IMPACT OF TRANSPORTATION INFRASTRUCTURE ON ECONOMIC DEVELOPMENT. MODERN MODELS AND ESTIMATIONS

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Abstract: *A considerable amount of studies on infrastructure around the world show a positive influence of improvements in different kinds of transportation infrastructure and infrastructure in general on economic growth and development of regions and countries as a whole. In this paper, we summarize several modern approaches, which deal with estimation of such impacts on economic growth, using different types of data sets.*

Key words: *Transportation infrastructure, economic growth, econometric models, gross domestic product, total factor productivity, networking effect.*

1. Introduction

The studies on this topic can be divided in several groups and sub groups according to the following structure: firstly, different kinds of development in transportation infrastructure may be used as independent variables to explain the dynamics of the real Gross Domestic Product (GDP), an alternative way is to use the same explanatory variables for Total Factor Productivity (TFP), which is also a very important driver of economic growth according to the Solow Growth Model. The next issue is the data, which can be used in such models. Generally, there are two alternatives: to use investments, both public and private, in transportation infrastructure as independent variables or to use real stock of corresponding infrastructure for the same purpose. Having real stock of infrastructure there are three ways of normalization: it is possible to use the length of transportation channels such as different types of roads, railways or water channels in per capita or per worker terms, another opportunity is the use of spatial density, meaning dividing the stock of infrastructure by the area of corresponding region or country.

2. TFP and real GDP as depended variables in growth model with infrastructure variables

Here we analyze the results of several researches, where TFP and/or GDP are used as dependent variables in growth models with specific infrastructure variables.

Cantos et al (2005) used both methods in order to estimate the impact of aggregated stock of transportation infrastructure and impact of four separate types of infrastructure: roads, airports, ports and railways on the case of Spain. Firstly they introduced transportation variables in Cobb-Douglas production function and estimated the impact of variables of interesting on real GDP. Secondly, having determined values of TFP they tried to explain it by infrastructure variables. They used fixed effect regressions and got the following results: about 10% increase in aggregated transportation infrastructure is associated with about 0.42% increase in the level of output and 0.38% increase in TFP. Regressions with different types of infrastructure showed that roads network generally contribute more than any other analyzed type in both GDP and TFP.

One more Cantos et al (2005) interesting finding is a positive network effect of transportation infrastructure. In order to estimate it they run the same regressions, but now they summed stocks of infrastructure from several geographically closed regions into one observation instead of using usual region data. So here they tested the hypothesis that stocks of infrastructure, which is available in one region has positive spillovers for neighbor regions. So they got higher coefficients on variables of interest using aggregated data than using regional data. For example they got that the same 10% increase in overall transportation infrastructure is associated with 0.62% increase in real GDP (instead of 0.4% in previous case) and 0.61% increase in TFP (instead of 0.38%, using regional data). Both coefficients shows that network effect on transportation infrastructure exists in Spain.

Another research, where TFP is used as explained variable in order to estimate network effect is written by Na at all in 2011. They find the network effect of motorway stocks in per workers terms. They used data for 19 OECD countries for the period of 17 years in order to estimate the impact of motorways stock on TFP. They used many models, which included a set of control variables, which also can be TFP drivers.

In the following articles the authors tried to explain dynamic of GDP by different types of infrastructure, including roads and overall transportation infrastructure.

Estache et. al (2005) also obtained significant results for African countries. They used the augmented Solow model in order to estimate the impact of the set of infrastructures such as roads, telecommunications, water supply, electricity supply and sanitation on the GDP. "All infrastructure sub-sectors, except sanitation, are shown to be statistically significant engines of growth. In other words, they contribute to explain Africa's GDP growth prospects" (Estache et. al, (2005)).

3. Real stock of infrastructure and investments as independent variables

Here we consider the articles, where different types of data are used in growth models, which deal with estimation of transportation infrastructure effect.

Sanchez at al (1998) used two data sets the first one with 57 countries for 15 years period and the second one with 19 countries for period of 12 years. The specification of their research is that they used two different approaches for both samples. First of all they estimated the impact of infrastructure on economic growth by using expenditures on infrastructure as independent variables. They unexpectedly obtained negative coefficients for the first sample (57 countries), however, these coefficients were statistically insignificant. Applying the same approach to the next sample they got both positive and significant coefficients, however, these coefficients were very small.

Nevertheless, using physical units of infrastructure as independent variables and the same samples, they estimated a positive and statistically significant influence on economic development. Another advantage of the second approach is that stocks of infrastructure represented in physical units are easily comparable among countries around the world.

The cases of using real stock arise the issue of normalization, there are three possible ways, as mentioned before: to divide stock of infrastructure capital by the number of people or workers, the third alternative is to divide stock of infrastructure by the area of corresponding region or country.

Queiroz and Gautam used two types of the regression analysis. They used GDP per capita of 98 countries as dependent variable and length of roads per inhabitant as independent variable in the first case and spatial road density as independent variable in the second. The second approach got the most significant result with the coefficient of determination about 0.76.

Canning (1999) used different types of infrastructure, including the stock of transportation infrastructure, in per worker terms. He used the panel data on cross-country level for the 30 years period (1960-1990) in order to estimate the impact of the following stocks of infrastructure: the number of telephones, electricity generated capacity and the lengths of roads and railways. He found that electricity and transportation stocks of capital have the impact on real GDP.

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