THE ECONOMIC EFFECTS OF INVESTMENTS IN ROAD INFRASTRUCTURE IN CZECH REPUBLIC

Jiří Alina – Pavlína Hálová

Abstract

The goal of given paper is to research the economic impact of road infrastructure investment in Czech Republic. The concentration is given on the effects for each from fourteen regions of both local investments and investments in other regions. We estimate by using econometric models for each of the fourteen regions, and using regression and correlation analysis- we suppose that investment in road infrastructures are and were robust tools to increase not only economics power and growth in defined regions. The important fact is that investment in road infrastructure can be useful at the total (aggregate) level and at the same time for each of the fourteen regions individually. They can generates multiplication effects that fundamentally exceed the opening investment. Therefore, typical trade-off effects do not exist either in the short and the long-term. Typical trade-off effects can be found in the field of economic effects and monetary effects. The negative monetary effects, connected with investments, take part and influence economics results by budgetary consequences. The results of this paper are part of wider research project related with impacts of infrastructure on regional growth and development.

Key words: infrastructure, investment, gross domestic product

JEL Code:C4, E01

Introduction

The Britain's transport infrastructure, and particularly its highway network, is singled out as a glaring example of this neglect, which, in turn, is seen as a major factor in the nation's relatively poor record of economic growth. This message was writ large recently in the report of the LSE Growth Commission (2013), which set out to articulate how the UK could improve its growth performance in the medium and long term and in so doing highlighted road projects (together with those in the energy sector) as having priority for the receipt of funds dispensed by a proposed national infrastructure bank under the direction of a new infrastructure strategy board (Starkie, 2015). In the opposite case, Portugal has seen steep

economic growth since the economic reforms started in 1969. Along with the increase in GDP, Portugal has experienced a rapid expansion of the transport network. The transport network growth has been one of the major engines of Portugal's economic growth (Pereira, Andraz, 2011). That is why, it is an important issue to identify the productivity effects of transport infrastructure at the sub-national level in order to determine whether the current regional investment patterns make economic sense or not. Transportation infrastructure is often mentioned as a key to promoting growth and development. The argument relies on the simple logic that one first needs to have access to markets and ideas before one can benefit from them. This belief is supported by the observation that the historical construction of infrastructure such as railroads coincided with periods of rapid economic growth in Western Europe, Japan and the United States (Kunert, Link, 2013).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 analysis of economy performance is primarily deal with the size and intensity of total output but, for better understanding is necessary to consider the size and intensity (productivity) of inputs. Productivity is one of the main factors which influences and determinates economic growth (Novotna, Volek, 2011). The transportation would be a key facilitator to sustainable economic growth is rarely questioned. In EU in particular, transportation has been noted to be a critical infrastructure required for economic growth. Indeed, the benefits and importance of transportation infrastructure to economic growth have been recognized for a long time. A well-oiled transportation infrastructure expands the productive capacity of a nation, both by increasing the mobilization of available resources, and by enhancing the productivity of those resources (Berrittella, 2010).

Good transportation infrastructure is essential in economic development. It promotes factor mobility and reduces trade costs. In addition, it promotes market integration, thereby providing avenue for the reduction of price volatility and reallocation of resources in line with comparative advantage. Investments in transportation infrastructure can also influence the productive capacity through its use as a direct input in the production process thereby increasing such resources. For example, a newly constructed road allows goods to be transported to market quicker thereby reducing the total cost of production and transportation. On the other hand, transportation infrastructure may affect economic output by changing

aggregate demand through the creation and increased demand for intermediate inputs from other sectors with concomitant multiplier effects in the economy (Calderón, 2011). Poor infrastructure and high transport costs are often identified as key constraints for industrial development in low-income countries. Manufacturing firms are intensive users of transport infrastructure services, so if such services are of poor quality, or high cost, manufacturing will be at a comparative disadvantage. Several studies of advanced economies have documented a positive and statistically significant effect of better transport infrastructure on the average number of entrants in a locality (Kemmerling, Stephan, 2015). Given their low stock of infrastructural capital, the marginal returns to infrastructure investment are likely larger in developing countries relative to developed countries. However, the evidence on the role of infrastructure for enterprise performance in developing countries is quite limited, and refers almost entirely to emerging economies in Asia. Most studies related to infrastructure on the implications either for international trade, or the decisions and outcomes of rural households (Efthymiou,, Antoniou, 2015). There is a common view that the infrastructure investments have played an important role in sustaining the rapid economic growth almost any country around the world (Henao, Piatkowski, Luckey, Nordback, Marshall, Krizek, 2015).

1 Methods and Materials

To specify significant determinants affecting GDP of all 13 regions of the Czech Republic except the region Prague including quantification of relations among economic quantities a method of regression analysis is used represented by a fixed effects method. Data are panel and were found out for 13 regions over the period 1995 – 2013.

The submitted work defines several presumptions which it would like to confirm or refute.

P1: GDP of regions will be influenced the most by a number of active inhabitants (EAP), so, at age of 16-65 years, which is considered the basic production factor work

P2: The production factor capital represented by an economic quantity creation of fixed capital (TFK) will share in the amount of GDP significantly positively from both view-points, the economic and statistical

P3: Investment in infrastructure (INV) about which a region decided will be less important, but a positive factor affecting growth of region efficiency

P4: A significant factor increasing GDP in a region is a number of university graduates (UEP) which represents here a non-mandatory factor

For specification and quantification of influence of important determinants of efficiency of selected regions, economic quantities were chosen in a regional monitoring from sources of the Czech Statistical Office (CzSO) and databases of regional offices, which by their presents and effect will enable to estimate a model verified for all sides, so from economic, statistical and econometric vies points.

For the variable GDP of particular region, a count of current prices of GDP into constant prices in particular regions with use of aggregates of these quantities in current prices and prices of the foregoing period. Year-on-year price index were found out and re-counted with use of relations between chain and basic indexes to price indexes with the base of 2005.

As determinants affecting performance of economies of the regions basic production factors were chosen: work represented by a number of economically active inhabitants, a capital in form of creation of fixed capital, and investment into building of infrastructure.

Selected variables are a part of below mentioned algebraic record of model (1) which use non-linear Cobb-Douglas production function. The chosen function form enables by a simple transformation by logarithmic calculation to transfer the power form into linearized form, mentioned in a formula of already econometric model (2), and can be estimated with classical linear techniques.

$$GDP_{it} = aEAP_{it}^{b}TFK_{it}^{c}UEP_{it}^{d}INV_{it}^{e}u_{it}^{\varepsilon} \qquad (1)$$

$$\ln GDP_{it} = \ln a + b\ln EAP_{it} + c\ln TFK_{it} + d\ln UEP_{it} + e\ln INV_{it} + u_{it} \qquad (2)$$

where:

GDP_{it} …gross domestic product in constant prices of i-th region and t-th period in bil. CZK

EAP_{it} …a number of economically active people at age 15 – 65 years in thousand persons

TFK_{it} …creation of gross constant capital in bil. CZK

UEP_{it} …a number of university graduates in thousand persons

INV_{it} …investment in infrastructure – roads of the 2nd and 3rd class

u_{it} …a random variable, residue

a, b, c, d, e, ε structural parameters

ln …logarithm of value of variable

i=1…13 … a number of regions

t=1…19 a number of years

Models in power form whose regression coefficients represents elasticity coefficients serve for determination of order of significance of explanatory variables because they enable a relative explanation of structural parameters.

The model (2) can be specified in case of panel data in form of model of fixed of random effects and will be estimated in SW Gretl.

The model of fixed effects is used for definition of regional specifics only a parameter constant which includes all pretermitted factors at time invariant. Thanks to particular constant it is possible to catch up heterogeneity of data.

If a specific effect is not constant in time, it is more suitable to use the model of random effects. Other advantage of a choice of this approach it is a possibility of insertion of so called dummy of variable among regressors which would express other characters of sectional units (Cipra, 2008).The estimated model has to be verified statistically. For these purposes a significance test of particular parameters t-test and a significance test of a model as the whole F-test serve. Other characteristics of a determination coefficient determining conformity of the model with data. Within the econometric verification Wald test of heteroscedasticity, a test of autocorrelation of residua (Durbin-Watson test), a test of normality of residua (JB test) and a multicolinearity test (VIF test).

Results

The model of Cobb-Douglas production function in its linearized form after findings of effect of selected production factors on the gross domestic product of CR regions was carried out on panel data by a method of fix effects. Just the model of fixed effects was chosen on base of Hausman test according to which the estimation of model of random effects brings non-consistent results.

In the model by the help of Wald test heteroscedasticity and autocorrelation of residua was found out – DW statistics with value 0.502 document a positive relation among random qualities. Their impact on efficiency of estimation is indisputable. For this reason, robust standard errors (HAC errors) were used which prevent the above mentioned influence on efficiency of the structural parameter.

Subsequently, multicolinearity by the help of VIF test was tested which confirm absence of this undesirable phenomenon occurring among explanatory variables.

In JarqueBera test it was determined that residua have normal distribution.

Estimation of parameters of chosen variables are introduced in a table 1.

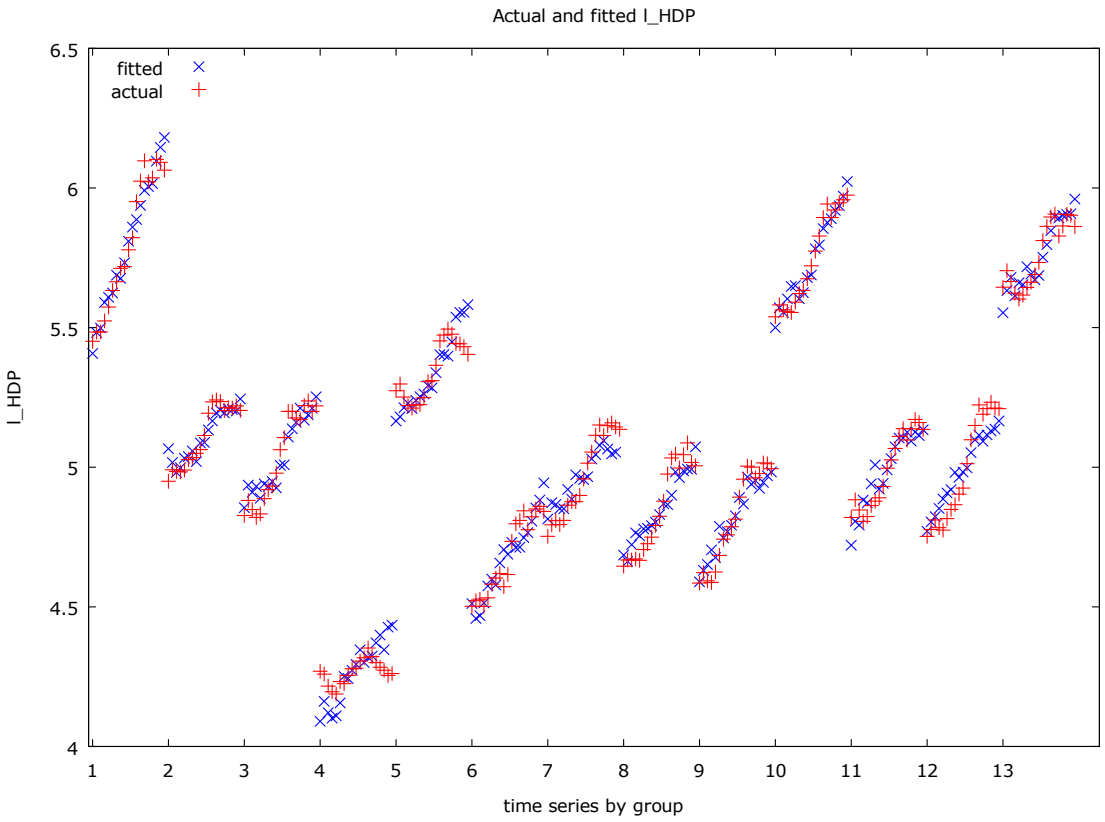
Tab. 1: Estimations of structural parameters of production function

Endogenous variable gross domestic product l_GDP							
Exogenous variable	Parameter	Stand. a	t-stat	p-value		R^2	DW statistics
Constant (a) (a(a	-1,599	1,765	−0,9052	0,3663		0,98	0,502
l_EAP	0,789	0,327	2,412	0,0166	**		
l_TFK	0,253	0,048	5,270	3,15e-07	***		
l_INV	0,026	0,015	1,775	0,0773	*		
l_UEP	0,264	0,051	5,184	4,77e-07	***		

Source: CzSO and own calculations in SW Gretl

In the estimated model, a high conformity of the model with data was found out which reaches according to R2 conformity of 98%; all parameters are statistically significant minimally at the significance level α=0,1. This is obvious also from the graph 1 where real and theoretical values of endogenous variable l_GDP are depicted.

Fig 1. Real and balanced values of endogenous variable l_GDP



Source: CzSO and own calculations in SW Gretl

From the presented results it is clear that the presumption P1 is unambiguously confirmed and it is possible to interpret it in this way: if the number of economically active inhabitants increases in a region by 1 %, GDP of the region will increase by 0.789 %. A positive relation between the number of economically active inhabitants and GDP is in accordance with economic theory. This factor appears as the unambiguously the strongest. It is possible with a high likelihood rate that the decrease in population development of society is a very big danger for the state and it is not possible to relly on inflow of immigrants from surrounding countries.

The presumption P2 is confirmed partially; the influence of fixed capital in form of Czech and foreign investments on the amount of GDP of the region from statistical view-point is a significant determinant, however, from a view-point of intensity of the effect is considered as a week factor. It is documented by interpretations when 1 % growth of creation of fixed capital will cause only 0.253 growth of GDP of the region. An interesting finding could be the effect of separated Czech and foreign investments which, however, exceeds the framework of this paper.

The presumption P3 is also confirmed because 1 % change of invested money in infrastructure in guarantee of the region, so roads of the 2nd and 3rd class effects directly proportionally on GDP of regions with a change by 0.026 %. This determinants works the least as it was expected. So, it is not possible to overestimate its influence and well calculate and evaluate the planned investments from a view-point of efficient evaluation of investment. A regional impact is almost neglect able.

The presumption P4 was also evaluated in accordance with expectations because increase in numbers of university graduated people will bring a similar effect as the capital. Its influence in comparison with other factors is on the second place after the number of economically active people. An interpretation is hold that if the number of university graduated people increases by 1 %, HDP of the region will react by an increase by 0.264 %.

The influence of investments is the smallest of all mentioned variables. A variant of the model with insertion of variable in investments in the infrastructure in the region Pilsen, so the neighbouring region showed itself as supporting the GDP growth in South-Bohemian region which is positive from the economic point of view, because a possible commuting in the near-by region will be faster and more available. However, parameters of both variables of investment results insignificantly, therefore this variant is not elaborated in more details.

Conclusion

The development of regions of the Czech Republic can be evaluated from many points of view. One of them is a measuring and comparison of efficiency of economy with use of various macro and micro economic indicators.To the given problem it is also possible to approach with various techniques and it is also possible to use differently constructed supportive data. Just the panel data used in the work have a big predicative ability.The structural analysis of the GDP factors in particular ČR regions in 19 years used the potential of Cobb-Douglas production function estimated by the help of the fixed effect model.From the structural analysis of GDP determinants is possible to say that the number of economically active inhabitants share in GDP the most significantly; their 1 = increase will support GDP growth comparably with less than 0.8 %.The second most important factor seem to be the number of university graduated people in whose the highest creation of added value is supposed. Their 1 % increase will have approximately 0.3 % positive influence on GDP.Also the third investigated quantity, the creation of gross fixed capital, affects positively HDP in

CR regions. With its 1 % growth, the GDP will increase approximately by 0.25 %. A more intensive effect was supposed in this indicator.The investments of regions in infrastructure, financed by the region, showed as the least significant, but in spite of that relevant determinant. These finances have a positive influence on GDP growth and it can be stated that 1 % growth of investments in infrastructure will bring 0.026 % growth of GDP. It is necessary to point, that investments in infrastructure attract further economic consequences as an employment, consumer spending etc.

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Contact

Jiří Alina

Jihočeská univerzita v Českých Budějovicích, Ekonomická fakulta

Studentská 13, 370 05 České Budějovice

jalina@ef.jcu.cz

Pavlína Hálová

Česká zemědělská univerzita v Praze, Provozně-ekonomická fakulta

Kamýcká 933, 165 01 Praha

halova@pef.czu.cz