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Influence of Main Macroeconomic Factors on the Level of Employment on Different Size Enterprises – The Evidence from the Sector of Transportation and Storage

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Abstract

The main aim of this paper is to verify the hypothesis that the shift in levels of main macroeconomic variables – in this case in levels of GDP and exports – cause shift of employment levels in private sector, and this change is different for smaller enterprises than for "big players". Calculated estimation will be presented on data from the sector of transportation and storage for four countries – the Czech Republic, Germany, Austria, Poland and Slovakia for the period 2005-2014, which cover the economic crisis in 2008. Countries were selected such that they cover both highly developed countries (Germany and Austria) and former Eastern Bloc countries (Czech Republic, Poland, and Slovakia) of the European Union placed in the close geographic area. Expected results would show different trends in employment levels for different types of enterprises in all countries.

Keywords: small and medium-sized enterprises; large enterprises; macroeconomic factors; employment levels.

JEL classification: J21; E24.

1. INTRODUCTION

The main aim of this text is to compare overall employment in the sector "Transportation and Storage" and in different size enterprises on main economic variables – namely exports and GDP for selected countries of European Union – the Czech Republic and its neighbours – Germany, Austria, Poland, and Slovakia. The focus will be on the segment of small and medium enterprises, defined with respect to European Commission rules. In general, in accord with European Commission recommendations, small and medium enterprises (SMEs) are enterprises with less than 250 persons employed, with an annual turnover of up to EUR 50 million, or a balance sheet total of no more than EUR 43 million.

Impact of size of enterprises can be studied from different points of view. This study is mostly concerned by the impact of macroeconomic performance of the country on the

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employment in different size enterprises in the segment of transportation and storage. As transportation and storage employment levels reflect the circulation of goods and services in economy, we could expect the positive impact of both export and GDP on the control variable, as shown in Taylor *et al.* (2011) on historical data. The relationship between export variables and productivity in economics was studied by Leichenko (2000) with uncertain results. He argued that "Export growth is found to promote increased production and higher productivity, but higher production and higher productivity also lead to export growth". On the other hand the international trade as defined by exports and imports does not bring only positive effects to employment levels – not only goods but also human capital can be used for cheapest price. For example in the case of the US economy the number of employees significantly decreased as a result of offshore outsourcing in many economy sectors, with no exception of transportation sector (Baily and Lawrence, 2004). The mutual causality relation between the export and economic growth variables was studied on different data sets with ambiguous results. For example Awokuse (2003) has shown that in the case of Canada the export variable in the long term precedes GDP variable; on the other hand Hatemi-J and Irandoust (2000) tried to link both variables by Granger causality and decided that causality is unidirectional, running from economic growth to export growth in Denmark, and bidirectional in Finland, Norway, and Sweden.

Labour levels in SMEs was studied for example in Major (2008), who found, that the small and medium enterprises are more labour intensive, while they lack of capital assets. Merz and Yashiv (2007) studies the link between the labour market and the financial market. Asiedu and Freeman (2007) focused on the impact of globalization on profits of small and medium sized enterprises in the U.S. They concluded that profits of SMEs are dependent on the industry, income per capita and globalization measure (assets of multinational corporations). They also studied effect of ethnicity of owners on outcome of SMEs. From older studies for example Hamermesh (1989) described macroeconomic fluctuations in employment and productivity, he tried to examine costs that firm face in adjusting labour demand to exogenous shocks. Another approach to the employment dynamics was done in work of Bentolila and Bertola (1990). They showed that there is a possibility to regulate labour market by setting the firing costs such that the employment level in overall economy is in general larger than under different policy. The regulation effect on labour market could lead to different results in different countries.

The main aim of the paper is to show a possible dynamic of employment levels in different size enterprises in the sector of transformation and storage and their dependence on economic factors. Because the studied period covers economic recession, the calculations should cover study of structural breaks. The structural breaks analysis was for example covered in work of Stock and Watson (2012), or Bloom (2009). The first step of the analysis is to determine the break dates on overall economy data, which covers unit root tests, and break points unit roots analysis. The second step in the analysis is the determination of basic trends in data, as well as discussion of similarities and differences through countries and enterprise sizes. Then the basic dependencies in SME data will be studied using regular and panel regression analysis.

The text is structured as follows: the theoretical background to unit root and the break point unit root analysis is given in Sections 2 and 3. The 4th Section covers the obtained results and some discussions, followed by conclusions in the 5th Section and the list of references.

2. THEORETICAL BACKGROUND

The main aim of the next analysis is to determine break points and to check for basic relationships. As we intend to investigate the break point analysis, we need first to test a stationarity of the process for each variable, which means to use the Dickey-Fuller test for unit roots for data. The Dickey-Fuller is used to determine if the variable ρ in an estimation such as:

$$y_t = \beta_0 + \rho.y_{t-1} + \varepsilon \tag{1}$$

is not statistically different from 1. For the purpose of statistical testing, it is more suitable to rearrange equation (1) such that:

$$y_t - y_{t-1} = \beta_0 + (\rho - 1).y_{t-1} + \varepsilon = \beta_0 + \beta_1.y_{t-1} + \varepsilon \tag{2}$$

Then there is a possibility to use a t-test of the statistical significance of the estimated coefficient for lagged variable. If the coefficient (ρ – 1) is not statistically significant, then the time series is expected to be stationary in the first differences, the hypothesis of unit root cannot be rejected. The null hypothesis – unit root is based on the test statistics equal to the t-ratio of the coefficient:

$$DF_t = \frac{\beta_1}{SE(\beta_1)} \tag{3}$$

In the case of more complicated relationship, the augmented Dickey-Fuller test can be used. For example, the model used for the Dickey-Fuller test with one lagged differential is of the form:

$$\Delta y_t = \beta_0 + \beta_1.y_{t-1} + \beta_2.\Delta y_{t-1} + \varepsilon \tag{4}$$

When looking for irregularities in data, one of the suitable tools is a break point analysis, which is also based on unit root tests. The structural breaks can occur in intercept or in a slope. In general, if the break occurs in the time series sample for time series [1, 2, …T] in time point T^* such that $1 \leq T^* \leq T$ then the correct estimation will cover dummy variable *d*:

$$d = \begin{cases} 0 & \text{for } t \leq T^* \\ 1 & \text{for } T^* \leq t \end{cases} \tag{5}$$

The estimation for break in intercept:

$$y_t = \beta_0 + \beta_0' d + \beta_1 x_t + \varepsilon_t \tag{6}$$

The estimation for break in slope:

$$y_t = \beta_0 + (\beta_1 + \beta_1' d)x_t + \varepsilon_t \tag{7}$$

The estimation for break from intercept to slope:

$$y_t = \beta_0 + \beta_1 d x_t + \varepsilon_t \tag{8}$$

Statistical program EViews supports the automatic break date selection methods by minimization of the Dickey-Fuller t-statistic for different values of variable *d*. As for the second part of the analysis, there was a problem with amount of available data. Therefore, the ordinary least squares and panel estimation results are only roughly informative.

3. DATA DESCRIPTION

This analysis is based on the macroeconomic data of employment, export and GDP in five European countries, in the Czech Republic with its neighbors - Germany, Austria, Poland, and Slovakia. The first part presented analysis – determination of break points – is based on quarterly data of overall persons employed and GDP of above mentioned countries for the period of 1998-2016. The second part of the analysis is using annual data of persons employed in the sector "Transportation and Storage", net exports, imports and GDP for the period of 2005-2014. The employment data of the sector "Transportation and Storage" cover annual data on employment in different size enterprises, namely data are divided into four main groups:

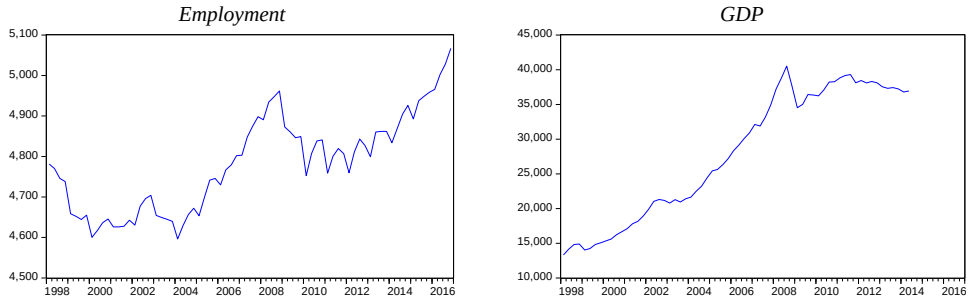
- micro enterprises: 2-9 persons employed;
- small enterprises: with 20-49 persons employed;
- medium-sized enterprises: with 50-249 persons employed;
- large enterprises: with 250 or more persons employed.

Even though the scope of the analysis is focused on small and medium-sized enterprises (SMEs), used data both the micro and large enterprises should have impact on movement of employment in SMEs.

The analysis is based on macroeconomic data; GDP values are given in current prices, seasonally and calendar adjusted data in million euro, net imports and exports are given in millions of ECU/EURO, quarterly data on persons employed are not seasonally adjusted. Used data are from EUROSTAT database (2017).

4. RESULTS AND DISCUSSION

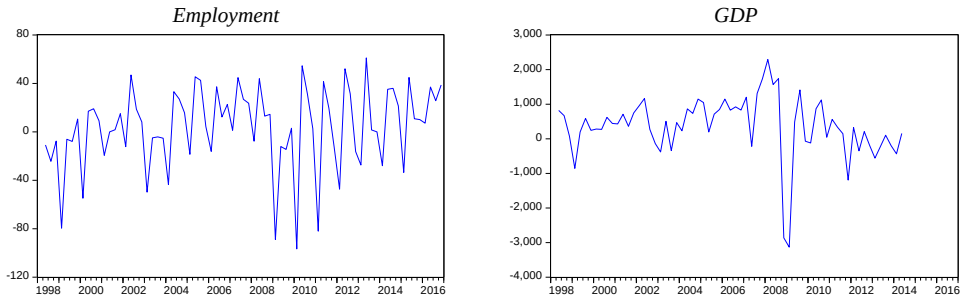
The break point analysis based on the Dickey-Fuller test should be performed on the stationary time series data. However, when looking at the available data for employment and GDP, they both have trend interrupted by sudden change as can be seen for illustration in Figure no. 1 for the data from the Czech Republic.



Source: data from EUROSTAT database depicted in EViews

Figure no. 1 – Employment and GDP levels in the Czech Republic

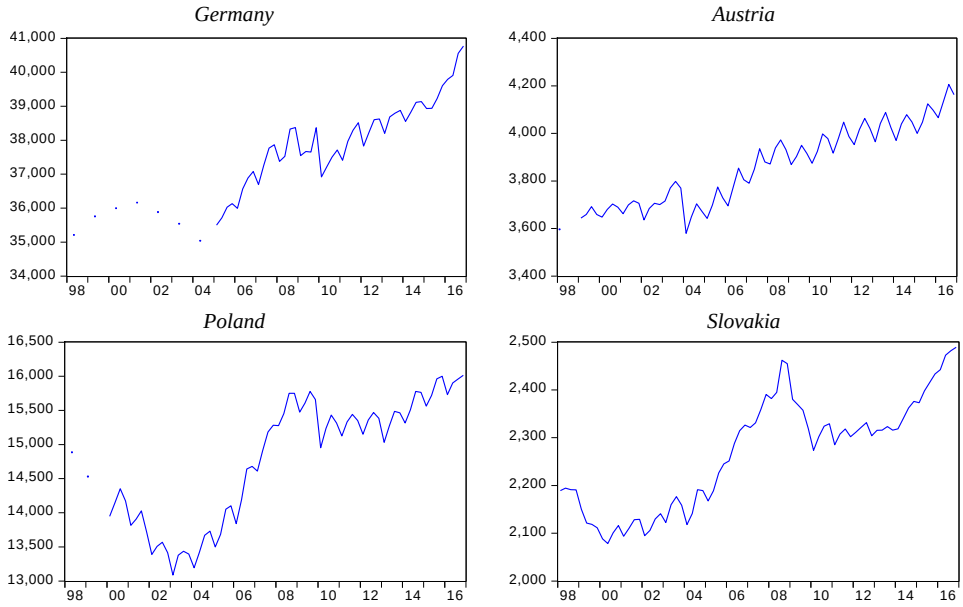
Therefore, the condition of stationarity of time series should be observed in their first differences. For illustration, first differences of the time series data of the employment and GDP in the Czech Republic are depicted in Figure no. 2. These data are looking stationary (with shift), the augmented Dickey-Fuller test was performed – this unit root test on first differences confirms stationarity of both data series.



Source: own calculations, EViews outcome

Figure no. 2 – First differences of employment and GDP data from the Czech Republic

When looking on overall data series (Figures no. 3 and no. 4 for employment data and GDP data, respectively), the break point should be detected around years 2008-2009 with the exception of Austria. In the case of Austria, the break point can be expected around 2004 for employment and around 2007 in the case of GDP.

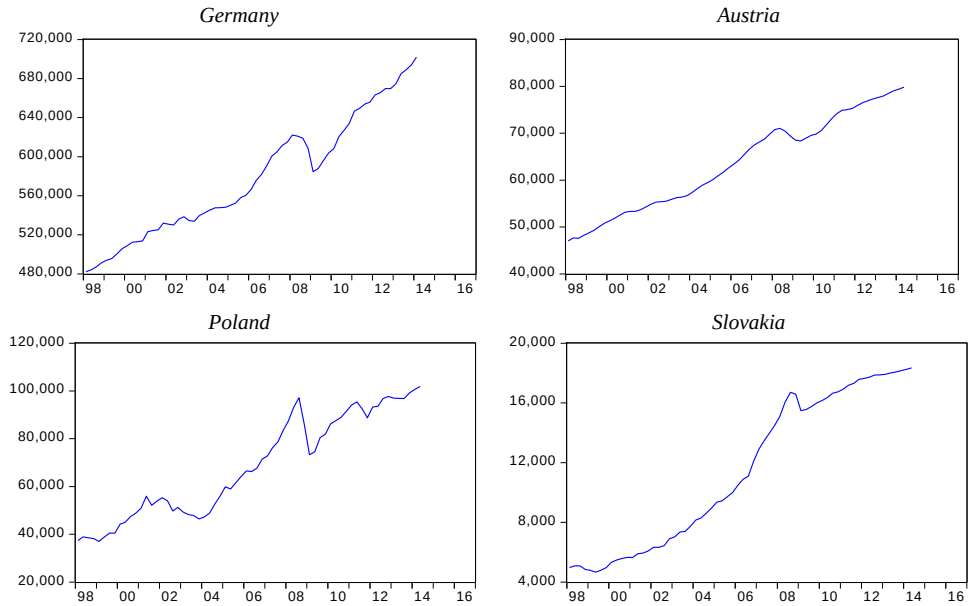


Source: data from EUROSTAT database depicted in EViews

Figure no. 3 – Data of employment in Germany, Austria, Poland and Slovakia through 1998-2016

Results of break point analysis, given in Table no. 1 are supporting these expectations. All results, with two exceptions (Germany and Poland in the case of employment data) are

statistically significant at 5% level of significance. All studied countries have a break point within short time interval with one exception of Austria.



Source: data from EUROSTAT database depicted in EViews

Figure no. 4 – Data of GDP in Germany, Austria, Poland and Slovakia through 1998-2016

The interesting point is that the break point in employment level precedes the break point in GDP time series data, which contradicts the economic expectation of leading changes in GDP influencing all other variables. For example in Holland and Scott (1998) authors studied economic cycles on data from UK with the result that most of influenced variables were unpredictable, while employment level was predictable because of factor inputs. Results of estimations on the Czech data set are not in accord with their findings. This discrepancy could be caused by a character of data used for break point analysis – while data of GDP are seasonally adjusted, the data on employment are a "rough" data without seasonal adjustment and without adjustment to overall working-age population of respective countries.

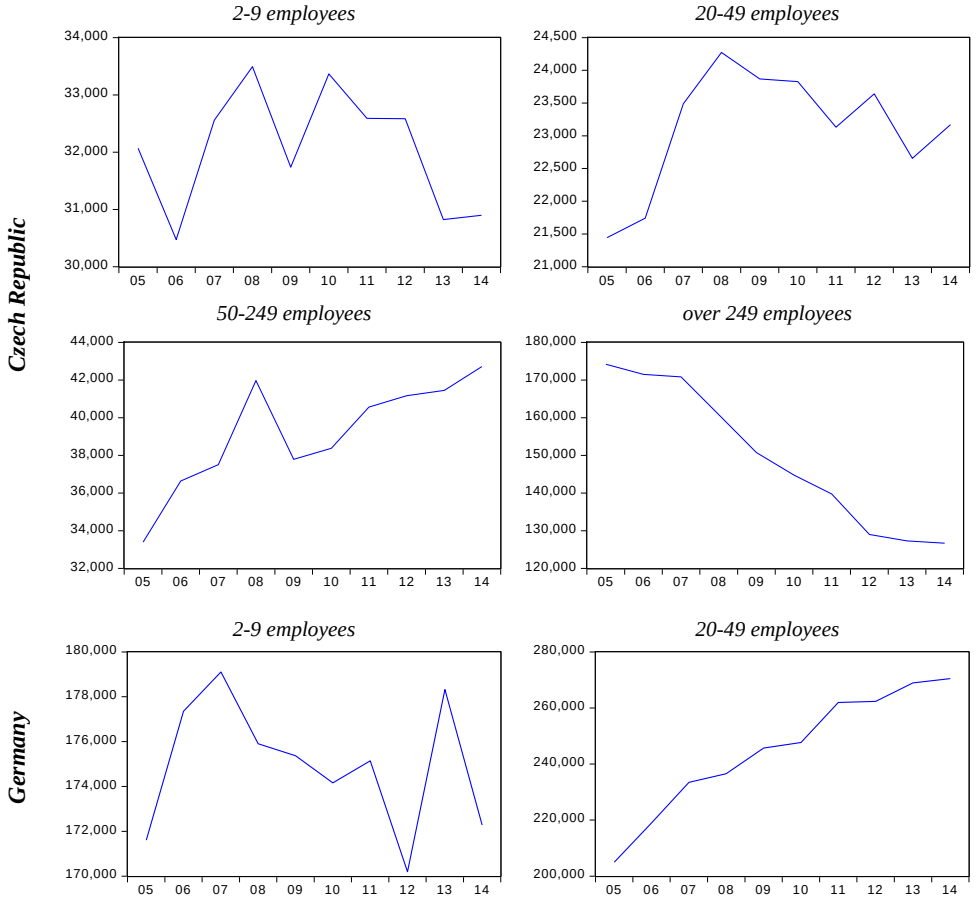
Table no. 1 – Results of break point analysis

Country	Brak Date - Employment	p-value	Break Date - GDP	p-value
Czech Republic	2008Q1	0.0317	2009Q1	<0.01
Geramany	2008Q4	0.4745	2009Q1	<0.01
Austria	2004Q3	<0.01	2007Q4	0.0151
Poland	2008Q4	0.6872	2009Q1	<0.01
Slovakia	2008Q3	<0.01	2009Q1	<0.01

Source: EViews calculations

Data of employment in the sector of "Transportation and Storage" are a short-term yearly data; therefore, it should be not correct to perform a break point analysis. However, from depicted graphs (Figure no. 5) we can see, that in the Czech Republic, and Austria, in the case

of the medium-sized enterprises (50-249 employees) the drop in number of employees after 2008 was significant, while there was not a significant drop in the case of small enterprises (20-49 employees). On contrary, in the case of sector employment in Poland, the significant drop was in the case of small enterprises, while this drop was not visible in the case of medium-sized enterprises. Finally, in the case of Slovak employment, the drop was visible both in the case of small and medium-sized enterprises; on contrary to the case of Germany, where this drop did not occur at all. The interesting point is also the fact, that there was the overall increasing trend in the case of medium-sized enterprises, but high differences were in trend in the case of large enterprises – they were increasing in number of employees in industry only in Germany, while in other countries they were decreasing or has not visible trend (Slovakia, Poland). This result corresponds with results of Aremu and Adeyemi (2011), who argued the small and medium-sized enterprises can be viewed as an "engine of economic growth and development" under difficult economic conditions; moreover, Carvalho and Gabaix (2013) argued that macroeconomic fluctuations are the results of many microeconomic shocks – and our results support this theory. While employment throughout the studied period in selected states had certain trend, trends in the specific sector distributed among different sizes of enterprises did not exactly copy the main trend.



Germany

50-249 employees

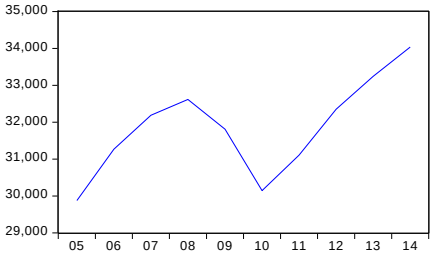
over 249 employees

Austria

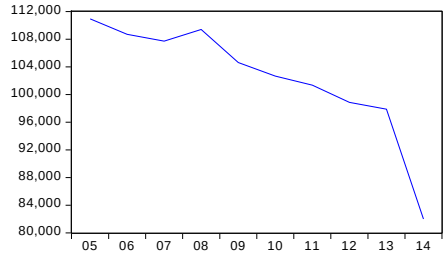
2-9 employees

20-49 employees

50-249 employees

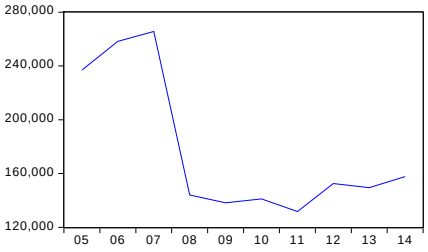


over 249 employees

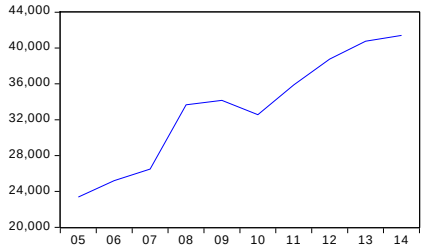


Poland

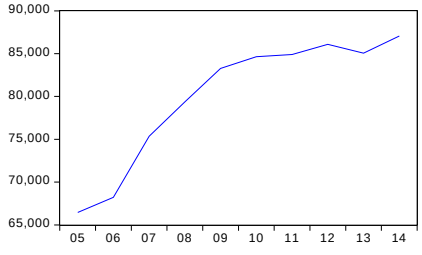
2-9 employees



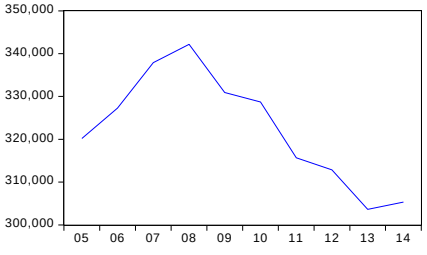
20-49 employees



50-249 employees



over 249 employees



Source: data from EUROSTAT database depicted in EViews

Figure no. 5 – Data in employment in the "Transportation and Storage" sector for different size enterprises in the Czech Republic, Germany, Austria, Poland and Slovakia

Results of basic regression analysis of SMEs employment data on export and GDP data are given in Table no. 2. From the obtained results we can see that both explanatory variables were statistically significant in the case of big employers in Poland and Slovakia, in the case of medium-sized enterprises in the Czech Republic and Germany, and in the case of small enterprises in Slovakia. In general, the values of R^2 are relatively high; however, because of the short time series these results can be viewed only as a rough approximation of real trends.

Table no. 2 – Results of regression of transportation and storage sector employment data on exports and GDP

Country	Constant	Exports	GDP	R^2
Czech Republic				
2-9 Employees	27388.1***	-0.0432	0.2577*	0.22
20-49 Employees	16436.8***	-0.0272*	0.2696***	0.66
50-249 Employees	22233.5***	0.0695**	0.2852*	0.87
250 and over Employees	228138.7***	-0.7163**	-0.1949	0.77
Germany				
2-9 Employees	177839***	0.0082	-0.0169	0.01
20-49 Employees	-115801*	-0.1258	0.7738***	0.89
50-249 Employees	−296572**	−0.23151*	1.4322***	0.92
250 and over Employees	4041.42	−0.1035	1.6290**	0.89
Austria				
2-9 Employees	23113***	−0.0249	0.0950	0.28
20-49 Employees	100779***	-0.0286	0.2577**	0.71
50-249 Employees	20904.7***	0.0159	0.1274	0.41
250 and over Employees	187358***	0.2163	−1.5536**	0.63

Poland				
2-9 Employees	465129***	1.2211	−5.1357	0.47
20-49 Employees	6757.91	0.1561	0.0922	0.85
50-249 Employees	43572.4***	0.0484	0.3632	0.72
250 and over Employees	304269***	−1.0770***	1.7414***	0.74
Slovakia				
2-9 Employees	1428.17	0.6810***	−1.7854**	0.87
20-49 Employees	2247.64	0.2026*	-0,3831	0.58
50-249 Employees	10988***	0.0635	0.0745	0.37
250 and over Employees	45114.8**	−1.0232*	4.5659*	0.24

Note: Asterisks in a regression table indicate the level of the statistical significance of a regression coefficient; three, two and one asterisks indicate the statistical significance of the regression coefficient at 1%, 5%, and 10% level of significance, respectively. Last column gives values of adjusted R2 value.

Source: EViews calculations

In results the dependence of employment in transportation and storage sector on level of exports revels the negative relation between the two variables in the case of big enterprises with one exception – positive relationship in Austria. This relation indicates that with increased export level of the country big firms decrease number of employees. In the case of Slovakia and Poland this decrease is compensated by increase of employment levels in small and medium-size enterprises – in the case of these two countries the higher slope of increase is in the case of employment in small enterprises with 2-9 employees (even though in the case of Poland the export slope variable is not statistically significant). This result might indicate that in the case of increased export levels employees tends to change jobs in favour of smaller enterprises or employees try and succeed in becoming entrepreneurs and starting new small enterprises; similar concepts of new firm creation and levels of entrepreneurships were discussed in Henrekson and Sanandaji (2014). However, the results of dependence of employment levels on exports in the Czech Republic show different trend; with increased exports the number of employees decrease with one exception – firms with 50-249 employees. This trend show higher specialization of the medium-sized Czech transportation firms and their capability to cover requirements of export markets. The situation in Germany is much different – with increasing export levels all transportation and storage employers decrease employment level. This result can have several explanations: on one hand when export levels increase, there is no need for enhanced storage facilities, hence not so many employees are needed. On the other hand, the employee levels can be decreased because of the higher effectivity of German transportation firms, as well as possible outsourcing of transportation facilities to neighbour states. The last possible explanation could be valid in the case of the US economy as shown in Baily and Lawrence (2004) – the number of employees significantly decreased as a result of offshore outsourcing in many economy sectors, with no exception of transportation sector.

As for the influence of real GDP on employment levels in the studied states, almost all statistically significant results are positive – this outcome supports the easy economic idea behind GDP and employment – the higher GDP, the higher employment in economy. There are two exceptions in obtained results: in the case of Slovakia the relation is negative in the case of small firms (-1.79), which indicate that Slovak employees favour to work for bigger transportation and storage companies (coefficient 4.57 is statistically significant and is the highest of estimated coefficients at GDP column). The second exception – result for Austria in

the case of big companies (coefficient -1.55) indicate that employees prefers small enterprises (coefficient 0.26 is the only one statistically significant) or different working sector.

The interesting feature is the influence of export on employment in transportation and storage firms with respect to size of companies for all countries at once – panel estimation of this effect is given in Table no. 3. This effect is, as expected, positive; moreover, we can see that the bigger the companies the higher is the dependence of employment level on value of exports in all countries in the region.

Table no. 3 – Results of panel regression of SMEs employment data on exports

Panel	Constant	Exports	R^2
2-9 Employees	47882,58	0.1319***	<0.01
20-49 Employees	-2014.598	0.2526***	0.991
50-249 Employees	5287.511	0.3771***	0.97
250 and over Employees	76072.97	0.8714***	0.93

Note: Asterisks in a regression table indicate the level of the statistical significance of a regression coefficient; three, two and one asterisks indicate the statistical significance of the regression coefficient at 1%, 5%, and 10% level of significance, respectively.

Source: EViews calculations

Once more, it is necessary to emphasize the fact that the estimations are, because of lack of data, only informative and for statistically supportive results, it is necessary to collect data for longer periods of time with shorter frequency (quarterly or monthly data).

5. CONCLUSIONS

The focus of this analysis was to compare overall employment in the sector "Transportation and Storage" of small and medium enterprises with main economic variables, in this case total GDP and exports volume. The first part was devoted to comparison of structural break dates with trend in SME employment data. In general, structural breaks caused by 2008-2010 recession are not always visible on employment data from studied sector.

Regression analysis determined dependence of employment on exports with mixed results. While the dependence of employment in transportation and storage sector on level of exports revels the negative relation between the two variables in the case of big enterprises with one exception – positive relationship in Austria, the positive statistically significant relation occurred for example in the case of micro and small size enterprises in Germany as well as in the case of SME's in the Czech republic. Even though results of Leichenko (2000) implies that the correct way should be avoiding multicollinearity by using only one of the two GDP or export variables, our obtained results do not fully support this reasoning. For example in the case of the big enterprises both regression coefficients of exports and GDP are statistically significant with export positively and GDP negatively influencing the outcome.

The importance of transportation, as well as the influence of transportation costs on productivity of economy was discussed in Adamopoulos (2011) – hence the calculations focused on the relation between the employment levels and the respective GDP. Results of the panel analysis of enterprises employment level show that the larger the enterprise the higher dependence on variable export, and the coefficient in the case of export is always

positive. This result confirms the conclusions of the research performed by Asiedu and Freeman (2007) about the impact of globalization on profits on firms – in the case of studied data the globalization can be represented by exports levels, and the profit of firms can be generalized by number of employees.

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