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Ďurčová, Júlia and Mirdala, Rajmund

Faculty of Economics, Technical University in Kosice, Slovak republic

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Júlia Ďurčová[1]
Faculty of Economics, Technical University of Kosice

Rajmund Mirdala[2]
Faculty of Economics, Technical University of Kosice

Abstract

Offshoring representing one of the main characteristics of the current stage of globalization contributed to reduction of the demand for relative unskilled workers resulting in falling wages of unskilled labor in developed countries. The shift away from low-skilled workers is driven by offshoring to Central and Eastern Europe (CEE) countries However, the Slovak Republic, like other European countries experienced considerable skill upgrading of employment over past decade. The study of intertemporal sectorial development of employment and growth rate of person engaged clearly indicates a change in the structure of employment. Therefore it is interesting to examine how offshoring and domestic outsourcing influences these trends. In order to estimate the impact of offshoring on skill structure of labor demand in the Slovak Republic the system of cost share equations will be derived from translog cost function. The equations for different cost shares are estimated using seemingly unrelated regression (SUR). Our results indicate that offshoring contribution to the change of employment share in case of low and medium skill-levels was negative while positive for high-skilled labor demand.

Keywords: offshoring, outsourcing, employment, translog cost function, skill level

JEL Classification: J31, F14, F16

[1] Júlia Ďurčová, Associate Professor, Faculty of Economics, Technical University of Kosice, Nemcovej 32, 04001 Kosice, Slovak Republic. E-mail: julia.durcova@tuke.sk
[2] Rajmund Mirdala, Associate Professor and Head of Department of Economics at the Faculty of Economics, Technical University of Kosice, Nemcovej 32, 04001 Kosice, Slovak Republic. E-mail: rajmund.mirdala@tuke.sk

1. Introduction

International fragmentation of production, as a new phenomenon of last few decades, emerged together with intensified distribution of value added within production chains across countries. While the territorial proximity or common trade areas are still considered as crucial determinants of this process, their importance is generally decreasing during the period of the last 15-20 years (Ederer and Reschenhofer, 2014). Narrow trade linkages among the Euro Union member countries represent one of the key implications of deeper economic integration in Europe. Intention to examine substantial characteristics of mutual flows of production among individual countries significantly increased since the establishment of the Euro Area due to growing current account imbalances between North and South of the Euro Area (Belke and Dreger, 2011). As a result, mutual linkages among national productions can be also examined according to their contribution to external imbalances (Ederer, Reschenhofer, 2014). Some authors analyses flows of goods and intermediate goods within the global supply chains, volumes of cross-country flows of production employed in domestic production that is subsequently exported abroad. Relationship between participation of a country in these flows and the overall advancement of the country can be also examined considering the role of regionalism in these production chains with clearly identified regional centers and regional structure (Baldwin and Lopez-Gonzalez, 2013). Increasing interdependence associated with international fragmentation of production also affects business cycle synchronization among countries (Ng, 2010; Takeuchi, 2011; Amighini, 2012).

Declining coordination and transport costs caused that production processes increasingly fragment across borders. This fundamentally alters the nature of international trade, away from trade in goods towards trade in tasks and activities, with profound implications for the geographical location of production, the patterns of gains from trade and the functioning of labor markets (Feenstr and Hong 2007).

In the paper we examine impact of offshoring on skill structure of labor demand in the Slovak Republic, one of the CEE countries. The industry level data indicate considerable skill upgrading of employment over past 14 years. The share of workers with low education has fallen between 1995 and 2009 from 9.5 to 3.8%. There is also evidence of increased offshoring and decreased domestic outsourcing for the Slovak Republic. We estimate the system of cost share equations derived from translog cost function. The equations for different cost shares are estimated using seemingly unrelated regression (SUR). The data covers period 1995-2009 and come from World Input–Output Database (WIOD) database.

The paper is divided into six sections. Following the introduction, the relevant empirical literature is reviewed in Section 2. In Section 3 we provide a description of facts regarding skill upgrading in the Slovak Republic. In Section 4 we provide a brief overview of model that we employ to examine the impact of offshoring on labor demand. In Section 5 we discuss main results. Finally, concluding remarks are made in Section 6.

2. Empirical Literature

The transfer of activities abroad is referred to as offshoring. Offshoring represents one of the main characteristics of the current stage of globalization. It is often felt that whilst

offshoring leads to important gains to producers and consumers, the costs appear to fall disproportionately on workers, especially those with low levels of skills. OECD suggests that trade openness is not systematically related to aggregate employment and that increased offshoring may not only represent a shock to which labor markets need to adjust, but may also have an impact on the way labor markets work. Labor demand has become increasingly elastic across a number of countries and the growing practice of offshoring may have contributed to this trend Hijzen and Swaim (2007). 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) and Hertveld and Michel (2012). Therefore the conclusion resulting for CEE countries assumed rising demand for low-skilled labor. However the position of CEE countries as low-skilled and cheap abundant countries has dynamically changed over time.

The WIOD that provides annual time-series of world input-output tables from 1995 onwards and contributes to the revision of the effects of offshoring on labor demand as well. The WIOD provides data on the factor inputs used in production, low, medium and high-skilled workers and capital. Timmer et al. 2015 studied the German automotive industry and the effects of offshoring on labor demand. Their findings showed that the decline in domestic value added appears to reflect declining contributions from less-skilled domestic labor, in particularly medium-skilled workers. The value added by domestic capital and high-skilled workers in contrast held up well as their shares did not, or only slightly, decline. The change in the factorial distribution of foreign value added did not mirror these domestic changes. Value added by less-skilled foreign workers increased somewhat but by much less than the decrease in Germany. Obviously, this is due to lower foreign wages, which is an important driver for international production fragmentation. In addition, it might also indicate that activities carried out by these workers are increasingly automated as they are typically routine-based. This hypothesis is buttressed by the finding that the income share of capital abroad rapidly increased, by more than seven percentage points. Hijzen and Swaim (2007) examined at the implications of offshoring for industry employment. The effects of offshoring on employment are analyzed using industry-level data for 17 high income OECD countries. Their findings indicate that offshoring has no effect or a slight positive effect on sectorial employment. Offshoring within the same industry ("intra-industry offshoring") reduces the labor-intensity of production, but does not affect overall industry employment. Inter-industry offshoring does not affect labor-intensity, but may have a positive effect on the overall employment of industries. These findings (Timmer et. Al, 2015) suggest that the productivity gains from offshoring are sufficiently large that the jobs created by higher sales completely offset the jobs lost by relocating certain production stages to foreign production sites. Similarly the offshoring effects were examined by Foster- McGregor, Stehrer and de Vries (2013). They studied the link between offshoring and the skill structure of labor demand for

40 countries and 35 industries over period 1995-2009 using data from WIOD. Their results indicate that offshoring has impacted negatively all skill-levels, the largest impact was observed for medium-skilled workers. An evidence of offshoring impact on the skill structure across industries of one country was examined by Hertveld and Michel (2012). They focused mainly on the contribution of offshoring on the fall of the low-skilled workers. The amount of this fall ranged approximately between 24% and 32% during the period 1999-2004. Their estimations show that it is mostly offshoring to Central and Eastern European countries that entails a fall in the low-skilled employment share. Ekholm and Hakkala (2005) searching the evidence for Sweden found that overall offshoring as well as offshoring to low-wage economies tend to shift demand away for workers with upper secondary education. This effect is robust to controlling for offshoring of final goods production. It contrasts with the estimated effect of R&D investments, which tend to shift demand away from workers with lower secondary education and towards workers with tertiary education. On the other hand, they do not found any statistically significant effect of offshoring to high-income countries. They interpret this as evidence of offshoring to high-income countries constituting the main part of measured offshoring from Sweden and being related to a more general fragmentation of production, rather than as a tendency for labor intensive activities to be re-located in response to labor cost differentials. A decomposition of offshoring to different geographical regions yields results suggesting that the negative effect on workers with upper secondary education is mainly driven by offshoring to Central and Eastern Europe. Los, Timmer and de Vries (2015) analyzed the impact of foreign demand on Chinese employment creation by extending the global input–output methodology. They found that between 1995 and 2001, fast growth in foreign demand was offset by strong increases in labor productivity and the net effect on employment was nil. Between 2001 and 2006, booming foreign demand added about 70 million jobs. These jobs were overriding for workers with only primary education. Since 2006 growth in domestic demand for non-tradable has become more important for job creation than foreign demand, signaling a rebalancing of the Chinese economy.

Lábaj using WIOD investigate the effects of domestic demand on final output and employment in national economies. The small and open countries such as Ireland, Estonia, Malta, the Czech Republic and the Slovak Republic indicated the lowest importance of domestic demand for their output creation. The collapse in international trade due to the economic recession in 2009 led to a substantial increase in domestic demand, particularly in India, Canada, Russia, China, Brazil and the rest of the world. Among the smaller economies, the Slovak Republic was affected significantly, as decline in demand for domestic products in foreign markets led to an increase of output generated by domestic demand for more than 2 percent (Lábaj, 2013, 2014). Slušná, Balog et al. (2015) based on the WIOD analyses states that the absolute number of jobs reduced in the majority of developed countries as well as the share of labor in value added creation decrease. However, the significant changes appeared in the internal structure of the workers. For example, in Germany and France during the period of 1995-2009 the share of high skilled labor in value added creation increased and opposite the share of low-skilled labor decreased. Thus, the loss of jobs occurred mainly in case of low-skilled work positions. 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). High share of capital is typical for the electronics industry. 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 work. 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. The share of high skilled labor in value added creation in the industry of vehicles production 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. Further development of the automotive industry in the Slovak Republic will have significant effects for the whole economy only if its participation in global value chains will increase.

Habrman (2013) study showed that export of the Slovak Republic in the examined period 1995-2009 generates directly and indirectly approximately 40% of value added and employment in the Slovak Republic. Despite the very high openness of the Slovak economy and regular high growth of exports, GDP and employment is not growing as the economists, politicians and the public would expect. The reason is that the Slovak exports create low value added, which is a serious problem of the Slovak economy. Despite the rising importance of export in the Slovak Republic, most of jobs are created by domestic demand. Employment generated per unit of value added in sectors producing for export corresponds with the sectors producing for the domestic demand. The extremely small proportion of manufacturers of modules and systems compared to the production of finished automobiles is the reason why the share of export on value added is low. The greater part of the value added is generally generated by manufacturers of modules and systems, including the development of those parts. Luptáčik et al. (2013) analyzed the Slovak automotive industry and states that one job in car manufacturing bring six additional jobs in the rest of the Slovak economy. 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 is over 11%. The value added generated directly by automotive industry is 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 (9% of total employment). For comparison, the economic growth sources of Ireland are generated by sectors such as biotechnology, pharmaceuticals, financial services and IT with high and inelastic wages. Even during the crisis the salaries and labor costs grew (the decline occurred in the public sector). Ireland saved previous economic structural changes - traditional industries such as the manufacture of computers has been moved to cheaper countries. However, the loss of these jobs was offset by growth in the service sector (Brejčák, 2016).

3. Skill Upgrading - Industry Level Data

The characteristic feature of the Slovak industry is its main orientation on one sector. The share of manufacturing in gross output creation is more than 30% (39% in 1995 and 34% in 2011). The share of this industrial sector in value added creation is around 20%, although comparing years 1995 and 2011, the share decreased by 7% (26% in 1995 and 19 % in 2011).

The highest shares in value added creation within these sectors was generated by the following divisions: basic and fabricated metal, electrical and optical equipment, transport equipment and food, beverages and tobacco. The second largest share in value added and total output creation generated constructions sector. The share of this sector in value added creation generally increases (5% in 1995 and 9% in 2011).

Table 1 The Share (%) of Labor and Capital in Value Added Creation for Whole Industries in the Slovak Republic (1995-2011)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
LAB/VA	37	38	41	41	40	40	38	38	38
CAP/VA	63	62	59	59	60	60	62	62	62
	2004	2005	2006	2007	2008	2009	2010	2011	
LAB/VA	38	39	38	38	38	40	39	39	
CAP/VA	62	61	62	62	62	60	61	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 vast inflow of foreign direct investments during early 2000s contributed to the overall success of the transition process of the Slovak Republic, while the creation of new jobs was considered as one of the most beneficial side effect. However, these positives effects were associated with increasing demand for medium and low skilled labor and high share of capital in value added creation (Slušná, Balog et al. 2015, Habrman, 2013). The labor and capital share in value added creation for all sectors in the Slovak Republic during the period of 1995-2011 shown in Table 1, confirm this assumption. However, it is important to note, that this share did not significantly change during monitored 17 years.

Comprehensive industry based investigation reveals interesting changes in the relative importance of labor. The analysis is made for main sectors of industrial classification according to ISIC available in WIOD. The sectorial data covers 35 industries (the WIOD database provides data for 11 sections and 32 divisions see Appendix 1). The development in individual sectors differs from main industry values. Table 2 present cumulated data for 16 basic industrial sectors.

The worst balance for labor share can be observed for construction sector where during 17 years the decline in the labor share is more than 20%. The similar conclusions can be made for the agriculture, hunting, forestry and fishing sector and electrical, optical and transport equipment as well. The capital and labor ratios changed significantly - more than 12% in favor of capital. However, the data for manufacturing as whole sector brings positive information and corresponds to the general industrial trend in the Slovak Republic. The decline of the labor share in value added creation can be seen also in sectors such as Education (-18%) and Renting of m&eq and other business activities (-13%). Contrariwise, the positive development of the labor share can be noticed for retail and wholesale trade and

financial intermediation. However, changes in the labor shares in individual sectors also induced changes in the internal labor structure.

The participation in global value chains raises the question whether the employment and created jobs are sustainable. The declining importance of manufacturing in developed OECD countries is often associated with a transfer of low-skilled jobs to CEE countries. The data of employment share for individual industries in Table 4 confirm the dominant position of manufacturing for job creation in the Slovak Republic. However, the intertemporal comparison reveals the decreasing share in total industries employment, though this is not true for division of transport equipment (the key sector of FDI inflow in the Slovak Republic). The growth rates between 1995 and 2011 show that the most jobs are created in sectors: Renting of m&eq and other business activities (such as computer and relative activities, software publishing consultancy and supply, research and development and other business activities) and retail trade. This information is very positive because these sectors create considerable demand for high skilled labor.

Table 2 The Share (%) of Labor and Capital in Value Added Creation for Individual Sectors in the Slovak Republic in 1995 and 2011

		1995	2011			1995	2011
agriculture, hunting, forestry and fishing	LAB/VA	44	28	retail trade	LAB/VA	38	48
	CAP/VA	56	72		CAP/VA	62	52
basic metals and fabricated metal	LAB/VA	42	41	other inland transport	LAB/VA	34	46
	CAP/VA	58	59		CAP/VA	66	54
manufacturing (total)	LAB/VA	37	41	financial intermediation	LAB/VA	16	31
	CAP/VA	63	59		CAP/VA	84	69
electrical and optical equipment	LAB/VA	59	34	real estate activities	LAB/VA	4	6
	CAP/VA	41	66		CAP/VA	96	94
transport equipment	LAB/VA	42	30	renting of m&eq, other business activities	LAB/VA	61	48
	CAP/VA	58	70		CAP/VA	39	52
electricity, gas and water supply	LAB/VA	20	18	public admin and defence	LAB/VA	50	52
	CAP/VA	80	82		CAP/VA	50	48
construction	LAB/VA	55	33	education	LAB/VA	83	65
	CAP/VA	45	67		CAP/VA	17	35
wholesale trade and commission trade	LAB/VA	34	41	health and social work	LAB/VA	57	62
	CAP/VA	66	59		CAP/VA	43	38

Source: WIOD, authors' calculations
Note: LAB/VA - share of labor in value added creation, CAP/VA - share of capital in value added creation

Although the leading employment sector - manufacturing lost the potential of the new job creation, the share of labor in value added formation increased. There has been also significant transformation of internal structure of labor force. For example, the share of high-skilled labor in total labor has increased in manufacturing (1.8%) as well as in all industries (5.4%, see Table 3 - the data are available only until 2009). The highest expansion of high-

skilled labor experienced sectors such as Education (14.5%), Public administration (14.9%), Renting of m&eq and other business activities (10.7%) and Real Estate activities (10.7%). Generally, the share of high-skilled labor in manufacturing is only 8.3% compared to Renting of m&eq and other business activities with 42.2%. It can indicate the low share of services in manufacturing. Slušná, Balog et al. (2015) state that the share of high-skilled labor in value added creation in manufacturing sector was one of the lowest in the EU. Thus the Slovak manufacturing sector competitive advantage was represented by the high share of (foreign) capital and average share of medium-skilled labor.

Table 3 The Share (%) of Hours Worked by High, Medium and Low Skilled Labor in Individual Industries in the Slovak Republic in 1995 and 2009 (Share in Total Hours)

		1995	2009	Δ			1995	2009	Δ
all industries	H_HS	13.4%	18.8%	5.4%	retail trade	H_HS	7.9%	10.5%	2.6%
	H_MS	77.1%	77.3%	0.2%		H_MS	87.6%	87.5%	-0.1%
	H_LS	9.5%	3.8%	-5.6%		H_LS	4.5%	2.0%	-2.5%
agriculture, hunting, forestry, fishing	H_HS	8.4%	9.5%	1.1%	other inland transport	H_HS	5.1%	10.3%	5.2%
	H_MS	70.4%	77.5%	7.1%		H_MS	84.3%	87.5%	3.2%
	H_LS	21.3%	13.0%	-8.2%		H_LS	10.6%	2.2%	-8.4%
basic metals and fabricated metal	H_HS	6.4%	8.3%	1.9%	financial intermediation	H_HS	32.9%	37.1%	4.2%
	H_MS	83.5%	87.9%	4.4%		H_MS	66.6%	62.1%	-4.5%
	H_LS	10.1%	3.8%	-6.3%		H_LS	0.5%	0.8%	0.3%
manufacturing (total)	H_HS	6.6%	8.3%	1.8%	real estate activities	H_HS	31.5%	42.2%	10.7%
	H_MS	83.0%	87.9%	4.8%		H_MS	65.7%	56.3%	-9.4%
	H_LS	10.4%	3.8%	-6.6%		H_LS	2.8%	1.4%	-1.4%
electrical and optical equipment	H_HS	5.2%	8.3%	3.1%	renting of m&eq, other business activities	H_HS	31.5%	42.2%	10.7%
	H_MS	84.5%	87.9%	3.4%		H_MS	65.7%	56.3%	-9.4%
	H_LS	10.3%	3.8%	-6.5%		H_LS	2.8%	1.4%	-1.4%
transport equipment	H_HS	5.2%	8.3%	3.1%	public admin, defense	H_HS	20.3%	35.2%	14.9%
	H_MS	84.5%	87.9%	3.4%		H_MS	72.8%	60.7%	-12.1%
	H_LS	10.3%	3.8%	-6.5%		H_LS	6.8%	4.1%	-2.7%
electricity, gas, water supply	H_HS	10.8%	17.3%	6.4%	education	H_HS	39.1%	53.6%	14.5%
	H_MS	83.4%	80.7%	-2.7%		H_MS	52.5%	42.7%	-9.8%
	H_LS	5.7%	2.0%	-3.8%		H_LS	8.4%	3.7%	-4.7%
construction	H_HS	5.2%	6.4%	1.2%	health and social work	H_HS	17.5%	24.0%	6.5%
	H_MS	85.1%	89.3%	4.2%		H_MS	75.2%	70.6%	-4.5%
	H_LS	9.7%	4.3%	-5.4%		H_LS	7.3%	5.4%	-1.9%
wholesale trade and commission trade	H_HS	7.9%	10.5%	2.6%					
	H_MS	87.6%	87.5%	-0.1%					
	H_LS	4.5%	2.0%	-2.5%					

Source: 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.

The qualification structure of selected sectors reported in Table 3 revealed the reduction of hours worked by low skilled workers (-5.6% change for all sectors). The largest decline of this indicator can be seen in the agriculture sector (-8.2%). Agriculture sector experienced negative trend considering the overall labor demand, however, the internal structure of labor shows that the ratio for high and medium skilled labor demand tends to rise. As a result, we suggest that the loss of jobs occurred mainly in low-skilled professions.

Table 4 The Share (%) of Persons Engaged in Total Number for Individual Industries in the Slovak Republic in 1995 and 2011

	1995	2011	Growth rate
all 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
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 defence	6	6	8
education	9	7	-16
health and social work	6	6	4

Source: WIOD, authors' calculations

The Slovak Republic, like other European countries, experienced considerable skill upgrading of employment over past decade. Examination of intertemporal sectorial development of employment and growth rate of person engaged clearly indicates a change in the structure of employment in the Slovak Republic. 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 CEE country as a cheap low-skilled production factory. Therefore it is interesting to examine how offshoring and domestic outsourcing influenced these trends.

4. Model Specification

To analyses the effect of 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). The general formulation of the translog cost function is as follows (Foster-McGregor et al 2013):

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

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:

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

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

$$\Delta s_i = \alpha_0 + \sum_{j=1}^{M}\gamma_{ij}\ln w_j + \theta_K \Delta \ln K + \theta_Y \Delta \ln Y + \delta_O \Delta \ln O + \delta_{DO}\Delta \ln DO + \varepsilon_i \quad (3)$$

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 2012). Specification of our model follows approach employed by Foster-McGregor et al (2013) and Hertveldt, Michel (2012) 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 35 industries over the period of 1995-2009. When examining effects of offshoring and domestic outsourcing the WIOD data allows 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:

$$O_n = \frac{\sum IIM_n}{V_n} \tag{4}$$

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:

$$DO_n = \frac{\sum DIM_n}{V_n} \tag{5}$$

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. Results and Discussion

Examination of offshoring is obviously focused on trade in intermediates in one way or another. The main drawback of focusing on trade in intermediates is that one necessarily excludes the offshoring of assembly activities. In line with many previous papers (i.e. Hijzen and Swaim, 2007; Foster-McGregor et al, 2013) we will also focus on trade in intermediates. We measure offshoring by focusing on the foreign content of production using the ratio of imported intermediates (using the import-use matrix) to value-added.

In order to investigate the impact of offshoring and domestic outsourcing on the skill structure of Slovak industries we will limit our analysis to aggregate data for all sectors. Table 5 reports initial and final levels (i.e. 1995 and 2009) of offshoring as well as cost shares. As expected, the value of domestic intermediate use is larger than imported intermediate use. The study of the evolution between 1995 and 2009 reveals increasing trend of offshoring and vice versa decreasing trend of domestic outsourcing on the value added creation. According to Foster-McGregor et al (2013) the offshoring ratios tend to be larger in smaller and open economies. This is confirmed for the Slovak republic with average offshoring rate of 0.52 (for example the offshoring ratio for all sectors in USA is around 0.05 and in Germany 0.09 (Foster-McGregor et al 2013)). The cost shares S_i reflect the payment to factor i relative to total costs representing wage share of different labor skill types and materials in total variable costs. The sum of shares is equal to 1 (100%).

Table 5 Levels of Offshoring, Outsourcing and Cost Shares

	O	DO	S_{LS}	S_{MS}	S_{HS}	S_{II}
1995	0.38	1.57	1.27%	13.94%	3.91%	80.89%
1996	0.43	1.13	1.23%	13.89%	3.94%	80.95%
1997	0.42	1.14	1.27%	14.57%	4.10%	80.07%
1998	0.45	1.14	1.23%	14.33%	4.07%	80.37%
1999	0.42	1.10	1.04%	14.73%	4.18%	80.04%
2000	0.52	1.09	0.81%	14.12%	4.18%	80.89%
2001	0.56	1.03	0.75%	13.99%	4.06%	81.20%
2002	0.55	1.03	0.66%	14.15%	4.03%	81.17%
2003	0.57	1.00	1.02%	13.79%	4.01%	81.18%
2004	0.56	0.88	0.62%	14.30%	4.91%	80.17%
2005	0.57	0.86	0.55%	14.11%	5.50%	79.85%
2006	0.63	0.85	0.53%	13.38%	5.43%	80.66%
2007	0.62	0.49	0.53%	13.82%	5.09%	80.56%
2008	0.59	0.90	0.63%	13.52%	5.22%	80.63%
2009	0.46	0.90	0.64%	14.96%	6.16%	78.24%

Source: WIOD, authors' calculations

Note: O = offshoring (constant), DO= domestic outsourcing (constant), s=cost share (wage shares of different labor skill types and materials)

The results in Table 5 reveal that the cost shares of low-skilled labor and materials have declined over the period with those of high and medium-skilled labor increasing. The high percentage of material costs (average 80%) confirms the largest portion of intermediates in total variable costs due to the dominance of capital in the value added creation (for example the share of material in total variable costs in 1995 was 62% in Germany, 66.4% in France, 64% in USA and 71% in Poland (Foster-McGregor et al 2013)).

In Table 6 we provide a summary statistics on average growth rates of all variables included in the analysis. The cost shares of low skilled labor have declined while for medium and high-skilled labor cost share we observe positive growth rates. The positive growth in the labor compensation per hour tends to be higher for all labor types than for materials. The similar results are found when we consider the quantity of fixed inputs that increased significantly. The average growth rate of offshoring and domestic outsourcing differ. The growth rate of domestic outsourcing has slowly declined while offshoring gradually increased.

According to equation (3) the whole industry results will be discussed. 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), so that the overall effect is ambiguous (Hijzen, Swaim 2007). The respective estimation results using SUR technique for each of the labor cost shares are shown in next table.

Table 6 Descriptive Statistics - Average Growth Rates of Variables (1995-2009)

Sample: 1995 2009					
Cost shares	Mean	Maximum	Minimum	Std. Dev.	Observations
ΔS_{LS}	-0.026951	0.557217	-0.398055	0.215341	15
ΔS_{MS}	0.005837	0.106090	-0.051102	0.041599	15
ΔS_{HS}	0.035907	0.225563	-0.063174	0.082395	15
Flexible Factor Prices					
Δw_{LS}	0.130975	0.814406	-0.356065	0.243276	15
Δw_{MS}	0.093979	0.183176	-0.006014	0.044501	15
Δw_{HS}	0.096557	0.255284	-0.027900	0.074542	15
Δw_{II}	0.084959	0.170924	-0.139479	0.077586	15
Fixed Input and Output Quantities					
ΔK	0.087211	0.151230	-0.089654	0.055472	15
ΔY	0.086857	0.153533	-0.107518	0.063571	15
Offshoring and Domestic Outsourcing					
ΔO	0.020114	0.213247	-0.221574	0.104198	15
ΔDO	-0.008605	0.858377	-0.431243	0.280492	15

Source: WIOD, authors' calculations

The results in Table 7 give mixed set of coefficients. The own-wage coefficients are found to be positive and significant for low and medium-skilled labor but insignificant for high-skilled labor. The medium-skilled wage impacts negatively upon the cost shares of high-skilled labor. The other coefficients tend to be insignificant. The price of intermediates has a strong and negative impact on the cost share of high-skilled labor and negative but insignificant effect on low-skilled labor cost share, suggesting that materials are substitutes for this type of labor but has the negative impact on high-skilled labor. These results for high-skilled labor correspond to Foster-McGregor et al (2013). Our results indicate the strongest effect of material price change upon the labor cost shares.

The cost share of all three types of labor is decreasing in capital. The impact of output growth is positive for the low and high-skilled labor and negative upon the medium-skilled labor. The coefficient of output effect reveals the most significant and strongest impact on the change of high-skilled labor cost share.

The results suggest that offshoring has reduced demand for low and medium-skilled labor contrary to high-skilled labor. Domestic outsourcing has also negative effect on low and medium-skilled labor demand and positive effect on high-skilled labor. Interestingly, the offshoring impact coefficient is largest in absolute value for high-skilled labor as well as domestic impact coefficient. We suggest that the high-skilled labor have been the most significantly affected by international offshoring and domestic outsourcing. The coefficients for low-skilled labor in both offshoring and domestic outsourcing were found as insignificant.

Table 7 SUR Results - The Full Sample of Industries

	ΔS_{LS}	ΔS_{MS}	ΔS_{HS}
Δw_{LS}	0.716760***	-0.014639	-0.045926
	(0.228946)	(0.033121)	(0.074639)
Δw_{MS}	-1.199389	0.429321***	-1.127491***
	(0.977984)	(0.141480)	(0.318835)
Δw_{HS}	-0.768684	0.038945	0.216149
	(0.688674)	(0.099627)	(0.224516)
Δw_{II}	-6.144889	0.136174	-14.08250***
	(5.740619)	(0.830467)	(1.871515)
ΔK	-3.673386*	-0.154096	-3.453205***
	(1.893873)	(0.273977)	(0.617427)
ΔGO	10.35747	-0.393331	18.51767***
	(7.913642)	(1.144827)	(2.579948)
ΔO	-0.117688	-0.255077***	0.676072***
	(0.533673)	(0.077204)	(0.173984)
ΔDO	-0.059728	-0.047849**	0.122468***
	(0.133451)	(0.019306)	(0.043507)
Constant	8.718654	5.810370	0.801124
R-squared	0.969625	0.918925	0.983749

Source: authors' calculations

Note: The set of equations are estimated by SUR, standard errors are reported in parentheses. ***, **, * - results are significant at 1, 5 and 10 percent respectively.

Overall findings indicate that the low-skilled labor share was mostly influenced by changes in material prices and capital (negatively) and gross output (positively). The medium-skilled labor share were mostly affected by the changes in own wages (positively) and offshoring (negatively). Finally, the main influence on high skilled labor share was observed in case of output (positive) and material prices (negative) change. Interestingly, all significant coefficients for high and low-skilled labor shares in absolute value are largest than for medium-skilled labor. We also suggest that the differences between the output determine the low and high-skilled labor share. It indicates that the output growth had the higher effect on high-skilled labor demand.

Generally, our results indicate high importance of offshoring on labor demand with stronger impact than domestic outsourcing. It is interesting to note that the impact of offshoring differs as it seems to be positive for the high-skilled labor demand and negative for the medium-skilled labor. In the section 3 we have suggested that the share of high as well as medium skilled labor in total labor force has increased over time. However, the change of high-skilled labor share was more significant (5.4%) than the medium-skilled labor change of share (0.2%). Offshoring could have play important role on this process. The positive influence of offshoring on high-skilled labor demand corresponds to the findings of Foster-McGregor et al (2013). Their results confirmed negative effect of offshoring as well as

domestic outsourcing on all types of labor demand. However, more detailed examination of this issue would require longer time dataset. When consider the regression coefficients the results showed that the medium-skilled labor was affected the most by offshoring. Such result is consistent with Foster-McGregor et al (2013).

Conclusion

Offshoring is frequently used for explanation of employment upgrading and a reason for reduction of the demand for relative unskilled workers. The main objective of this paper was to examine how offshoring and domestic outsourcing affects the trends in labor demand over the period 1995-2009. The offshoring intensities was computed as the share of imported intermediate in value added creation and domestic outsourcing as the share of domestic intermediate use in value added. A system of cost share equations derived from translog cost function was estimated using SUR technique.

The Slovak Republic, like other European countries, experienced considerable skill upgrading of employment over past decade. The study of intertemporal sectorial development of employment and growth rate of person engaged clearly indicates a change in the structure of employment in the Slovak Republic. The growth of jobs requiring the medium and high skilled workers increases the demand for high skilled labor.

According to the results of the estimations for all sectors, the contribution of offshoring to the change of employment share in case of low and medium skill-levels was negative while it seems to be positive for high-skilled labor demand. When consider the regression coefficients the results showed that the medium-skilled labor was hit hardest by offshoring. The coefficient for low-skilled labor for both offshoring and domestic outsourcing we found insignificant.

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Appendix 1

Table 8 Industry Classification in WIOT

INDUSTRY NAME	ISIC Code
TOTAL INDUSTRIES	TOT
AGRICULTURE, HUNTING, FORESTRY AND FISHING	AtB
MINING AND QUARRYING	C
FOOD , BEVERAGES AND TOBACCO	15t16
Textiles and textile	17t18
Leather, leather and footwear	19
WOOD AND OF WOOD AND CORK	20
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21t22
Coke, refined petroleum and nuclear fuel	23
Chemicals and chemical	24
Rubber and plastics	25
OTHER NON-METALLIC MINERAL	26
BASIC METALS AND FABRICATED METAL	27t28
MACHINERY, NEC	29
ELECTRICAL AND OPTICAL EQUIPMENT	30t33
TRANSPORT EQUIPMENT	34t35
MANUFACTURING NEC; RECYCLING	36t37
ELECTRICITY, GAS AND WATER SUPPLY	E
CONSTRUCTION	F
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	50
Wholesale trade and commission trade, except of motor vehicles and motorcycles	51
Retail trade, except of motor vehicles and motorcycles; repair of household goods	52
HOTELS AND RESTAURANTS	H
Other Inland transport	60
Other Water transport	61
Other Air transport	62
Other Supporting and auxiliary transport activities; activities of travel agencies	63
POST AND TELECOMMUNICATIONS	64
FINANCIAL INTERMEDIATION	J
Real estate activities	70
Renting of m&eq and other business activities	71t74
PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY	L
EDUCATION	M
HEALTH AND SOCIAL WORK	N
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	O
PRIVATE HOUSEHOLDS WITH EMPLOYED PERSONS	P