

HOW IMPORTANT IS A STRUCTURAL CHANGE TO EMPLOYMENT DEVELOPMENT: A COMPARISON OF GERMANY VS. SLOVAKIA

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Abstract: The employment level of Eastern European countries is even after two decades of transformation process not reaching the employment levels of developed Western countries. This phenomenon can be clearly observed in the case of employment development in Germany vs. Slovakia. The paper utilises structural decomposition analysis for these countries within 1995 – 2008 time-frame based on World Input-Output Database to bring some light to the importance of structural change in employment development. Beside typical and deeply analysed contribution of labour productivity change, also the contribution of other determinants, such as share of imported intermediates on total intermediates, technology change and change in the structure of final demand are elaborated. Various dimensions of final demand structure are analysed with orientation on the industrial and sectoral structure. The decomposition provides new results with aim to better understand the role of structural changes in the labour market of post-transformed economies.

Keywords: structural decomposition, input-output, employment development, Germany, Slovakia.

JEL Classification: J21, O11

1. 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 the assumption that economy with strong economic growth invokes job process creation and therefore growth of total employment. Empirically, this is true for developed Western countries (especially in the Germany) where the connection between economic growth and employment is relatively intense. Economic growth occurred in the Slovakia during past two decades affected mainly the growth of labour productivity; however such effects lacked in the field of employment growth. Consequently, the country has been challenged with relatively low employment rate and persisting jobless economic growth. The growth of labour productivity is usually the factor to which this situation is attributed. It lowered job creation once the significant economic growth occurred due the efficiency increase. However, such rigid relationship between economic growth and employment could also be determined by some others factors (other than labour productivity) which are not regularly analysed. In particular, structural development of the economy and its individual parts is one of the determinants with unknown, but relatively intuitive influence.

Literature

There has been much available literature on structural change and its influence on employment development utilising input-output analysis. It allows revealing direct and indirect effects of the structural change to employment level and development. One of such

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papers is the paper by Huachu (2008). He utilises structural decomposition to uncover contribution of particular sectors to employment development in China during years 1997 – 2002. The author notes in results that if all other variables remained 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 suggests to focus growth of the economy to domestic consumption and not to investments. The topic of labour productivity decomposition was addressed in the 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 the low comparative base, especially in the agriculture sector. Skolka (1989) studied structural changes of Austrian economy during 1964 – 1976. One of the analysed factors was a change in employment. The analysis came to the conclusion that aggregate change in the 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, the change in technologies used in economy expressed by changes in Leontief inverse matrix played a significant role in explaining the development of the whole economy and employment as well. Moreover, the latest paper in the field of structural decomposition focused on employment changes is by Tin (2014) where he pays attention to the 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 the first period 1970 – 1991 the change in structure of domestic final demand, in the 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 relatively unusual approach and has not been regularly applied.

2. Methodology and data

The data used in the analysis are taken from World Input-Output Database (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).

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, we are able to compute the total production that is necessary 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 industry i that is necessary to satisfy one unit of final demand for commodities from industry j . A 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:

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

then the model can be augmented by the effects of final demand on total employment in the economy. The elements of the vector $\mathbf{l} = \{l_j\}$ 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

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

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 the 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

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

From equation (4) follows that the total employment in the 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

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

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 final decomposition presented in the paper is thus given by the following formula

$$D_E = \frac{E_1}{E_0} = D_l^F \times D_D^F \times D_A^F \times D_B^F \times D_s^F \times D_F^F \quad (7)$$

3. Empirical results

Our results reflect already mentioned contributions of each determinant to employment development in the Slovak Republic and Germany as a 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

To provide deeper analysis, the results of structural decomposition are aggregated in three selected time periods. These periods differ by their characteristics when first period 1995 – 2002 could be described as a period when signs of transformation from centrally planned to the market-oriented economy were still present (in Slovakia). The second period 2003 – 2008 is known as the period of very favourable economic development (both countries) and the third period is conclusive for the total period of analysis (1995 – 2008). It depicts the total period of analysis without the negative impact of the latest crisis in 2009.

3.1 Contribution of changes in labour productivity

The process of technological catching up to Western countries (still presents even nowadays) had a substantial impact on employment in the early years of transformation. The technological gap and its gradual reduction resulted in an underlying growth rate of labour productivity. We consider Germany as a well-developed economy which has already

achieved a high level of labour productivity. So in the field of labour productivity, the major increase rather occurred in the Slovakia than in Germany. 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, regarding employment development, such growth of labour productivity decreased possible additional growth in total employment.

Table 1 shows that the Slovak Republic experienced a decrease in volume of employment by 0.5 % per year on average in 1995 – 2002 period. Such negative development was mainly caused by diminishing aftermaths of the transformation process and privatisation of state enterprises. Similar negative effect on employment development was imposed by the 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 the potential growth of employment was hampered by more than 4 % per year on average. It can be assigned to the catching-up process of technologies in SR, productive gap and inflow of foreign capital which pushed the economy towards better and more efficient 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 the 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 neutralised 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 the contribution of productivity development weakened potential growth of employment.

It is clear from Table 2 that employment development in Germany has different nature in the total period. In fact, the development of employment is stable over the total period at level 0.6 % per year. The contribution of labour productivity has negative nature as well. However, when compared to the Slovakia, the level of this contribution is dramatically lower. The average contribution was in the first period -1 % per year. In the second period the negative contribution deepened to level -1.3 % per year. So we can conclude the same characteristics of the productivity growth influence in both countries. However, the effect was in the Slovakia much higher.

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.

3.2 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 a major 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 of 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 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.

That means the import of such products is for manufacturers cheaper than produce them by themselves in domestic country.

The gradual inflow of foreign investments in Slovakia along with more intense involvement in international trade reflected in the 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 a clearly positive phenomenon, but regarding 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. It could be interpreted as the increase of intermediate consumption products from foreign countries affected the potential growth of employment by almost a 1 percentage per year. However, in the second period, the contribution of this determinant decreased by nearly half of its intensity to 0.5 % per year.

In the overall period, this determinant affected the employment growth negatively by the average contribution of -0.7 % per year. Based on this finding, 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.

Again, the same determinants have in the Germany a different contribution to employment. In the first period, the change in the intermediates import had a slightly negative contribution at level -0.2 %. With the gradual expansion of German companies in foreign countries, the influence increased in the second period to almost -0.4 % per year, however, the outsourcing or transferring of companies overseas did not affect employment as much as it did in the case of the Slovakia.

The second factor from the group of determinants connected with the structural change of economy is the change of economy itself and particularly the change in the links between different sectors of economy. Such changes are expressed as changes in the Leontief inverse matrix which indicate 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 in both countries. On the other hand, the contribution of the determinant increased to almost -1 % per year in the Slovakia. It was the period of huge FDI inflow which imported in the country new technologies. However, they do not require such significant involvement of human labour in the manufacturing process and therefore the technology indirectly hampered potential employment growth despite the fact that economy was achieving high economic growth. We assume that this technology change had already occurred a long time ago and the country became one of the most advanced nations in terms of efficiency and production process. Also, the orientation of country to more sophisticated activities is rather more labour intensive than the focus of Slovakia just on manufacturing industry.

In the overall period, the contribution of this determinant fell to a relatively low value of -0.5 % per year in Slovakia and remained in positive values for Germany. We can conclude that while in the case of Slovakia, the changes occurred negatively contributed in both parameters of structural change, the Germany remained indifferent and slightly negative contribution of change in production of intermediates was cancelled out by the positive influence of technology used.

3.1 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 the specific contribution of all kind of dimensions of the determinant so further elaboration to another three dimensions is performed.

3.1.1 Changes in industrial structure of final demand

The first dimension is change in the industrial structure of final demand. It represents how the production was produced by all industries. The Slovak economy went through some changes with the gradual development of certain industries that have become pillars of the economy. The changes were mainly represented by the significant inflow of FDI in manufacturing. The Germany can be characterised by an increase in the foreign investments. So on the one hand, the Slovakia was the receiver of investments and Germany the exporter.

Transformation process which took place in SR did not contribute to employment growth positively. The same effect was still present in the Germany, but diminishing in Germany after both parts reunion. 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 an economy with a similar effect on employment development.

In the case of Slovakia, the labour intensive branches in manufacturing, such as textile industry gradually disappeared and were replaced by new branches, which are characteristic of their lower labour intensity of production. Manufacturing of vehicles or electronic and optic equipment could be considered as one of these “new” industries. The role of the manufacturing was already stable in the Germany, so the change has not influenced the country’s employment.

In Slovakia, the change had negatively affected employment development in the 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 the industrial structure of final demand contributed negatively to the employment growth. As already mentioned, the German’s employment remained untouched by an industrial change in final demand and the average contribution was close to zero.

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 in Slovakia and indifferent relationship to German’s employment.

3.1.2 Changes in sectoral structure of final demand

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

Even though the results for the first period 1995 – 2002 show marginal effect of contribution in a sectoral change of final demand for both countries, the second period 2003 – 2008 is characteristic for negative contribution to potential employment growth. It affected mainly Slovak economy when the export of economy was continuously increasing. The

same effect was also experienced in the case of Germany, but with rather lower magnitude. In total period 1995 – 2008 this determinant became similarly significant as the previous change in industrial structure for both countries. Even though the contribution of these determinants is relatively small, the cumulative effect was strictly negative and affected employment development in a non-negligible way.

3.1.3 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 understood 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 the case of GDP import is subtracted from export so final value differs from final demand category. However, with a certain level of caution, results can be interpreted as a substitute for economic growth itself.

Table no 1 refers to change of volume in final demand as the only determinant with a positive contribution to employment change. Average annual contribution in the first period was above 6 % per year. The value of this contribution represents potential growth of employment per year in a 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 known findings.

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 the rate of employment growth (1.6 % per year). The differences between these different rates of growth could be partially explained by the development of labour productivity. However, the significant role could also be attributed to contributions of structural changes of economy. In total, the contribution of volume change in final demand was an adamant 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 the 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 non-significant values.

The Germany is in this matter substantially different. The change in volume of final demand is contributing to employment at a lower level than in the Slovakia. The contribution was just 2.2 % per year in the first period, but when considered with positive average employment growth, the situation on labour market could be seen as a positive. In the second period, the contribution of economic growth increased but remained below the 3 % per year level.

Especially results for Slovakia 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 – 2009).*

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
1995-2002	-0.47	-4.17	-0.90	-0.15	-1.09	0.08	6.03
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.

Table 2 *Structural decomposition analysis of employment growth in the Germany (1995 – 2009).*

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
1995-2002	0.56	-1.01	-0.23	0.05	-0.16	-0.26	2.20
2003-2008	0.57	-1.31	-0.37	0.17	-0.02	-0.43	2.57
1995-2008	0.56	-1.15	-0.29	0.11	-0.09	-0.34	2.37

Source: Authors calculations based on WIOD.

4. 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 Germany. 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 the structure of the analysis), but simultaneously when each factor was just one piece of the greater jigsaw in the field of employment growth. That is the reason why some of the relatively low influencing determinants also partially contributed to the whole pattern of employment development. The results support already known facts about the negative contribution of labour productivity growth in the country. This applies to both analysed countries; however, the strength of the influence is much higher in the case of Slovakia. The productivity growth was one of the highest negatively contributing factors affecting the growth of employment. There have also been some other factors identified from an aggregate point of view as factors of 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. Other significant factors were a change in the industrial and sectoral 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 case of SR was the change in the volume of final demand which had the highest contribution to employment growth among all analysed factors. In the Germany, also the change in technologies used in production process contributed to employment development positively. The reason for such influence can be found in the entirely different level of used technology represented by technology gap.

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 the interesting object of further research (except technology used in the Germany). Therefore, the economic policy makers should also take into account the role of structural change when analysing the possible reasons of labour market unresponsiveness 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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