Analysis of investment in infrastructure and other selected determinants influence to unemployment in CR regions

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Abstract

Over the past years, number of attempts has been made to empirically research whether investments in transport infrastructure can create job opportunities throughout an economy. The situation and condition of road infrastructure in Czech Republic is not at perfect, even though density of road infrastructure is very high compering average of EU. According to theories, improvements in transport infrastructure definitely reach long-term economic impacts by influencing firms on the one side and inhabitants on the other side. The impacts go mainly through decisions that are made by employers. The effect on employment and obviously unemployment rate takes place at many points in time period and space, and can differ considerably across diverse sectors of the economy. Providing of transport infrastructure is endogenous and at the same time exogenous. From this reason, the contributory relationship between transport investment and employment is probably indefinite.

Key words: infrastructure, investment, GDP, coefficient of elasticity, time series

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Introduction

The investment into road infrastructure is considered to be a key prerequisite of social and economic development of any country (Jercea, 2012). The expansion and upgrade of the road network is vital to increase economic performance. Hence, poor road infrastructure poses hindrance to foreign investments in countries depending on them in terms of their economic performance and competitiveness enhancement. The expenditures on the road infrastructure trace the GDP development with a certain delay (Ivanová, Masarová, 2013). For example China has made large scale road infrastructure investments since 1990s. According to China Statistical Yearbooks, the total length of roads in China has more than doubled since 1990, reaching 2.6 million kilometres by 2008. The total length of expressways has increased from 147 km in 1988 to over 50,000 km in 2007, ranking second only to the United States. At the

same time, China's GDP grew by about 9% per year, while GDP per capita increased by 8% annually. There is a common view that the infrastructure investments have played an important role in sustaining the rapid economic growth of China (Li, 2013). Transportation investment effects are composed of distributive and generative effects that induce a change in the spatial distribution of economic activities between regions and an increase in the economic value. Such effects can be disaggregated into short term effects during the construction phase and long term effects during the operation phase of the transportation project (Hensher, D. A., Truong P., Mulley, C. & Ellison, R. 2012). During the construction phase, the investments stimulate final demand, but generate little effect on the economic behaviour of users. During the operation phase, the supply of transportation services has a positive impact on regional economic growth by increasing the production of goods and services at a lower average production cost. The regional impacts of transportation costs and new road development of the Trans-European Transport-Networks using a static model for more than 800 regions. The reduction in transportation costs through road development could reduce the income disparity between regions. Kim and Hewings (2009) analysed the long-run regional effects of an increase in total factor productivity in the transportation sector, resulting in the development of the Multisectoral and Regional/Interregional Analysis. It found that all of the highway projects have positive effects on GDP and export growth as well as regional equity in terms of wage and employment of population (Kim, Hewings, 2009). In Sweden was the relationship between economic growth and traffic describe in analyses in SIKA (2005). The results indicate that the time series of traffic and GDP are not cointegrated and hence that traffic and GDP will not converge to a long-run equilibrium relationship after short-run deviations from each other. Therefore, GDP and traffic do not share a stochastic trend in addition to the deterministic trend exhibited by both time series (Krüger, 2012). The European Union average debt was about 85% of GDP in 2012. That is why Germany and the majority of EU countries have undertaken austerity measures. Nevertheless, even as constraints on spending and borrowing have grown, many governments have been emphasizing the importance of infrastructure in assisting economic growth. A number of countries have explicitly recognized this as part of their stimulus packals (Yanushevsky, 2013). Investment in transportation infrastructure may also help to reduce the impact of the crisis through its immediate effect of job creation, while building the basis for achieving fast-paced growth when the crisis subsides. Thus, at the present time, when the global economic crisis has created substantial uncertainty concerning global investment, and is expected to lower growth and raise the debt-to-GDP ratio, advancement of infrastructure projects through the private

sector may provide a solution for securing long-term growth, while providing low-risk investment channels for the financial sector (Lavee, Beniad, Solomon, 2011). Whereas transport infrastructure affects GDP after five years, other infrastructure seems to induce short-run demand effects. As transport infrastructure has a larger and longer-lasting effect on GDP, these infrastructure projects seem to have especially induced, or at least enabled, the integration of markets which were regionally and functionally separated before. (Sturm, Jacobs, Groote, 1999). The results of the empirical investigation demonstrate the existence of such links and that the impact of transport investments can indeed bring about changes in the economic system, although one must consider that the nature of investments is a strategic factor to have desirable effects and that other variables, such as technology, have a greater importance in the short term on the economic system (Venezia, 2011).

1 Methods and Materials

Regression and correlation analysis used to determine the major determinant and to quantify of the relationships between economic variables using time series for the period 1995-2012. The paper has several scientific questions. These questions will addressed using a linear regression model, which will be applied in the structural analysis of the gross domestic product of selected regions and unemployment in these regions.

Q1 – Will have the regional GDP and the rates of unemployment a major impact on economically active population (EAOB), aged 16-65 years?

Q2 – Is the number of university (VYS) and high school - educated people (STR) an important factor that will increase GDP in millions CZK in the region?

Q3 – Does unemployment (NEZ) in % decrease the GDP and vice versa?

Q4 – Will be investment in infrastructure in millions CZK (INV), decided by the region, an important factor affecting on the growth performance of the region? Similarly, can we consider investing in infrastructure neighbouring region?

Q5 – Does rising inflation measured by the consumer price index in% (CPI), reduce unemployment in the region, which interprets in the same way Philips curve?

Q6 – Does reduce the number of university-educated people unemployment in the region?

Economic variables were selected to determine and quantify the impact of significant determinant of performance of selected region. In the presence of economic variables and influence they are allow to estimate the models verified in all aspects. These selected variables are included below double sided equation recursive econometric model (1).

$$GDP_t = \gamma_{11} + \gamma_{12} EAOB_t + \gamma_{13} VYS_t + \gamma_{14} UNE_{t-1} + \gamma_{15} INV + u_{1t} \quad (1)$$

$$UNE_t = \gamma_{21} + \beta_{21} GDP + \gamma_{22} EAOB_t + \gamma_{23} VYS_t + \gamma_{26} CPI_t + u_{2t}$$

when $u_{it} \sim$n.i.d. $(0,\sigma^2)$, for i=1,2…

In the framework of econometric verification, tests of autocorrelation according to Durbin-Watson test were carried out which are introduced in all tables in the text and subsequently further verified by Breuch-Godfrey test. The results confirmed the absence of autocorrelations of residues of the 1st order.

For verification of multicolinearity among explanatory variables a correlation matrix was used where pair correlation coefficients do not exceed the critical value 0.8 except the variable the number of graduate people and the number of economically active people. Therefore, the test VIF was carried out further which did not confirm occurrence of multicolinearity because none of values was bigger than 5.

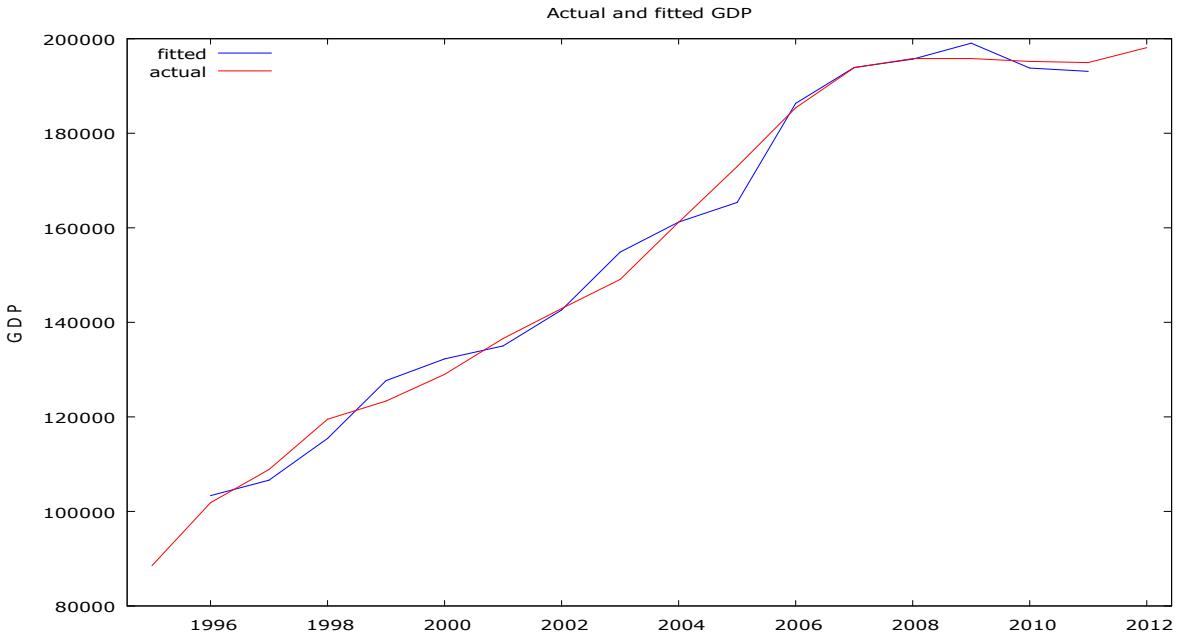
To avoid a spurious regression in the model, tests of unit root with use of ADF-test, which detected nonstationarity in time series, were carried out. However, the resulting residues of estimated models are already stationary. It is possible to presume that there is a long-term relation among the variables and that the monitored economic quantities converge in time to the equilibrium.

1.1 Structural analysis of GDP and unemployment of the South Bohemian region

Development of GDP in the South Bohemian Region, according to graph number 1 and the actual values, reports dynamic growth until the year of 2009, which is followed by stagnation that reacts to the economic crisis, which has resulted in reduced performance of the national economy and with that associated saving measures particularly in the areas of investment like in other regions and entire Czech Republic.

In the graph are also mentioned balanced values of GDP based on forecasts of the econometric model below.

Fig. 1: Development of GDP in the South Bohemian Region



Source: ČSÚ and author´s calculations in SW Gretl

According to formula 1, estimates of the regression model coefficients were made, which are provided in table number 1. In the table are also entered characteristics, which are used to review the quality of estimates.

Tab. 1: Estimations of structural parameters of GDP function in South Bohemia region (GDP)

Endogenous variable - GDP in the South Bohemian Region mil. CZK (GDP)								
Exogenous variable	Parameter	Stand. deviation	t-stat	p-value	R^2	DW statistic	LMF	Number of observations
constant	-1,03e+06	117501	-8,79	<0,00001***				
EAOB	2493,42	286,172	8,71	<0,00001***				
VYS	1452,79	222,53	6,53	0,0004***				
UNE-1	2514,79	689,608	3,65	0,0038***				
INV	5,5538	2,786	1,99	0,0716**	0,99	2,13		17
Endogenous variable - GDP in the South Bohemian Region mil. CZK (l_GDP)								
constant	-29,58	5,45572	-5,42	0,00021***				
l_ EAOB	6,446	0,934	6,90	0,00003***				
l_VYS	0,497	0,075	6,67	0,00199***				
l_UNE-1	0,108	0,022	4,99	0,00005***				
l_INV	0,026	0,021	1,24	0,07093*	0,98	2,052		17

Source: ČSÚ author´s calculations in SW Gretl

Based on the results above is obvious that scientific question Q1 is clearly confirmed and can be interpreted this way: if the number of economically active population of the South Bohemian region increases by 1 person, the GDP of the South Bohemian region will increase in CZK 2,493.42 million, shown relatively, 1% growth in number of economically active population, will cause 6,446% growth in regional GDP. This factor has the biggest effect on GDP. Scientific question Q2 is confirmed only partially, impact on the amount of GDP of the county was significantly demonstrated only in the group of university-educated people, this situation is therefore interpreted as an increase in the number of college graduates in the region in 1 person will increase GDP by 1,452.79 million CZK or relatively , increase in the number of college graduates by 1% leads to an increase in GDP of 0.497%, which compared to the number of economically active population is inelastic reaction. Factor number of university-educated people with its impact intensity on GDP is ranked on second place. Impact of secondary educated persons was not economically nor statistically verified. Because of this, the variable STR was excluded from the model. Scientific question Q3 is rejected because the change in the unemployment rate affects proportionally the GDP of South Bohemian region. The expected inversion in the relationship between unemployment and GDP results from the assumption that unemployed people don't bring economic performance, but on the other side take social benefits in form of unemployment benefits. However the question remains, whether these unemployed people do not work without legal relationship also known as undeclared work. It was found that the slightly better model performance delivers model dynamism in the form of lagged unemployment rate. If the unemployment rate increases by 1 percentage point, the regional GDP will increase by CZK 2,514.79 million, according to power functions, then a 1% increase of unemployment causes 0,108% increase in GDP of South Bohemian region. Scientific question Q4 was confirmed only partially increased investment into roads II. and III. class will cause an increase in the economic performance of the region. Their effect, however, in comparison with other factors, is the lowest. Interpretation is, if the investment increases by 1 million CZK, regional GDP responds by increasing in 5.5538 million CZK, which is only a percentage of 0.026%. Therefore the effect of investment is of all of these variables the lowest. Variant of the model with insertion of the variable investment in infrastructure in Pilsen, a neighbouring county, has emerged as supporting GDP growth in South Bohemian region, which in economic terms is positive as possible commuting into the next region will be faster and more affordable. But the parameters of both variables of investment are statistically insignificant, and therefore this option is not further processed. Graphic representation of the evolution of unemployment,

which is shown in the figure 2, demonstrates the connection with GDP and unemployment. As it has seen since 2009 the unemployment falls to a level of almost 4.5%, which corresponds to the years 1997 and 1998, because of the stagnation and a slight decline in GDP.

Fig. 2: Development of unemployment in the South Bohemian region

Source: ČSÚ and author´s calculations in SW Gretl

Estimates of functions of unemployment in South Bohemian region are listed in table 2. Just as the first equation, it contains estimates of linear and power function and also statistical characteristics.

Tab. 2: Estimations of structural parameters of unemployment function in South Bohemia region (UNE)

Endogenous variable - unemployment in the South Bohemian Region mil. CZK (UNE)								
Exogenous variable	Parameter	Stand. deviation	t-stat	p-value	R^2	DW statistic	LMF	Number of observations
constant	233,326	52,97	4,41	<0,00001***				
GDP	0,0001482	3,65e-05	4,06	<0,00001***				
CPI	-0,3394	0,09	-3,77	0,0004***				
EAOB	-0,4679	0,125	-3,75	0,0038***				

VYS	-0,1916	0,067	-2,82	0,0716**	0,89	2,09		17
Endogenous variable - unemployment in the South Bohemian Region mil. CZK (l_UNE)								
constant	197,562	46,292	4,27	0,00109***				
l_GDP	4,137	0,731	5,66	0,00010***				
l_CPI	-5,245	1,773	-2,96	0,01197**				
l_EAOB	-35,16	8,711	-4,04	0,00165***				
l_VYS	-1,752	0,476	-3,68	0,00316***	0,83	2,104		17

Source: ČSÚ author´s calculations in SW Gretl

Scientific question Q1 is again confirmed because the number of economically active population works the most on the unemployment rate, interpretation in this case is: if the number of economically active population increases by 1 person, the unemployment reduces by 0.4679 percentage points, so if, the number of economically active population increases by 1%, the unemployment responds to the approximately 35% decrease in the unemployment rate. The inflation measured by the consumer price index which measures the gradual price increases for selected products in the consumer basket, is the second most significant factor of the unemployment of the region of south Bohemia. There is again the evident inversely proportional effect of going up in price on the unemployment here, which confirms the scientific question 5. If the inflation increases about 1 per cent point, the unemployment decreases about 0,3394 per cent point. It is about an elastical reaction with the coefficient of elasticity of the inflation 5,245%. According to the results of the estimates of the second equation of the model of the increase in GDP about 1 million Czech crowns in the region of south Bohemia gives rise to the increase about 0,0001482 per cent point of the unemployment. The coefficient of elasticity of GDP with the value of 4,137% arranges determinant of GDP for third place. There is a question in this situation, if it doesn't occur an erosive effect in the form of a labor migration by the economically active population between more and less growing regions.

The last place from the position of quantification of the regressive coefficients the variable occupies number of university graduated people, which decreases the unemployment about 0.1916 per cent points with increase of number about 1 person. But the coefficient of elasticity again takes a value greater than 1, specifically the value of -1.752%. So the scientific question 6 is confirmed.

1.2 Structural analysis of GDP and unemployment of the Pilsen region

For the structural analysis of determinants of the GDP and unemployment in the Pilsen region the most appropriate specification has been proved the following form of econometrical model.

$$GDP_t = \gamma_{11} + \gamma_{12} EAOB_t + \gamma_{13} VYS_t + \gamma_{14} UNE_{t-1} + \gamma_{15} INV_{t-1} + u_{1t} \qquad (2)$$

$$UNE_t = \gamma_{21} + \beta_{21} GDP + \gamma_{22} EAOB_t + \gamma_{23} VYS_t + \gamma_{26} CPI_t + u_{2t}$$

On the basis of the underlying data from 1995-2012 and the model (2) the theoretical values of the endogenous variable of GDP has been estimated. According to real values there is the evident as similar development of GDP as in the South Bohemia region.

Tab. 3: Estimations of structural parameters of GDP function in Pilsen region (GDP)

Endogenous variable - GDP in the Pilsen Region mil. Kc (GDP) (l_GDP)								
Exogenous variable	Parameter	Stand. deviation	t-stat	p-value	R^2	DW statistic	LMF	Number of observations
constant	-30,2975	4,705	-6,44	0,00003				
l_ EAOB	6,88183	0,835	8,24	<0,00001				
l_VYS	0,44554	0,079	5,61	0,00011				
l_UNE-1	0,147391	0,037	3,99	0,00178				
l_INV-1	-0,0632175	0,012	-1,49	0,16118	0,97	1,85		18

Source: ČSÚ author´s calculations in SW Gretl

According to the coefficients of elasticity estimates the direction of action almost all of the selected determinants of GNP of the region of Pilsen is the same as the computations of the region of south Bohemia. The intensity of impacts by exponent function also very similar to estimates of South Bohemia region. The order of variables in table 3 is also the order of importance of particular determinates. Different result we can see at determinant of investment, but p-value signalize insignificantion of this parameter.

Tab. 4: Estimations of structural parameters of unemployment function in Pilsen region

Endogenous variable - unemployment in the Pilsen Region mil. CZK (l_UNE)								
Exogenous variable	Parametre	Stand. deviation	t-stat	p-value	R^2	DW statistic	LM F	Number of observations
constant	105,387	32,649	3,23	0,00660 ***				
l_GDP	1,8824	0,764	2,46	0,02850 **				
l_CPI	-5,75496	2,65	-2,17	0,04897 **				
l_EAOB	-16,2943	6,247	-2,61	0,02166 **				
l_VYS	-0,505869	0,493	-1,03	0,32317	0,69	1,09		18

Source: ČSÚ author´s calculations in SW Gretl

The estimations in tab. 4 correspond with results contained for South Bohemia region, too. The direction and intensity of structural parameters are similar.

Conclusion

Development of regions in the Czech Republic can be judged from many points of view. One of them is a measuring and comparison of economy efficiency including basic macro-economic indicators. From the mentioned structural analysis of determinants of GDP and unemployment in the South-Bohemian and Pilsen regions it is possible to say that in both the regions the number of economically active inhabitants shares the most significantly in GDP; their 1 % increase will support GDP growth comparably by less than 7 %.

The second most significant factor appear to be the number of graduate inhabitants in whom the highest creation of added value is supposed; their 1 % increase will have approximately 0.5 % positive influence on GDP. Also the third investigated variable, the employment rate, influences GDP in the same way in both the regions. With its 1 % growth, GDP will grow approximately by 0.1 %. This phenomenon was not supposed, so it would be suitable to carry out a further and more detailed research of this phenomenon across all regions. Regional investments in infrastructure in the South-Bohemian region having a positive influence on GDP appeared the less significant but despite this relevant; in Pilsen region this presumption was not confirmed and investments don´t have statistically significant parameter, also the direction of effect is opposite. In case of evaluation of unemployment determinants in both the regions it is possible to say that the number of economically active inhabitants with negative elasticity coefficient effects the most in the South -Bohemian region – 35.15 %, and in Pilsen region where it is almost on the half value 16.29 %. The second most significant factor is the inflation measured by the consumer price index which effects negatively with the elasticity coefficient in both the regions less than 6 %. GDP effects positively in both the regions; however, in the South-Bohemian regions with a double intensity 4.137 %, and it ranks on the third place according to the size of elasticity coefficient. The number of graduate person, which has indirectly proportional influence on unemployment, was placed on the last position; in the South-Bohemian region 1 % increase of the number of graduates would decrease inflation by almost 2 %, but in Pilsen region four-times less, so only by 0.5 %.

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