995 and 2011

		1995	2011
automotive	LAB/VA	42	30
	CAP/VA	58	70
construction	LAB/VA	55	33
	CAP/VA	45	67
total industries	LAB/VA	37	39
	CAP/VA	63	61

Source: WIOD, own calculations

Note: LAB/VA = share of labor in value added creation, CAP/VA = share of capital in value added creation

The share of high skilled labor in value added creation in the industry of automotive in the Slovak Republic was one of the lowest in the EU. Therefore, the Slovak Republic competed mainly with large stock of (foreign) capital and average high proportion of medium skilled labor. Slušná, Balog et al. (2015). Table 2 supports these conclusions and also points to a significant change in favor for capital share in the construction sector.

The Slovak economy is significantly specialized in the area of industry, especially in the area of industrial production with higher and lower medium technology. In the EU27 approximately 4.5 % of labor force works in the industrial production with medium-high technology, whereas in Slovakia this share is 8.1 %. Slovakia is the third most specialized economy in this area in the EU. In Slovakia almost 65 % of this production is created by production of motor vehicles and spare parts thereof. Such a high share in the production demanding medium-high technologies can be seen in no other EU27 country. Similar situation is in the case of industrial production with medium lower technology where in the EU27 the share in the total employment is on the level of 4.4 % and in Slovakia 7.5 %, which makes 176 thousand workers MHSR (2013).

Table 3. Share (%) of Persons Engaged in Total Number for Individual Industries in Slovakia in 1995 and 2011

	1995	2011	Growth rate
total industries	100	100	6.83
agriculture, hunting, forestry, fishing	9	4	-57
basic metals and fabricated metal	4	3	-7
manufacturing (total)	27	20	-21
electrical and optical equipment	3	3	4
automotive (transport equipment)	1	1	24
electricity, gas and water supply	2	2	-15
construction	7	9	34
wholesale trade and commission trade	5	7	61
retail trade	5	11	112
other inland transport	5	4	-15
financial intermediation	1	2	46
real estate activities	1	1	15
renting of m&eq and other business activities	5	9	107
public admin and defense	6	6	8
education	9	7	-16
health and social work	6	6	4

Source: data from WIOD

From the point of view of job creation (see Table 3), the construction industry belongs to the sectors with the greatest employment. Automotive does not directly produce such employment as construction, but its indirect effects are significant. Luptáčik et al. (2013) as already mentioned stated that in 2012, 9% of total employment in the Slovak economy, direct and indirect depends on the automotive industry. The growth rate of employees during period of 1995-2011 was 24%.

The current situation in advanced countries give an impression that firms shifts low-skilled intensive stage of production to low-skilled abundant countries and that offshoring is a cause of rising demand for skilled workers. This could tent to conclusion that offshoring will contribute to reduction of the demand for relative unskilled workers resulting in falling wages of unskilled labor in developed countries (Foster- McGregor, Stehrer and de Vries, 2013). The studies on the impact of offshoring for individual old EU member states (e.g. Belgium, Sweden) confirm that the shift away from low-skilled workers is driven by offshoring to Central and Eastern Europe countries (Ekholm and Hakkala, 2005; Hertveld and Michel, 2012). Therefore the conclusion resulting for CEE countries assumed rising demand for low-skilled labor. However, this is not confirmed in Slovakia (see Table 4). The share of low-skilled labor is declining (although the data from the WIOD are available only for 1995-2009), but we believe that this trend continues. Overall, the share of high-skilled labor increases, even faster in automotive than in the construction sector.

The Slovak Republic, like other European countries, experienced considerable skill upgrading of employment. The growth of jobs requiring the medium and high skilled workers increased the demand for high skilled labor and thus it is in contrast with the image of Slovakia as a low-skilled production factory. In addition, the strategy for future industry clearly indicates that new innovative manufacturing systems will need flexible labor force with innovative knowledge level and IT experiences.

Table 4. Share (%) of Hours Worked by High, Medium and Low Skilled Labor for Individual Industries in Slovakia in 1995 and 2009 (share in total hours)

		1995	2009	Δ
Total Industries	H_HS	13.4%	18.8%	5.4%
	H_MS	77.1%	77.3%	0.2%
	H_LS	9.5%	3.8%	-5.6%
Automotive	H_HS	5.2%	8.3%	3.1%
	H_MS	84.5%	87.9%	3.4%
	H_LS	10.3%	3.8%	-6.5%
Construction	H_HS	5.2%	6.4%	1.2%
	H_MS	85.1%	89.3%	4.2%
	H_LS	9.7%	4.3%	-5.4%
Manufacturing (total)	H_HS	6.6%	8.3%	1.8%
	H_MS	83.0%	87.9%	4.8%
	H_LS	10.4%	3.8%	-6.6%

Source: data from WIOD

Note: H_HS = share of hours worked by high-skilled labor, H_MS = share of hours worked by medium-skilled labor, H_LS = share of hours worked by low-skilled labor. The data are available only for period 1995-2009.

4. Input-Output Analysis for Selected Sectors

In the next section, through the input-output analysis, the development of the production multipliers and value added of these two sectors will be monitored, allowing us to look closer at sectorial performance.

4.1 Input-Output Model

Identification of the key sectors in the economy requires structural models and input-output analysis, taking into account the complex links between sectors in the national economy. Backward linkages are the most advanced analyses built on the Leontief inverse matrix and intermediate input matrix. Forward linkages are a slightly less used model. According to Cardanet and Sancho (2006), no general consensus about optimal model has been adopted so far, because each of the methods has its advantages and disadvantages, although models based on the Leontief inverse matrix can be clearly interpreted and are well supported by the theory of production. The Leontief model is based on a symmetrical input-output table, presented for the first time in the 1930s by the Nobel Prize winner, Wassily Leontief. The model is based on the equilibrium of resources (supply) and their usage (demand). Leontief's input-output model allows analysis of cross-sector and interregional structural links in the world economy therefore represented an advantage compared to other macroeconomic models. While aggregated models consider total output in the economy as one product, the Leontief model assumes that outputs from the production process are different goods and services. The interest is focused on the volume of total output as well as on the structure of production. Standard input-output analysis is typically made for one country or region where foreign countries are represented by import and export. By deriving it is possible to obtain an input-output model for two regions or more regions of the world economy (Lábaj, 2014).

Leontief's input-output model for one region assumes the division of the economy into the n sectors, with the output of each sector being used to satisfy final demand (households, public administration, investment or exports) or used as an intermediate product for the manufacture of other products (in the same or other sectors). Country's gross output can be expressed as column vector:

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} \tag{1}$$

Final use as the ultimate goal of production serves to satisfy the needs of various economic subjects. Under this notion, we understand the purchase and use of various goods and services by households, investment by firms, final government consumption and export, indicating the final consumption of products and services abroad (foreign demand for products and services). Final demand vector can be written as follows:

$$y = \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} \tag{2}$$

The matrix Z represents the $n \times n$ input-output $(I-O)$ matrix of coefficients that stand for intermediate use (specifying units of intermediate goods in the production of one unit of gross output). The matrix Z can be written as:

$$Z = \{z_{ij}\} = \begin{bmatrix} z_{11} & \cdots & z_{1n} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nn} \end{bmatrix} \tag{3}$$

So country's gross output has to satisfy the following accounting relationship (Koopman et al., 2014):

$$\begin{gathered} x_1 = z_{11} + z_{12} + \cdots + z_{1n} + y_i \\ \vdots \\ \vdots \\ x_n = z_{n1} + z_{n2} + \cdots + z_{nn} + y_n \end{gathered}$$

The country production system can be written as input-output model as follows:

$$\begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} = \begin{pmatrix} z_{11} & \cdots & z_{1n} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{mn} \end{pmatrix} \times \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix} + \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix} \tag{4}$$

By reorganizing the equation (4), the gross output vector X can be expresses as (Vrh, 2015):

$$x = Z_i + y \tag{5}$$

where *i* represents a unit column vector.

From the intermediate input matrix Z it is possible to calculate the matrix of technical coefficients noted as A. From the matrix A we can read the structure and volume of direct inputs of different commodities to produce one unit of production in the sector j. For example, we can find an answer to the question as how many agricultural products and minerals are used to produce one unit of production in manufacturing. The individual elements of the matrix A are noted as a_{ij} and are calculated as follows (Lábaj, 2014):

$$a_{ij} = \frac{z_{ij}}{x_j} \tag{6}$$

therefore the enrolment of the technical coefficient matrix calculation is as follows

$$A = Z(x) \tag{7}$$

using equivalent adjustments, we calculate Leontief's inverse matrix L

$$x = Ax + y \tag{8}$$

$$x = (I - A)^{-1} y = Ly \tag{9}$$

where I stands for unit matrix $(n \times n)$ and $(I - A) - 1 = L$ represents Leontief inverse matrix.

Leontief's inverse matrix links final demand and production. It represents the overall direct and indirect effects for each sector's production when the final demand increases. If the inverse matrix L is multiply by individual component of final consumption (for example export), the getting result will capture the part of the output generated by this component (export). The horizontal sum of the L matrix elements represents the production multiplier, which characterizes the need for both direct and indirect inputs if the final demand for one commodity increased by one. The vertical sum of the Leontief matrix captures the direct and indirect demand of the domestic sector inputs, thus how much domestic output will grow if demand for the sector is increased by an additional unit (Duvajová, 2014).

For measuring the domestic and foreign contents, the value-added coefficient vector *v* is defined as:

$$v = [v'_1 \cdots v'_n] \tag{10}$$

where v'_1 represents the total value added of industry 1 for whole economy. Dividing the elements of the value added vector v' by the elements of the total production vector x, we obtain the vector of the direct value added coefficients *v* that give us the value added generated in a given sector per unit of production of the sector.

To find the matrix of value added cumulative coefficients it is necessary to multiply unit vector of direct value added coefficients $V(n \times n)$ with Leontief inverse matrix that can be written as:

$$VL = \begin{pmatrix} v_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & v_n \end{pmatrix} \times \begin{bmatrix} l_{11} & \cdots & l_{n1} \\ \vdots & \ddots & \vdots \\ l_{1n} & \cdots & l_{nn} \end{bmatrix} \tag{11}$$

The individual elements of the VL matrix represent directly and indirectly generated value added in a particular sector caused by one final-use unit of the commodity. The multiplier of the value added of the j-commodity is then calculated as the corresponding column sum of the matrix elements. The value added multiplier reflects the value added that generates one final consumption unit of the j-th commodity. Multiplying the matrix VL by final demand *y*, we obtain the direct and indirect value added generated by one sector of economy.

$$VA = VLy \tag{12}$$

To determine value added generated by, for example, export or domestic demand, the value in the VA expression is replaced by its part, i.e. by export $e(n \times 1)$, or domestic demand $d(n \times 1)$ (Habrman, 2013).

$$va = VLe \; ; \; va = VLd \tag{13}$$

4.2 Results of Input-Output Analysis for Automotive and Construction Industries

Multiplier of production can be defined as the production of all commodities in the economy necessary to satisfy one unit of final demand for one commodity. It can be calculate as the sum of individual column in the Leontief inverse matrix. It should be noted that the multipliers of production are bigger when the links with domestic production are stronger and weaker with foreign countries (import). These multipliers are greater than one, since increasing the final consumption of the commodity by one unit causes an increase in production at least by this unit. Based on the results in Table 5, we can state that both industries have a multiplier effect on the development of other industries. However, in both sectors, their impact is reduced. The decline of this indicator may be due to an increasing dependence on imports.

Value added indicator specify the share of value added per unit of production. In the case of these two sectors, it is possible to find a significantly higher share of value added of the construction sector where the trend during observed period is positive. Contrary, the automotive sector reduced the share of value added per unit of production during the period although its total production significantly increased. The reason of this low value added is the limited share of module and system manufacturers compared to the production of finished cars. Then the production of finished cars in Slovakia consists in general of assembly of individual modules together.

Table 5 Results of Multipliers for Automotive and Construction Sectors

	2000	2008	2009	2011	2014
production multiplier - automotive	1.72	1.48	1.47	1.48	1.55
production multiplier - construction	1.98	1.79	1.80	1.78	1.64
share of value added per unit - automotive	0.16	0.15	0.14	0.14	0.12
share of value added per unit - construction	0.36	0.40	0.40	0.47	0.47
value added multiplier - automotive	0.37	0.30	0.29	0.28	0.27
value added multiplier - construction	0.71	0.72	0.73	0.79	0.76
share of exported value added (%) - automotive	77.4	93.7	94.3	95.4	95.2
share of exported value added (%) - construction	6.5	11.5	11.6	13.8	16.9

Source: data from WIOD

The value added multiplier examines the relationship between value added and final demand. This multiplier indicates the value added created by increasing one unit of final demand for the selected sector. The value of this multiplier confirms the decreasing importance of automotive industry for value added creation in Slovakia during observed period. The value added creation of this industry compared to other sectors is third lowest. The low values of this multiplier indicate that input for production is mainly intermediate consumption and thus the real value added creation diminish. Multiplier of value added in

Construction industry did not change significantly although the trend is positive. As expected, it is possible to conclude the important significance of construction for value added creation in Slovak economy.

The relatively low value added generated in the automotive sector in Slovakia, according to the last indicator - the share of exported value added in 2014, is almost all exported abroad. This confirms the high connection to GVCs, but also the high vulnerability of the Slovak automotive industry to external influences. Moreover, there is an important network of domestic subcontractors connected to the production of cars. It is necessary for domestic intermediate suppliers to focus not only to subcontracting Slovak companies but to increase their importance as intermediary suppliers abroad. Conversely, the construction sector is mainly driven by domestic demand, when only 17% of the value added is exported from the Slovak Republic. However, it is interesting that the value added in export is considerably growing.

From these findings it is clear that, despite the low creation of value added, the position of the automotive sector is significant for the Slovak economy and affects the production of the whole economy. Similar results were obtained for the construction sector. It´s disturbing due to the strong dependence of the automotive sector on developments abroad, and due to the cyclical character of the industry that is prosperous especially in times of economic boom. Similarly, the construction sector is highly sensitive to economic developments and expectations either in the Slovak Republic or outside the Slovak Republic. The strong impact of these sectors on the Slovak economy may pose a significant threat to sudden unexpected external shocks.

The OECD also states that Slovak Republic needs, to reconsideration of its position in GVCs. The involvement of the Slovak Republic in GVCs is highly concentrated, with strong involvement in a limited number of industries. With a relatively high share of intermediate inputs used for exports abroad, combined with a relatively low level of the share of domestically produced inputs in third countries' exports, the Slovak Republic is mainly positioned in the downstream activities of GVCs, often involving the assembly or manufacturing of components and parts. This contributes to the relatively limited domestic value added created by exports. Half of the value of exports is value added from abroad embodied in intermediates, compared to one quarter on average in the OECD. There is a great potential for diversification of the economy, which, however, needs an appropriate supply response, driven by skills and innovation. The Slovak economy can make more out of its privileged position in by upgrading and diversifying its supply capacity. This could contribute to increasing the domestic value added created by exports. Competitiveness in GVCs requires strengthening factors of production that are unlikely to cross national borders. This implies mainly investment in human capital and skills OECD (2013).

4. Effects of GVCs on the Skill Structure of Labor Demand in Selected Sectors

Rising participation in GVCs caused not only changes in sectorial performance but also important socio-economic impacts. The recent empirical studies supposed that the demand for skilled workers relative to unskilled workers as well as the relative wages of skilled workers have risen in OECD countries. The question is whether increased participation in GVCs is a cause of the rising demand for skilled workers? Whether outsourcing and offshoring is a large enough activity to have an adverse effect on labor market? Foster-McGregor et al (2013) suggest that the demand for skilled workers was closely related to various measures of technology such as R&D but not with measures of trade. The changes of skill demand away from medium skilled workers toward high-skilled workers are explained by changes in ICT capital inputs. Michaels et al. (2014) concluded that ICT polarized labor market by increasing demand for the highly educated at the expense of the medium educated workers. The effects of trade openness are positive but insignificant when proxies for ICT are included in the model.

In the following section, attention will be focused on a detailed specification of significant factors for employment, namely the impact of offshoring, but also on other factors of the labor demand in the automotive and construction sectors of Slovakia.

5.1 Model Specification

To analyses the effect of GVCs represented by offshoring on the skill structure of labor demand we follow the approach that considers the relative demand for labor. Model will be based on translog cost function (see Berndt, Wood 1975) that is frequently used in empirical studies. Instead of estimating the translog cost function directly, we estimate a system of cost share equations derived from it. The translog cost function, so-called flexible functional forms, allows substitution elasticities to be unrestricted and they should not even be constant. Cost minimizing relative input demands may depend on the level of output.

Denoting C as total variable costs, w_i represents wages for different skill types and prices of material that are optimally selected for $i=1,...,M$, x_k represents fixed inputs and outputs (fixed input capital K and gross output Y), z represents proxies for technological change, O represents offshoring and DO represents domestic outsourcing (quasi-fixed) (notation of variables see in Appendix 1). The general formulation of the translog cost function is as follows (Foster-McGregor et al 2013):

$$\ln C = \alpha_0 + \frac{1}{2}\sum_{i=1}^{M}\alpha_i \ln w_i + \sum_{k=1}^{K}\beta_i \ln x_k + \sum_{y=1}^{Y} y_y z_y + \frac{1}{2}\sum_{i=1}^{M}\sum_{j=1}^{M}\gamma_{ij}\ln w_i \ln w_j + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K}\delta_{kl}\ln x_k \ln x_l + \frac{1}{2}\sum_{y=1}^{Y}\sum_{p=1}^{R} y_{yp} z_y z_p + \frac{1}{2}\sum_{i=1}^{M}\sum_{k=1}^{K}\theta_{ik}\ln w_i \ln x_k + \frac{1}{2}\sum_{i=1}^{M}\sum_{y=1}^{Y}\delta_{iy}\ln w_i z_y + \frac{1}{2}\sum_{k=1}^{K}\sum_{y=1}^{Y}\delta_{iy}\ln x_k z_y \quad (14)$$

Taking first derivatives of the cost function with respect to wages and material we obtain $\frac{\delta \ln C}{\delta \ln w_i} = \left(\frac{\delta C}{\delta w_i}\right)\left(\frac{w_i}{C}\right)$ where $\left(\frac{\delta C}{\delta w_i}\right)$ represents the demand for input i. Differentiating the translog cost function (1) with respect to input prices we obtain a set of N cost share equations of the form:

$$s_i = \alpha_i + \frac{1}{2}\sum_{j=1}^{M}\gamma_{ij}\ln w_j + \frac{1}{2}\sum_{k=1}^{K}\theta_{ik}\ln x_k + \frac{1}{2}\sum_{y=1}^{Y}\delta_{iy}\ln z_y, \quad i=1,\ldots,M \tag{15}$$

Taking differences between two periods the equations for wage shares of different labor skill and material in industries $n=1,\ldots,N$ become:

$$\Delta s_i = \alpha_0 + \sum_{j=1}^{M}\gamma_{ij}\ln w_j + \theta_K\Delta\ln K + \theta_Y\Delta\ln Y + \delta_O\Delta\ln O + \delta_{DO}\Delta\ln DO + \varepsilon_i \tag{16}$$

Instead of estimating the translog cost function directly, most authors estimate the system of cost share equations because the number of parameters to be estimated is lower (Hertveldt, Michel 2013). Specification of our model follows approach employed by Foster-McGregor et al (2013) and Hertveldt, Michel (2013) that considers labor and material inputs to be flexible and other inputs to be quasi-fixed. Dependent variables in the model are represented by the shares of each labor type on total variable costs. Total variable costs are calculated as the sum of total labor compensation plus the value of intermediate input purchases.

The source of data is the WIOD database consisting of a complete dataset for industries over the period of 1995-2009. When examining effects of offshoring and domestic outsourcing the WIOD data enables us to measure the intermediate input purchases by each industry from each industry. Foster-McGregor et al (2013) distinguish between narrow and broad offshoring considering imported intermediates in a given industry from the same industry and imported intermediates from all industries. In our analysis we consider a broad measure of inter-industry offshoring O calculated as:

$$O_n = \frac{\sum IIM_n}{V_n} \tag{17}$$

where IIM refers to imported intermediate purchases from industry, n is the industry index and V refers to value added. Measures of domestic intermediate use DO are constructed in a same manner:

$$DO_n = \frac{\sum DIM_n}{V_n} \tag{18}$$

where DIM stands for domestic intermediate purchases, n is the industry index and V refers to value added. Domestic intermediate use or domestic outsourcing can capture efficiency gains due to a reallocation of production within industries in a country while international offshoring capture efficiency gains due to fragmentation and includes industry specialization across borders.

Data for labor is split into three different skill categories (low, medium and high skilled) according to ISCED classification. The average wages by education level are calculated as the ratio of labor compensation for each labor skill type to the total hours worked of each labor skill type (according to Foster-McGregor et al 2013). The values for gross output and capital stock are available directly from the WIOD.

The cost functions are estimated as a system of demand equations for all variables. The complete system of equations is estimated using seemingly unrelated regression (SUR) method.

5.2 Results

The model implies that outsourcing, offshoring and capital inputs may substitute for labor of different skill types. The estimation results for Eq. (16) gives the mix set of the coefficients for all variables. To save the space the descriptive statistics for the variables are not reported here, they are available upon request. The results for each of the labor cost shares for automotive industry (see Table 6) and then for construction industry (see Table 7) will be discussed.

Table 6 SUR Results for Automotive Sector

	ΔSLS	ΔSMS	ΔSHS
ΔwLS	0.885645**	-0.284341**	-0.695522**
	(0.347663)	(0.123200)	(0.329953)
ΔwMS	-2.024672*	1.363281***	0.645269
	(1.141585)	(0.404540)	(1.083434)
ΔwHS	0.793834	-0.699650**	-0.139118
	(0.798795)	(0.283066)	(0.758105)
ΔwII	-0.116344	0.059008	0.060607
	(0.336492)	(0.119242)	(0.319352)
ΔK	-0.296899	-1.107201***	-2.538717***
	(0.797206)	(0.282503)	(0.756598)
ΔGO	-0.201047	0.831622*	2.805503**
	(1.159916)	(0.411035)	(1.100831)
ΔO	-0.087817	-1.053631***	-1.861268***
	(0.639532)	(0.226629)	(0.606955)
ΔDO	-0.269534	-0.492583***	-0.882438**
	(0.350252)	(0.124118)	(0.332411)
Constant	10.71186	11.00018	16.64463
R-squared	0.977814	0.989346	0.921883

Source: own calculations

Note: The set of equations are estimated by SUR, standard errors are reported in parentheses. ***, **, *, Significant at 1, 5 and 10 percent respectively. For notation of variables see in Appendix 1.

In general, offshoring should have a negative effect on the labor-intensity in an industry (the technology effect), but a positive effect on the level of output, due to the productivity gains from offshoring (the scale effect) Hijzen, Swaim (2007). The results of recent empirical studies show, that offshoring has impacted negatively upon all skill levels within industries for sample of 40 countries and 35 industries over the period 1995-2009 Foster-McGregor et al (2013). The impact of offshoring on manufacturing employment for example in Belgium between 1995 and 2007 is found to be significant and lower the employment share of low-skilled workers Herveltd, Michel (2013). Ekholm and Hakkala (2005) searching the evidence for Sweden found that offshoring tends to shift labor demand away from workers with an intermediate level of education.

The results for Slovak automotive industry indicate that offshoring influenced negatively the cost share of medium and high skilled labor demand. The coefficient for low skilled level we found insignificant. The offshoring impact coefficient is larger in absolute value as domestic outsourcing coefficient that underline the international fragmentation of this industry. The significant negative effect of capital influence is reported for medium and high skilled level. This could be explained by increasing capital intensity. The low-skilled labor demand is influenced mainly by changes in own wages and wages of medium-skilled labor. The coefficient for price of domestic intermediates tend to be insignificant for all skilled labor highlighting the facts about high level of imported intermediate in automotive industry and low influence of domestic intermediate suppliers.

Table 7 SUR Results for Construction Sector

	ΔSLS	ΔSMS	ΔSHS
ΔwLS	0.442306	-0.031265	0.444685
	(0.543893)	(0.106465)	(0.307094)
ΔwMS	2.588125*	0.317181	-1.952589**
	(1.458584)	(0.285513)	(0.823547)
ΔwHS	-3.133852*	-0.022819	2.087059**
	(1.493018)	(0.292253)	(0.842990)
ΔwII	-0.795494	0.055456	0.029207
	(1.013381)	(0.198366)	(0.572176)
ΔK	-1.438398***	-0.439334***	-0.291970
	(0.366900)	(0.071819)	(0.207159)
ΔGO	2.222195***	0.262727**	-0.041393
	(0.540821)	(0.105864)	(0.305359)
ΔO	-0.477714	-0.265398***	-0.250183
	(0.340754)	(0.066701)	(0.192397)
ΔDO	-0.295215	-0.299069***	-0.213066
	(0.397178)	(0.077746)	(0.224255)
Constant	8.846314	6.543458	5.431079
R-squared	0.929083	0.846271	0.905428

Source: own calculations

Note: The set of equations are estimated by SUR, standard errors are reported in parentheses. ***, **, *, Significant at 1, 5 and 10 percent respectively. For notation of variables see in Appendix 1.

It is possible to conclude that the most significant factor influencing different skill level of labor demand differs. The strongest effect on the cost share of low-skilled is found in the case of wages (negative), on the medium-skilled labor in the case of own wage (positive) and on the high-skilled labor in the case of gross output (positive). The decreasing demand for low-skilled labor could be so attributed to wages contrary to medium skilled labor. The rising demand for high skilled labor in automotive industry is driven by growth of gross output (see Table 4 and table 6).

The negative influence of offshoring can be observed in construction industry as well (see Table 7). The comparison of results for these two industries revealed as expected significantly stronger impact of offshoring on the labor demand in case of automotive industry. The coefficient for offshoring in construction industry is quite low and insignificant in the case of low and high skilled labor. The significant factors for labor demand in construction industry are mainly the wages, capital and gross output changes. The capital substitution decrease demand for low-skilled labor in construction industry contrary to results for automotive industry. The results clearly revealed the differences between domestic and foreign orientated industry. The main driver of changes in labor demand for domestic industry such as construction industry was level of wages, output growth and capital substitution.

Conclusion

Increasing participation of the Slovak republic in the GVCs were influenced the position of important industries in term of value added creation and employment. Slovak Republic is mainly positioned in the downstream activities of GVCs, often involving the assembly or manufacturing of components and parts. This contributes to the relatively limited domestic value added creation.

The position of two important industries such as automotive and construction is different. Although in both sectors, the impact on total industrial production is reduced due to an increasing dependence on imports. Significantly higher share of value added is observed in the construction sector contrary to the automotive sector. The multiplier of value added confirms the decreasing importance of automotive industry for value added creation in Slovakia. The multiplier in construction industry did not change significantly although the trend is positive. As expected, it is possible to conclude the important significance of construction for value added creation in Slovak economy. From these findings it is clear that, despite the low creation of value added, the position of the automotive sector is significant for the Slovak economy and affects the production of the whole economy. Similar results were obtained for the construction sector. It´s disturbing due to the strong dependence of the automotive sector on developments abroad, and due to the cyclical character of the industry that is prosperous especially in times of economic boom. Similarly, the construction sector is highly sensitive to economic developments and expectations either in the Slovak Republic or outside the Slovak Republic. The strong impact of these sectors on the Slovak economy may pose a significant threat to sudden unexpected external shocks.

Rising participation in GVCs caused not only changes in sectorial performance but also the important socio-economic impacts. The question is whether increased participation in GVCs is a cause of the negative effect on the labor-intensity in an industry? The results for Slovak automotive industry indicate that offshoring influenced negatively the cost share of medium and high skilled labor demand. The decrease demand for low-skilled labor could be attributed to wages. The rising demand for high skilled labor in Slovak automotive industry is driven by growth of gross output. The negative influence of offshoring is observed in construction industry as well. The comparison of results for these two industries revealed as expected significantly stronger impact of offshoring on the labor demand in case of automotive industry. The results clearly revealed the differences between domestic and foreign orientated industry. The main driver of changes in labor demand for domestic industry such as construction industry was level of wages, output growth and capital substitution.

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Appendix 1

Notation of Variables for Translog Cost Function

cost shares	
S_{LS}	cost share of low skilled labor
S_{MS}	cost share of medium skilled labor
S_{HS}	cost share of high skilled labor
S_{II}	cost share of intermediate inputs
input quantities	
LS	number of hours worked by low skilled labor
MS	number of hours worked by medium skilled labor
HS	number of hours worked by high skilled labor
II	intermediate inputs
flexible factor prices	
w_{LS}	wage of low skilled labor
w_{MS}	wage of medium skilled labor
w_{HS}	wage of high skilled labor
w_{II}	prices of intermediate inputs
fixed input and output quantities	
K	capital
Y	gross output
offshoring and domestic outsourcing	
O	offshoring
DO	domestic outsourcing