

## PECULIARITIES OF INTERACTION BETWEEN TRANSPORT INFRASTRUCTURE AND ECONOMIC GROWTH

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The link between transport infrastructure and economic development has to play a significant role in the development of transport network plans in any country. In fact, the relationship between investment in transport infrastructure and economic development has been the subject of investigation for quite some time. Despite this, the subject remains mired in controversy. The difficulty of establishing the relationship between transport and economy is that numerous other factors influence this relationship. The process of economic development, where besides transport other factors play a part, must have a central place in a consideration of transport and economy. This paper, based on recent exploration of the authors, examines the question whether and under what conditions developed transport infrastructure engender economic activity. The paper explains the nature of the problem and describes the foundations of the possible interrelation between the effects themselves. Seeking to analyze the effects and alternatives of their evaluation in more compressive manner, the authors of the article present firstly initiative processes of interaction between transport infrastructure and economic growth, secondly mechanism of their development in producing economic environment. The results of empirical testing of the model are also presented.

**Key words:** transport, infrastructure, effects, cost, economic growth, measurement

### 1 Introduction

As far back as the beginning of the 20th century, transport was started to be treated not only as a catalyst of harmonious economic, cultural and social development but as a tool to manage the mentioned processes as well. Establishment and management of strategic rates and priorities of transport sector development related to the issues of infrastructure upgrowth became the object of scientific and political discussions in many countries. The development of transport infrastructure is considered to be the means to induce economic prosperity and earns one of the predominant positions in the headlines of scientific periodicals and broadsheets. Although scientists tend to focus on a paradigm of transport infrastructure as a factor of economic growth in recent years, it has received little attention in Lithuania despite the fact that country's integration into the EU has provided a new space and background to solve the problems. It is paradoxical that the topic of functions and significance of the essential network of the corridors, road infrastructure of motor vehicle transport, is not also developed widely in scientific literature. Scientists and politicians are often focused on the analysis of

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interregional and interstate aspects of the interaction. The object of scientific research is the impact of road infrastructure of transport corridors on internal economic growth. The aim of scientific research is to create a model to assess the impact of road infrastructure of transport corridors on internal economic growth in terms of travel cost change.

Research methods:

1. In order to conceive the analyzed problem, general methods of scientific literature comparative structural analysis and synthesis as well as those of logic analysis were applied.
2. When determining the impact of road infrastructure of transport corridors on goods and services market in terms of internal economic growth, the area method was applied to determine consumer and producer surplus.

## **2 The interaction between transport infrastructure and economic growth: literature review**

The beginnings of analysis into the impact of transport infrastructure on economic growth are considered to be an academic discussion on the quantitative assessment of the impact initiated by USA scientists in 1950s. The pioneers in analyzing the impact of transport infrastructure on economic growth are A. Hirschman (1958) and H. Mohring (1961); individual aspects of the issue were also investigated by P. Rosenstein-Rodan (1961). Until the beginning of 1970s, rather little attention was paid to the impact of transport infrastructure on economic growth in scientific literature since the topic was researched under other economic and managerial topics narrowly and in a generalized way. The essential change in this attitude was scientific works published in 1980s, introducing methodological principles to assess the impact of transport infrastructure on economic growth. The works also emphasized the significance of roads on economic development [1-6].

The topic of the significance of transport infrastructure in economics was escalated in scientific literature when the European Union started to form the Trans-European Transport Network (TEN-Tr.). The development of the corridors was evaluated as one of the factors that guarantee competitiveness and economic advance of countries. The issues of variety and quality of services of transport corridor infrastructure and purposeful state intervention spheres when choosing and adapting efficient models of infrastructure development were especially emphasized [3-6]. However, exclusively the impact of transport corridors and one of their elements – road infrastructure – on economic growth has not been virtually analyzed in scientific studies. Scientists focus on highly generalized conception of the impact of transport infrastructure on economics and distinguish various effects such as direct and indirect ones, those of short, long and average duration as well as macroeconomic and microeconomic ones [1-5].

The impact of transport infrastructure on economic growth using the methods of cost-benefit analysis, modified production function approach and correlation-regression analysis was assessed in general terms [2]. It was initiated the discussion on application of qualitative methods to analyze the impact of transport infrastructure on economic growth.

While the need to justify investments into transport corridor infrastructure developed in Europe, Asia and Africa was increasing, scientific literature started to pay more attention to the impact of exploitable transport infrastructure on economic growth mechanism. Yet the paradox is that using this approach, the national, regional and international aspects of relationship between transport corridors and economics were also evaded. Though authors [6] recognized the impact of transport infrastructure on economic growth to be positive, their opinions diverged in terms of level, factors and subject of the impact analysis. Nevertheless, the change in travel costs was unanimously distinguished as an essential object of the impact of developed transport infrastructure on economic growth. Present experience of experts is to be treated as a rudiment in the sphere of research into the impact of road infrastructure of

transport corridors on internal economic growth. It was determined there was no structurally coherent assessment model that would allow to analyze the impact of road infrastructure of transport corridors on internal economic growth in terms of travel cost change in a complex manner

### **3 Transport infrastructure's impact on internal economic growth: model structure**

#### ***3.1 Modelling the impact of transport infrastructure on internal economic growth***

Economy respond to such changes. The structure, integrating most assumptions, presented in former section, and most other important details discovered by the authors, would undoubtedly ease the process of mathematical modeling practices. To this point we recommend to take into account the following relations between formally discussed variables.

Typical transport infrastructure improvements reduce effective distances between origins and destinations by reducing congestion, thereby lowering travel times. Travelers gain directly from travel time savings and lowered vehicle-operating costs. Companies enjoy direct efficiency gains from cheaper and more reliable freight services and reduced assembly and delivery costs. Cheaper and better transportation services provide incentives for firms to reorganize and reduce their inventories, sometimes to just-in-time levels. The advantages of scale economies occur as firms consolidate production and distribution sites and increase outputs. Assessments of short-term effects from improved transportation typically focus on benefits to and adjustments in transport-providing firms, but the changes made by transport-using firms can generate economy-wide adjustments and redistributions over the long run.

However, the authors conclude, that some idea is needed of the way the economy respond to such changes. The structure, integrating most assumptions, presented in former sections, and most other important details discovered by the authors, would undoubtedly ease the process of mathematical modeling practices. To this point we recommend to take into account the following relations between formally discussed variables. Typical transport infrastructure improvements reduce effective distances between origins and destinations by reducing congestion, thereby lowering travel times. Travelers gain directly from travel time savings and lowered vehicle-operating costs. Companies enjoy direct efficiency gains from cheaper and more reliable freight services and reduced assembly and delivery costs. Cheaper and better transportation services provide incentives for firms to reorganize and reduce their inventories, sometimes to just-in-time levels. The advantages of scale economies occur as firms consolidate production and distribution sites and increase outputs.

Assessments of short-term effects from improved transportation typically focus on benefits to and adjustments in transport-providing firms, but the changes made by transport-using firms can generate economy-wide adjustments and redistributions over the long run. As transport improvements lower costs and increase accessibility among various market actors (input suppliers, labor, and customers), market expansion and integration follow. The economy is constantly being restructured as firms enter and leave, making for leaner production processes, lower production costs, and higher productivity. Third, lowered transport costs and increased accessibility enlarge markets for labor and other inputs. Firms are able to draw labor from broader areas and with wider ranges of attributes, improving labor supply and lowering its costs. Similar effects occur when transport improvements open up new land for economic activities. Cumulating processes reinforce the clustering, and regional specialization develops.

Transport infrastructure improvements can also lead to major shifts in technology, new production structures, and a dual structural shift: a new social and technical environment or a new set of economic opportunities emerges, and the pattern of relationships between the environment and social actor's

changes. Improvements in transport technology and infrastructure have promoted major structural changes in national economies. These impact effects are generalised in Fig. 1.

### 3.2 Results of empirical testing of the model

The practice of scientific research does require empirical testing of any model formed. For the purpose the structure of the model was tested using the quantitative method – survey of experts. The questionnaire, consisting of 25 questions were prepared. The rank-order scale was introduced so that the experts could choose the appropriate item in order to assess the interaction between the variables in a proper way. In the social sciences, scaling is the process of measuring or ordering entities with respect to quantitative attributes or traits. Seeking to get the reliable results the Cronbach's alpha coefficient was calculated using the SPSS (Statistical Package for Social Sciences) program. Technically speaking, Cronbach's alpha is not a statistical test - it is a coefficient of reliability (or consistency): Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items.

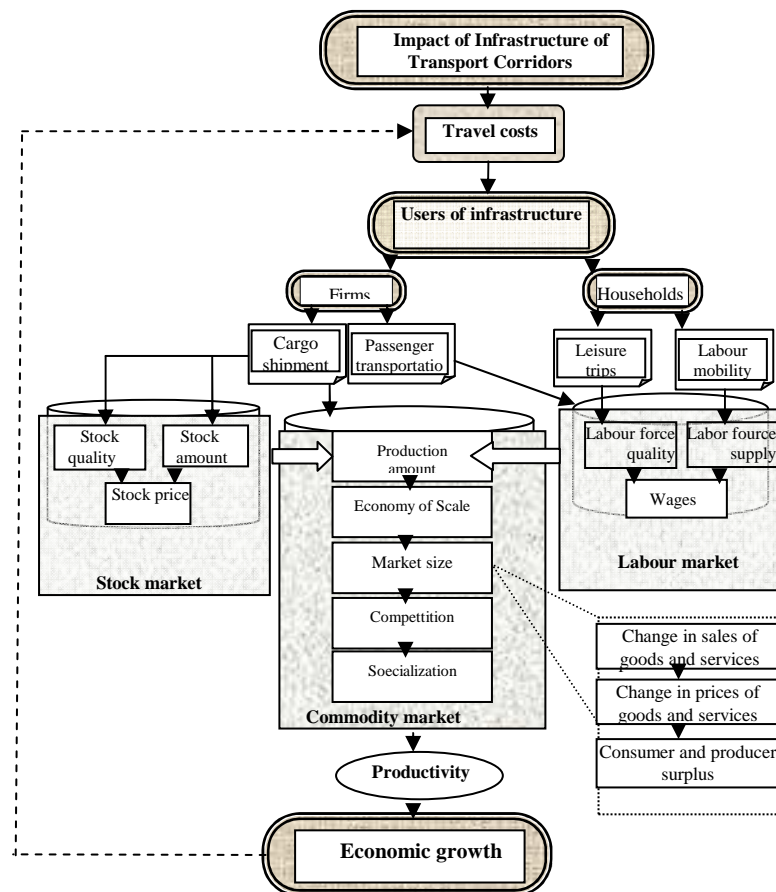


Fig. 1: Impact of transport infrastructure on internal economic growth

Below, for conceptual purposes, we show the formula for the standardized Cronbach's alpha:

$$\alpha = \frac{N}{N-1} \left( 1 - \frac{\sum_{i=1}^N \sigma_{Yi}^2}{\sigma_x^2} \right) \quad (1)$$

where N is the number of components (items or testlets), is  $\sigma_x^2$  the variance of the observed total test scores for the current sample of persons,  $\sigma_y^2$  and is the variance of component i for the current sample of persons. Alpha can take values between negative infinity and 1, although only positive values make sense. So the value received 0,543 shows, that the structure of the model might be considered to be appropriate. The feasibility of the designed model of the impact of road infrastructure of transport corridors on internal economic growth was validated when assessing the impact of the 1<sup>st</sup> European transport corridor (Via Baltica) on Lithuanian economic growth in terms of travel cost change has shown, that based on the distinct principles of the cost-benefit analysis and using the data of Lithuanian Transport and Road Research Institute and Lithuanian Department of Statistics furthermore on restrictive assumptions, it was established that in the period analysed improved quality of transport corridor road infrastructure allowed business users and individuals save travel time but had greater effect on the costs of transport mean exploitation. Corridor infrastructure improvement poorly enabled the workcenters to increase the effective size of labour market. Reduced travel costs, provided condition for firms to lower the prices of goods and services, hence to increase the expectancy of the consumer and producer surplus. Furthermore, employing the method of areas, the expression of consumer (a) and producer surplus (b) – as the indicators of welfare change of society were prepared:

$$gp = \frac{\alpha \left( \frac{\alpha}{\beta} \right)^{\frac{\mu+1}{\mu+\gamma}} (1+\Delta)^{\frac{-\gamma(1+\mu)}{\mu+\gamma}}}{\mu+1} \quad vp = \frac{\beta \left( \frac{\beta}{\alpha} \right)^{\frac{1-\gamma}{\mu+\gamma}} (1+\Delta)^{\frac{-\gamma(1+\mu)}{\mu+\gamma}}}{\gamma-1} \quad (2)$$

a b

where gp – producer surplus, vp – consumer surplus,  $\alpha$  and  $\beta$  are parameters controlling the slopes of demand and supply curves,  $\mu$  and  $\nu$  - elasticities. Despite the fact that the lack of the data did not allow to get the exact evaluation of the surpluses, but the methodics developed might be considered as an instrument for further research.

## 4 Conclusion

The research into the preconditions of road infrastructure of transport corridors development showed that they have not been analyzed separately from other structural elements. Discussions in scientific literature are confined to generalized assessment of the impact of transport infrastructure on economic growth, studies are characterized by functional polarity and different orientation in time axis. The structures of this impact models are presented only in individual cases, are of intermittent nature, there is a need for integrated approach to the constituent parts that link them. It was determined that effects typical of “internal” and/or “open” economy are not discerned when assessing the impact of transport infrastructure on economic growth.

## Reference literature

1. BRATHEN, S. HERVIK, A. Strait Crossings and Economic Development. Transport policy, vol. 4(4), p.193-200.

2. ARTIS, M., NIXSON, F. (eds.) *The Economics of the European Union. Policy and Analysis* (4rd edition). Oxford: Oxford University Press, 2007. 436 p. ISBN 978-0-19-929896-9
3. ASCHAUER, A. Is infrastructure productive? *Journal of Monetary Economics*, March, 1989, vol. 23 (2), p.177-200.
4. BAUM, H., KORTE, J. Influence of Economic Growth on Transport Infrastructure. *Transport and Economic Development. Report of the hundred and ninth round table of transport economics*. March 29-30, 2001, Paris, p. 5-50.
5. BERECHMAN, J. Transport, Investment and the Economic Development. Is There a Link? *Transport and economic development. Report of the hundred and ninth round table of transport economics*. March 29-30, 2001, Paris, p. 103-132.
6. VICKERMAN, R.W. The regional impacts of Trans-European networks. In *Regional science* Springer, 2001. p. 237-254 .