

LINK BETWEEN STRUCTURAL CHANGE AND EMPLOYMENT: THE CASE OF SLOVAKIA

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Abstract

Employment growth rigidity became one accompanying signs of freshly transformed economies in the region of Central Europe. The Slovak Republic was no exception and its inability of labour market to employ additional labour force into production process was one of the most important tasks for policy makers. The most analysed determinant of such development was rapid growth of labour productivity. However, the paper provides also additional, less analysed determinants of employment development by utilizing structural decomposition based on I-O analysis. Structural change itself, but also change in share of imported intermediate products on total production proved to be negatively influencing employment development. Also contribution of change in the structure of final demand was found to be strictly negative. These results provide new, not yet quantified results of various determinants contribution and aim to be important extension of current state of research in given area.

Keywords

Structural Decomposition, Structural Change, Employment Development

I. Introduction

The connection between economic growth and low unemployment level (or high employment level) as partial aims of economic policy is in economic theory defined relatively straight forward. It is based on assumption that economy with high economic growth invokes job process creation and therefore growth of total employment. Empirically, this is true for developed Western countries where the connection between economic growth and employment is relatively intense. Economic growth occurred in past two decades affected mainly the growth of labour productivity; however such effects lacked in field of employment growth. Consequently, the country has been challenged with relative low employment rate and persisting jobless economic growth. So far, this relative lack of connection between these two variables was blamed on labour productivity growth. It expelled job creation once the significant economic growth occurred. However, such rigid relationship between economic growth and employment could be also determined by some others factors (not just labour productivity) to which economic theory did not pay much attention. In particular, structural change of economy and its individual parts is one of potential candidates for determinants of the relationship. This implies the aim of the paper – to provide deep explanation of Slovak labour market rigidity with regards to economic growth. Another aim is also to explain how important was the role of changing economy structure in such non-flexible labour market relation to economic growth.

II. Literature

There has been a lot of available literature on structural change and its influence of employment development utilizing input-output analysis. It allows to reveal direct and indirect effects of structural change to employment level and development. One of such papers is paper by Huachu (2008). He utilizes structural decomposition to uncover contribution of particular sectors to

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employment development in China during years 1997–2002. The author notes in results that if all other variables would remain constant, the export would be main contributing sector to employment growth (on average about 4 % per year).

On the other hand, the technological progress occurred in country lowered the employment growth by approximately 6 % per year. The author suggest to orient growth of the economy to domestic consumption and not to investments. The topic of labour productivity decomposition was addressed in paper by Yang a Lahr (2010) which identify the determinants of labour productivity growth in China between years 1987–2005. The conclusion of their study explains that rapid growth rate of Chinese labour productivity is caused by low comparative base especially in the agriculture sector. Skolka (1989) studied structural changes of Austrian economy during the period of 1964–1976. One of analysed factors was a change in employment. The analysis came to conclusion that aggregate change in structure of domestic and foreign final demand was the main driver of employment development. The changes in industry structure of employment changed mainly due different rates of labour productivity growth among individual industries. Also change in technologies used in economy expressed by changes in Leontief inverse matrix played significant role in explaining the development of the whole economy and employment as well. And the latest paper in field of structural decomposition focused on employment changes is by Tin (2014) where he pays attention to development of Malaysian economy. There are three input-output tables used for decomposition (1970, 1991 and 2000). The main contributor to employment growth was in first period 1970–1991 the change in structure of domestic final demand, in second period 1992–2000 the change in export. So far, there has been none paper published yet focusing on the development of employment in the SR with the use of structural decomposition approach. However the phenomenon of jobless growth creates ideal conditions to perform such analysis. Also use of continual structural decomposition of employment for each year of study and in such detailed breakdown composition of determinants is to our knowledge new approach and has not been conveyed on any data yet.

III. Methodology and data

The data used in the analysis are taken from World Input-Output Database² (WIOD). The database covers 27 European Union countries and other 13 major countries in the world for the period from 1995 to 2009. We use the data Slovakia. Two types of sources are used from this database. First, world input-output tables in previous years' prices, denoted in millions of dollars. Second, Socio Economic Accounts, where employment data by industries are available. World Input-Output Tables are constructed for 35 industries. More information on the construction of the World Input-Output Tables can be found in Dietzenbacher, Los et al. (2013).

IV. Input-output model with employment effects

Open Static Leontief model is a widely used empirical method that allows us to analyse the complex linkages among industries. Assuming the fixed industrial input structure it is able to compute the total production that is necessary in order to satisfy exogenously given final demand. The basic equation of the model looks as follows

$$\mathbf{x} = (\mathbf{I} - \mathbf{A}^D)^{-1} \mathbf{f} \quad (1)$$

Where \mathbf{x} stands for a total production vector, \mathbf{f} for a final demand vector and \mathbf{A}^D for a matrix of input coefficients. The upper index D indicates the use of domestic intermediate products. Matrix $(\mathbf{I} - \mathbf{A}^D)^{-1}$ is called Leontief inverse and its elements represent the amount of production from

² World Input-Output Database in available at: http://www.wiod.org/new_site/home.htm.

industry i that is necessary to satisfy one unit of final demand for commodities from industry j . Detailed description of the properties and assumptions behind the input-output model can be found in Miller and Blair (2009).

If we assume fixed proportions between labour requirements and total production by industries, that can be expressed in following way

$$l_j = \frac{e_j}{x_j}, \quad j = 1 \dots n \tag{2}$$

then the model can be augmented for the effects of final demand on total employment in the economy. The elements of vector $\mathbf{I} = \{l_j\}$ are direct labour coefficients computed as a ratio between employment in industry j and total production of industry j . The inverse value of direct labour coefficients is a labour productivity. Augmented input-output model then takes this form

$$E = \mathbf{I}'(\mathbf{I} - \mathbf{A}^D)^{-1} \mathbf{f} \tag{3}$$

where E is a total employment in the economy. There are three determinants of the employment given by equation (3): labour requirements per one unit of production (inverse of labour productivity), structure of the production represented by Leontief inverse matrix, and final demand vector \mathbf{f} . Further, we can decompose the input coefficient matrix \mathbf{A}^D into two components and final demand vector \mathbf{f} into three components. The use of domestic intermediate products per unit of production is given by the total use of intermediate products and corresponding share of domestic intermediates on total inputs. Thus, matrix $\mathbf{A}^D = \mathbf{D} \circ \mathbf{A}^T$, where \mathbf{D} is a matrix of import shares of domestic products, \mathbf{A}^T is a matrix of total input coefficients based on domestic and imported commodities and symbol \circ represents the element-wise multiplication of the matrices (Hadamard product). Input-output tables provide the information about the final demand according to industries as well as final demand categories (final consumption expenditures of households, final consumption of government, gross capital formation and export). So, we can calculate the share of each final demand category on final demand \mathbf{s} and the share of each industry on total final demand of particular final demand category \mathbf{B} . Final demand vector is then given by this expression $\mathbf{f} = \mathbf{B}\mathbf{s}F$, where F is the total volume of final demand. Taking these factors explicitly into account, we can rewrite the equation (3) like this

$$E = \mathbf{I}'(\mathbf{I} - \mathbf{D} \circ \mathbf{A}^T)^{-1} \mathbf{B}\mathbf{s}F \tag{4}$$

From equation (4) it follows, that the total employment in economy depends explicitly on six factors. The volume of final demand F is just one of these determinants. We will elaborate more on this in the following sections.

Multiplicative structural decomposition analysis

If we use an index 1 for a comparison period and index 0 for a base period then the index of employment between two periods is given by

$$\frac{E_1}{E_0} = \frac{\mathbf{I}'_1(\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_1 F_1}{\mathbf{I}'_0(\mathbf{I} - \mathbf{D}_0 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0} \tag{5}$$

The overall change in employment, measured as employment index, is given by the change in six factors described above, such that

$$D_E = \frac{E_1}{E_0} = D_l \times D_D \times D_A \times D_B \times D_s \times D_F \quad (6)$$

where D_E - the index of employment

D_l - weighted change in labour productivity (or direct labour intensity)

D_D - weighted change in import shares

D_A - weighted change in total input coefficient matrix

D_B - weighted change in final demand structure by industries

D_s - weighted change in final demand structure by sectors (by final demand categories)

D_F - weighted change in final demand volume.

The first polar decomposition starts with the weights in the base period for the first factor and ends with the weights in the comparison period for the last factor. In this way, the first polar decomposition takes following form

$$\begin{aligned} D_l^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_0 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0}{\mathbf{l}'_0 (\mathbf{I} - \mathbf{D}_0 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0} \\ D_D^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0}{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_0 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0} \\ D_A^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0}{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_0^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0} \\ D_B^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_0 F_0}{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_0 \mathbf{s}_0 F_0} \\ D_s^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_1 F_0}{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_0 F_0} \\ D_F^1 &= \frac{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_1 F_1}{\mathbf{l}'_1 (\mathbf{I} - \mathbf{D}_1 \circ \mathbf{A}_1^T)^{-1} \mathbf{B}_1 \mathbf{s}_1 F_0} \end{aligned} \quad (7)$$

The second polar decomposition is obtained by reversing the index for weights. So factors weighted by base period become weighted by comparison period and the other way round. In this way, we decompose the overall change in employment D_E into the contribution of $D_l^2, D_D^2, D_A^2, D_B^2, D_s^2$ and D_F^2 (where upper index indicates the second polar decomposition).

From these two polar decompositions we obtain the final decomposition calculating the geometric mean for contribution of each factor. This leads to decomposition based on Fischer index. The contribution of the change in labour productivity is for example given by $D_l^f = (D_l^1 \times D_l^2)^{1/2}$. The final decomposition presented in the paper is thus given by following formula

$$D_E = \frac{E_1}{E_0} = D_I^F \times D_D^F \times D_A^F \times D_B^F \times D_S^F \times D_F^F \quad (8)$$

Empirical results

Our results reflect already mentioned contributions of each determinant to employment development in Slovak Republic as result of performed structural decomposition. In total, we can attribute and evaluate the list of following main determinants of employment.

- Contribution of labour intensity change (labour productivity)
- Contribution of economy structure change
 - Contribution of changes in import of intermediates
 - Contribution of changes in the structure of production
- Contribution of final demand change
 - Contribution of change in the industrial final demand structure
 - Contribution of change in the final demand structure by sectors
 - Contribution of change in the final demand volume

In order to provide deeper analysis, the results of structural decomposition are aggregated in two selected time periods. These periods differ by their characteristics, when first period 1995–2002 could be described as period when signs of transformation from central planned to market oriented economy were still present and second period 2003–2008 is known as period of very favourable economic development. At the end, the summary of results for the whole period 1995–2008 are provided.

Contribution of changes in labour productivity

The process of technological catching up to Western countries (still presents even nowadays) had a major impact on employment in the early years of transformation. The technological gap and its gradual reduction resulted in a fundamental growth rate of labour productivity. From the whole economy point of view, such growth had a positive impact on the value added growth and created pressure on wages growth. However, in terms of employment development, such growth of labour productivity blocked additional increase in total employment.

Table 1 shows, that in first analysed period 1995–2002 the Slovak Republic experienced decrease in volume of employment by 0.5 % per year on average. Such negative development was mainly caused by diminishing aftermaths of transformation process and privatization of state enterprises. Similar negative effect on employment development was imposed by recession in late 90's when employment decreased by more than 2 %.

The contribution of change in labour productivity was in this period negative, when potential growth of employment was hampered by more than 4 % per year on average. This could be assigned to catching up process of technologies in SR, productive gap and inflow of foreign capital which pushed the economy towards better and more effective use of production capacities.

In the second analysed period 2003–2008, well known for its unusual positive development economic growth, the employment had developed in qualitatively better pattern. The employment experienced increase with average rate of 1.6 % per year. However, such growth rate could be even more pronounced if the contribution of productivity growth would not act against this trend. It negatively contributed to employment growth by more than 4 % per year.

In total period 1995–2008, the positive trend of the second period in employment development was neutralized by the negative effects of the first period and total average growth of employment

remained on values close to zero (0.4 % per year). Also the negative impact of labour productivity was confirmed over the total period, when contribution of productivity development weakened potential growth of employment. It needs to be underlined again that such labour productivity development could not be perceived as negative phenomena in the economy, in fact it is quite the opposite.

Contribution of structural changes in economy

Labour productivity growth was not the only factor that influenced the development of employment. Also the changing structure of the economy has played an important role in affecting the development of employment growth. The total effect of the structural change has been split into two special factors. The first factor is the contribution intermediate consumption share of imported products on the total intermediate consumption needed for production and contribution of the overall structure change in the economy (direct and indirect effects) which could be obtained by the means of input-output analysis.

The first factor has an intuitive economic interpretation. The larger share of imported intermediate products from abroad, the lower contribution to the domestic employment because employment effect is generated in origin country of intermediate products. There may be a several reasons for such negative contribution, one of them might be cheaper labour costs and the overall price competitiveness of intermediate consumption products in abroad. This means the import of such products is for manufacturers cheaper than produce them by themselves in domestic country.

Gradual inflow of foreign investments in Slovakia along with more intense involvement in international trade reflected in share of domestic intermediate consumption on total intermediate consumption. The negative trend of the indicator demonstrates that share of foreign intermediate products over the time significantly increased. From the economy point of view this is clearly positive phenomenon, but in terms of employment not that much. The employment remains generated abroad and therefore the contribution of this factor is slightly negative.

In the first period 1995–2002, the contribution of changes in import was on average negative by –0.9 % per year. This could be interpreted as the increase in amount of intermediate consumption products from foreign countries affected potential growth of employment by almost a 1 percentage per year. However, in the second period, the contribution of this determinant decreased by almost half of its intensity to 0.5 % per year.

In the overall period, this determinant affected the employment growth negatively by average contribution of –0.7 % per year. Based on this founding, the growing share of foreign intermediate products in total intermediate consumption could be considered not to be as strong determinant of employment development as productivity growth, however, we can still consider it to be strictly negative.

The second factor from the group of determinants connected with structural change of economy is the change of economy itself and particularly change in the links between different sectors of economy. Such changes are expressed as changes in the Leontief inverse matrix which indicates how many products of *i*-th sector must be produced for the purpose of supplying one more unit of final demand in the *j*-th sector (Miller a Blair, 2009). The actual change in the Leontief inverse matrix shows the change in technology that various sectors use for production and how they evolve in time.

The impact of changes in technology used in the economy shows that in the first period the size of the determinant is marginal or even insignificant. On the other hand, the contribution of the determinant increased to almost –1 % per year. It was the period of huge FDI inflow to Slovakia which imported in the country new technologies. However, they do not require such significant involvement of human labour in manufacturing process and therefore the technology indirectly hampered potential employment growth despite the fact that economy was achieving high economic

growth. In the overall period, the contribution of this determinant fell to a relatively low value of -0.5% per year. Roughly the same size as the determinant of changes in the volume of imported intermediate products.

Contribution of changes in final demand

The final group of employment development determinants included in the analysis is the contribution of changes in final demand. However, this specification does not allow us to reveal detailed contribution of all kind of dimensions of the determinant so further elaboration to another three dimensions is performed.

Changes in industrial structure of final demand

The first dimension is change in industrial structure of final demand. It represents how the production was produced within all industries. The Slovak economy went through some changes with gradual development of certain industries that have become pillars of the economy. The changes were mainly represented by significant inflow of FDI in manufacturing.

Transformation process which took place in SR did not contributed to employment growth positively. Partly due to the situation when the transformed corporations were exposed to global competition and many of them faced bankrupt. Partly due the fact that transformation process led indirectly to structural changes in economy with similar effect on employment development. Labour intensive branches in manufacturing, such as textile industry gradually disappeared and were replaced by new branches, which are characteristic by their lower labour intensity of production. Manufacturing of vehicles or electronic and optic equipment could be considered as one of these "new" industries.

This change has negatively affected employment development in first period 1995–2002 when the average annual contribution of this determinant was more than -1% per year. In the second period 2003–2008 the negative contribution climbed even further and weakened potential employment growth by approximately -1.3% per year. By extending the decomposition to total period 1995–2008 we can conclude that changes in industrial structure of final demand contributed negatively to the employment growth. Although the magnitude of this determinant is not as high as was in changes in labour productivity, it is necessary to take into account a non-positive character of the determinant.

Changes in sectorial structure of final demand

The Slovak economy gradually became typical small open economy where significant proportion of production is meant for export. Habrman (2014) in his paper came to conclusion that export oriented industries tend to generate less employment than industries oriented for domestic consumption. The results of decomposition support these findings, because mainly increase in export sector and decline of domestic demand share on total production led to negative contribution of sectorial structure change to development of employment.

Even though the results for first period 1995–2002 show marginal effect of contribution in sectorial change of final demand, the second period 2003–2008 is characteristic for negative contribution to potential employment growth. In total period 1995–2008 this determinant became similarly significant as previous change in industrial structure. Even though the contribution of these determinants is relatively small, the cumulative effect was strictly negative and affected employment development in non-negligible way.

Changes in volume of final demand

The last dimension which was analysed in case of structural change of final demand was its volume. It can be vaguely perceived as economic growth of country measured by GDP, even though they are not the same categories. GDP measured by expenditure way similarly to final demand includes final consumption, gross capital formation and export, but in case of GDP import is subtracted from

export so final value differs from final demand category. However, with certain level of caution, results can be interpreted as substitute of economic growth itself.

Table no 1 refers to change of volume in final demand as only determinant with positive contribution to employment change. Average annual contribution in first period was above 6 % per year. The value of this contribution represents potential growth of employment per year in scenario where no structural change or productivity growth would appear. Even though the country was growing rapidly, its effect on employment growth was just marginal. The employment growth was even negative with magnitude -0.5 % per year. Such strong rigidity of labour market is in line with already mentioned facts in first chapter.

The second analysed period characteristic for its strong economic growth. The average annual contribution of determinant exceeded 11 % level what reflected in very mild increase in rate of employment growth (1.6 % per year). The differences between these different rates of growth could be partially explained by development of labour productivity, however, the significant role could be also attributed to contributions of structural changes of economy. In total, the contribution of volume change in final demand was very strong positive determinant of employment growth in SR. The highest effect was recorded in the second period due to rapid economic growth which pulled employment growth from previously negative values in first period. Although the contribution of the factor was strongly positive, the combination of other negatively acting variables caused very mild and relatively poor results approaching indifferent values. This provides a strong recommendation for economic policy makers, when the sole economic growth should not be the only benefiting factor to employment development, but also the structure of the growth represents (among others) significant determinant of labour market responsiveness to growth.

Table 1 Structural decomposition analysis of employment growth in the Slovak Republic (1995–2008).

Period	Employment growth index	Changes in labour productivity	Changes in import of intermediates	Changes in the structure of production	Changes in the industrial final demand structure	Changes in the final demand structure by sectors	Change in the final demand volume
1996/1995	2.08	-5.95	-1.27	0.64	-0.66	-0.51	10.52
1997/1996	-1.03	-7.72	-0.59	0.14	1.46	-0.77	6.99
1998/1997	-0.47	-3.73	-0.01	-0.99	-2.37	0.29	6.66
1999/1998	-2.53	-0.96	0.16	0.29	-1.77	1.74	-1.97
2000/1999	-1.95	-2.38	-2.68	-1.04	-1.82	0.18	6.03
2001/2000	0.58	-4.37	-2.17	-0.02	-1.40	0.19	8.83
2002/2001	0.09	-3.90	0.27	-0.09	-1.03	-0.52	5.59
1995-2002	-0.47	-4.17	-0.90	-0.15	-1.09	0.08	6.03
2003/2002	1.08	-1.03	-0.99	-3.19	-2.06	-0.65	9.50
2004/2003	-0.23	0.47	-1.33	-3.36	-1.08	-3.05	8.59
2005/2004	1.61	-6.38	0.03	-0.07	0.31	-0.95	9.28
2006/2005	2.08	-6.69	-0.85	-0.59	-2.83	-1.86	16.38
2007/2006	2.09	-6.14	0.12	-0.26	-1.58	-2.16	13.11
2008/2007	2.95	-4.52	-0.10	0.62	-0.60	-0.44	8.39
2003-2008	1.59	-4.09	-0.52	-1.15	-1.31	-1.52	10.84
1995-2008	0.41	-4.13	-0.74	-0.58	-1.18	-0.61	8.06

Source: Authors calculations based on WIOD.

V. Conclusion

From the results achieved by use of structural decomposition of employment based on I-O analysis we can conclude that several factors have influenced the development of employment in SR and these factors have not been much analysed in recent available studies. It is important to note that analysed factors have not been influencing the development of employment individually (as one might want to interpret it from structure of the analysis), but simultaneously when each factor was just one piece of greater jigsaw in field of employment growth. That is the reason why some of relatively low influencing determinants also partially contributed to the whole pattern of employment development. The results support already known facts about negative contribution of labour productivity growth in country. The productivity growth was one of the highest negatively contributing factors affecting growth of employment, however, there have been also several other factors influencing employment growth which effect has been revealed in the analysis. From aggregate point of view, all factors could be considered as total change in the structure of economy, in individual approach it was mainly change in the share of imported intermediate products on total products, but also change in the technological level of economy expressed as change in the inverse Leontief matrix. Another significant factors were change in the industrial and sectorial structure of final demand, mainly due the growth of industries orienting their production on foreign markets

(export). The only positive determinant of employment growth in SR was change in the volume of final demand which had the highest contribution to employment growth among all analysed factors. From the alternative point of view, it is necessary to note that labour productivity growth affected the employment development in two dimensions. In first dimension, as already concluded, it hampered the potential employment growth, but in the other dimension, the growth of productivity supported the growth of final demand volume what makes the final effect of such growth mixed. Remaining determinants kept their negative affection on employment during the whole period what makes them interesting object of further research. Therefore, the economic policy makers should also take into account the role of structural change when analysing the possible reasons of labour market irresponsiveness to economic growth (especially in long-run perspective). It would help them to predict and model more precise outcomes of their analyses and better targeting of policy tools on actual economic problems of countries.

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