

УДК 338.47+332.1
JEL O18, R40

ILCHENKO S.V.

*Doctor of Economic Science, Senior Research Officer
Institute of market problems and economic & ecological research NAS of Ukraine
Frantsuzskyi Boulevard, 29, Odessa, Ukraine
E-mail: ilchenko.svit@gmail.com*

KARPENKO H.Y.

*Junior researcher
Institute of market problems and economic & ecological research NAS of Ukraine
Frantsuzskyi Boulevard, 29, Odessa, Ukraine
E-mail: ecolog.ok@ukr.net*

ASSESSMENT OF THE TRANSPORT INFRASTRUCTURE IMPACT ON THE REGIONAL DEVELOPMENT

The development of infrastructure, and transport infrastructure in particular, can be attributed to key factors in the economic growth of regions. In conditions of the development of society, the requirements for infrastructure are constantly increasing, which inevitably changes its quantitative and qualitative characteristics, modifying the structures of the infrastructure complex of a specific region. At the same time, it is necessary to take into account both the impact of the social and economic situation in a particular region on the development of infrastructure, and the reverse impact of infrastructure on regional development. In this connection, the transport infrastructure in the article is proposed to be considered as a subsystem of the regional economic system, which establishes institutional links and provides transport services both to the sectors of the regional economy and to the population. The increase in government spending on infrastructure development provides a multiplier effect in the economy. However, in modern conditions, a country may face investment restrictions. Most likely, in the coming years, the share of government spending on infrastructure will decline due to falling incomes first of all when selling energy resources. Obviously, in such conditions it is necessary to change the traditional forms and methods of managing the infrastructure complex, to find new "growth poles". The urgency of improving the spatial organization of the economy is explained by the need to increase the quality of life of the population on the basis of increasing the efficiency of the functioning of the regional economy. The use of transport accessibility as a criterion for the development of regions destroys departmental barriers, promotes a combination of sectoral and territorial planning, allows to take into account both the efficiency of the commercial activity of the transport complex itself, its quantitative and qualitative characteristics, and the impact of transport on economic and demographic processes, the standard of living of the population, and territorial economic development. At the same time, one of the problematic aspects of ensuring transport accessibility is its assessment. Since, if there are difficulties with the adequacy of the results of the assessment of existing realities, then decisions to increase it, as well as decisions related to the development of regions, may prove to be erroneous. The article analyzes different approaches to assessing the impact of transport on the social and economic development of regions. Methods for determining the impact of the territorial concentration of the transport infrastructure, taking into account production, social and population factors, are proposed.

Keywords: *transport infrastructure, regional development, transport accessibility*

ІЛЬЧЕНКО С.В.

*доктор економічних наук, старший науковий співробітник,
Інститут проблем ринку та економіко-екологічних досліджень НАН України,
Одеса, Україна
E-mail: ilchenko.svit@gmail.com*

КАРПЕНКО Г.Ю.

*молодший науковий співробітник,
Інститут проблем ринку та економіко-екологічних досліджень НАН України,
Одеса, Україна
E-mail: ecolog.ok@ukr.net*

ОЦІНКА ВПЛИВУ ТРАНСПОРТНОЇ ІНФРАСТРУКТУРИ НА РІВЕНЬ РОЗВИТКУ РЕГІОНІВ

Взаємозв'язок між транспортом і просторовим розподілом ділової активності здійснюється на різних рівнях. На макроекономічному рівні зусилля сконцентровані на структурі і виді економічної діяльності в окремій країні, регіоні, місті в залежності від наявності та технічного стану транспортної системи, яка обслуговує її. На мікроекономічному мається на увазі спосіб, за допомогою якого агенти приймають рішення про розміщення своєї діяльності. Основна проблема полягає в тому, що при проведенні економічної оцінки регіональної виробничої функції виникає небезпека недообліку випадкових зв'язків і ефектів заміни між виробничими факторами. Питання постає про скорочення яскраво вираженого ступеня поляризації, оскільки така ситуація призводить до розширення суспільства - соціального, економічного, культурного. Проте результати моделювань лише констатують і інтерпретують отримані результати, але не вирішують автоматично поставлених завдань. Більш того, не завжди об'єктивні дані, отримані в результаті розрахунків, виправдовують себе, і реалізовані проекти стають економічно, екологічно і соціально вигідними.

Ключові слова: транспортна інфраструктура, регіональний розвиток, транспортна доступність

Formulation of the problem and its connection with important scientific and practical tasks.

Interconnection between transport and spatial distribution of business activity is carried out at different levels. At the macroeconomic level, efforts focus on the structure and type of economic activity in an individual country, region or city, depending on the availability and technical condition of the transport system serving it. Microeconomic means the way that agents decide to place their activities [1]. The concept of "spatial" indicates that the analysis is produced at all its levels - from global (continental, national, regional) to local, and each of them has its own specific transport aspects, which requires different mechanisms and ways of taking them into account in valuation models impact of transport on economic development. At the same time, the territorial concentration of the transport infrastructure (often with a significant time lag) corresponds to the concentration of production and the population, reflecting (to a certain extent and determining) the overall "picture" of the economy.

For the economic research of territorial-network influence for each type of transport to locate the factors of production and development of the regions, economists of different countries have developed and tested a certain number of approaches, including and economic-mathematical. These models are conditionally grouped into three large blocks - interregional, regional and inter-branch, each of which in turn represents a complex of proposed options.

Analysis of recent publications on the problem. In 1996 year, the Institute for Spatial Planning of the University of Dortmund, in cooperation with the Technical University in Vienna, developed a recursive imitation model of the spatial and socio-economic impact of transport investment and the improvement of the transport system, which was subsequently successfully used in some national and regional EU projects [8, 12, 13, 14]. It differs from other regional economic models in that it takes into account not only the demand in the regional labor market as a production factor, but also the population and the level of migration (supply). The entire statistical database required for the study is included in the software, three groups of indicators are proposed to be output: population, economic, indicators of attractiveness, the latter directly concern the transport system, the level of access for passengers and cargo to the transport infrastructure. In addition, these metrics can be viewed and analyzed during the simulation using time charts and 3D maps on the monitor display.

At the University of Karlsruhe, a simulation-dynamic system-type model was developed to assess the most desirable impact of transport on the regional economy and the environment. This macroeconomic model determines regional demand and supply, as well as inter-industrial relations through the use of "input-output" tables. The regional proposal is projected with the help of the Cobb-Douglas production function, which calculates the output potential, taking into account the production factors - supply of labor, fixed capital, natural resources and technological progress in the form of common production factors depending on regional investment, saving time on freight transportation and labor productivity. In addition, a submodel is used for passenger and freight transport, the size and composition of the fleet of vehicles and the impact of transport on the environment - emissions, noise, traffic congestion and accidents. The model has been successfully used in national projects in Germany and Italy, as well as in major EU projects [10, 14].

Allocation of previously unsolved aspects of the general problem. The approach to determining the economic activity of the region on the basis of the production function estimates the influence of a set of factors of production on obtaining the maximum possible volume of the product produced by these factors.

Classically, production factors are capital, labor and land [5, 6, 7]. We will try to add all the above mentioned factors to the infrastructure as public costs used by the company within the region. This assumption is explained as follows: the higher the technical condition of the infrastructure in the region, the higher the level of output, those, the more in the region of cheap infrastructure in sufficient quantity, the greater the volume of transport-attractive cargoes will be produced and attracted. The main problem of the regional production function is that, when carrying out its econometric evaluation, there is a danger of underestimating the random links and replacement effects between production factors. The same goes for the approach that takes into account the quantitative provision of the region with the transport infrastructure, since the quality of the infrastructure is ignored, so we are talking about those approaches where the number of kilometers of railways or highways is entered as parameters without assessing their condition. Hardly application in practice of such models will show its consistency, that is, in such a simplified form they can not be used.

Formulation of research objectives. Today hybrid approaches are needed in which the transport infrastructure is considered as one of the factors, and the indicators used must be different and include, including the type of production and mode of transport. This is what served the main purpose of the article.

Results and discussions. As a long-term forecast of the country's spatial development in the world, a model developed at the Polytechnic University of Milan. The program simulates the growth of national and regional GDP, the population and the level of migration based on the assumption of macroeconomic trends such as investment, security, exchange rate and inflation, social spending, energy prices and migration policy, and institutional changes, agricultural potential and transport infrastructure. The region's accessibility is interpreted as an economic potential, that is, the difference in per capita income compared to other regions is divided by the distance to them [2, 3].

The next block of models is based on the Wassily Leontief (1966) model of the input-output inter-industry balance sheet.[4]. The final demand in each region is exogenous, the regional proposal is elastic, so the models can be used in forecasting the region's economic development in response to changes in transportation costs. When transportation costs in the region grow, producers seek to order more goods from suppliers from the nearest regions, thus, exports in the nearest regions grow, and in more remote regions it decreases.

On the basis of Leontief's balance for assessing the economic development of the region, one can use a model that estimates the economic activity of the region and the transport flow therein, based on the regional «cost-release» structure. Its main idea is that in it supply and demand in transport is viewed as an integral part of the economy. Using this model it is possible to get answers to questions - what is the connection of transport with the regional economy and how can the improvement in transport affect it, how to determine and forecast the growth of freight and passenger traffic in conditions of demographic and economic inconsistency. In addition, it allows us to forecast the geographic distribution of production in the region and the demand for freight and passenger transport, taking into account the possible growth of the region's economy and demographic changes, as well as the conditions for the formation of the supply of transport services. Thus, through this regional model, we forecast transport demand and assess the impact of transport in the context of the regional economy.

Based on the spatial model of "input-output" and using the function of random utility, it is possible to simulate the location of production and consumption at the regional level, taking into account the cost of production and transport costs, thus generating flows of goods and services, which in turn are transformed into freight and passenger transportation. This approach has been successful in projects of different levels in Spain, the United States, Venezuela and most recently in Chile.

As another group of models, it is possible to propose models that include economies of scale and imperfect (monopolistic) competition. Differences with the "cost-release" model are negligible, since the latter also determines the overall equilibrium between transport and deployment and works using software. It should be noted that the model for each region assumes the condition of Dixit-Stiglitz's (1977) imperfect (monopolistic) competition of commodity markets and perfect competition for local commodity markets and production factors. In them, the price and volume of goods depend on the time of delivery of goods and transportation costs.

Thus, all the models considered have much in common, they all take into account the production factor as transport as the most important in the development of the regional economy. At the same time, in each of the models, some omissions are obvious, the under receipt of which as a result does not give an opportunity

to obtain an adequate result. For example, the expression of the region's accessibility only through the kilometers of roads in the region or through the time of cargo transportation, which leads to an underestimation of the impact of changing the quality of the transport network. Or the assumption that the labor resources of the region are permanent, the absence of the fact of demographic changes and interregional migration in the regional labor market. Nevertheless, if necessary, the described models can be adjusted both at the entrance and during the study.

In any case, the features of transport in them are taken into account in different ways:

- when choosing a mode of transport and for routing, depending on the supply of transport, in other words on the quality of the infrastructure and the volume of the transport stream;
- when determining the amount of traffic that depends on transport costs between regions;
- the dependence of interregional trade on the territorial location of one region relative to another, the nature of the transported goods, the prices of goods in each region and the transport costs of the carried goods;
- the impact of transport costs on the change in the coefficients in the «input-output» matrix and on the formation of its share in the added value of each commodity;
- the definition of population migration between regions through income per capita, employment level and distance (in the form of transportation costs);
- the dependence of the investment of the region and individual sectors on the change (or expected change) in the level of production in each region, which in turn depends on the expected changes in transport or in the access level.

Amano and Fujita [11] proposed their own version of modeling transport processes and determining their role in the spatial development of regions in 1970. Their model was successfully used in Japan to assess the economic effect of building a bridge between the islands of Hokkaido and Shikoku. One of the latest developments, applied in 2002, is a model that uses tools to assess and plan urban areas, transport networks and the environment, the interaction of strategies in markets, including dynamic instability, through analysis and planning mechanisms. The functioning of markets and used state strategies are represented through a polynomial logical function using the maximum possible spatial disaggregation of the system, taking into account the spatiotemporal dynamics with a duration of a year. To perform the calculations, the necessary data are entered in relation to households, businesses, environmental restrictions, estimated development costs. The mobility factor is also used, which is introduced into location models and, on its part, affects the cost of land and territorial development decisions, calculated in a multi-digit logical model. The equilibrium point between the first and second models is determined: in each digit. The locational model represents the demand structure, the results obtained are introduced into the next model, which determines the transportation costs and transportation time; then on their basis an index is determined, which in the next stage is invested back into the location model. Along with the above, defining and simulating quantitative approaches, it is proposed to use formalized models that allow estimating the results of the improvement of the transport system quantitatively:

$$A_i = \sum_j E_j \exp(-\mu C_{ij}), \quad (1)$$

where

A_i – accessibility of region i ;

E_j – weight of region j (GRP, population, including employment level);

C_{ij} – transport costs or time for delivery of goods from i to j .

The relative importance of the results of these changes can be determined using the formula:

$$\Delta q_i = \Delta \left(\frac{A_i E_i}{\sum_j A_j E_j} \right) \quad (2)$$

Changes in the region i can be determined using:

$$\Delta E_i = \sigma E_i \Delta q_i, \quad (3)$$

where σ – The sensitivity parameter, calculated on the basis of previous studies.

These models can be used as one of the approaches for assessing the socio-economic and spatial-network impact of the components of the transport system on the quality of life of the population of the country. Similar methods were used to assess the economic result of the construction of the Eurotunnel under the English Channel, which, unfortunately, does not yet economically justify itself, the British programs for the development of the road network, the integrated assessment of the impact of the program for the development of high-speed highways in the Trans-European transport network and many others.

Conclusions and perspectives of further research. Calculations carried out for all the models presented emphasize the greater or lesser degree of polarization of regions and their infrastructure, respectively, the maximum benefit is derived by regions that are most provided with infrastructure not only quantitatively but also qualitatively. The question is about reducing the pronounced degree of polarization, since this situation leads to the stratification of society - social, economic, cultural. However, the results of simulations only ascertain and interpret the results obtained, but do not solve automatically assigned tasks. Moreover, not always objective data obtained as a result of calculations justify themselves, and the implemented projects become economically, environmentally and socially beneficial.

REFERENCES

1. Butyrskaya I.V. (2006) Infrastrukturnezabezpechennyarehionalnohorozvytku : problemy ta shlyakhyyikhvyrishennya [Infrastructure provision of regional development: problems and ways of their solution] Chernivtsi: Books – XXI [in Ukrainian]
2. Iksarova N. O. (2010) Transportnainfrastruktura yak komponentekonomichnoyibezpekyUkrayiny [Transport infrastructure as a component of Ukraine's economic security] *Ekonomicheskoye prostranstvo–Economic space* 36, 55–61 [in Ukrainian]
3. Krugman P. (2005) Prostranstvo: posledniyrubezh [Space: The Last Frontier] *Prostranstvennaya ekonomika – Spatial Economics* 3, 121-126 [in Ukrainian]
4. Leontiev V. (1997) *Mezhotraslevaya ekonomika [Interindustry Economy]* (Trans) Moscow: Economy [in Russian]
5. Praiger D. (2011) Transportnaya infrastruktura Ukrainy: sostoyaniye i problem postkrizisnogo razvitiia [Transport infrastructure of Ukraine: the state and problems of post-crisis development] *EkonomikaUkrainy - Economy of Ukraine* 5, 23-26 [in Ukrainian]
6. Tkachenko N. Yu. (2006) *Transportna infrastruktura: sutnist, funktsii ta rol u zabezpechenni ekonomichnykh protsesiv [Transport infrastructure: the essence, functions and role in the provision of economic processes]* Donetsk: Vesnik DonNUET series: Econ. science. 4(32), 56-61.[inUkrainian]
7. Shlikhter S.B. (1995) *Geografiia mirovoi transportnoi sistemy. Vzaimodeystviye transporta I territorial'nykh system khozyaistva [Geography of the world transport system. Interaction of transport and territorial systems of economy]* – Moscow [inRussian]
8. Cervero Robert. Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century. WORKING PAPER. UCB-ITSVWP-2005-3, 2005. 38 .
9. Dixit A. K., Stiglitz J. E. Monopolistic Competition and Optimum Product Diversity *Amer. Econ. Rev.* 1977. 67, 297-308; Spence A. M. Product Selection, Fixed Costs and Monopolistic Competition *R. Econ. Stud.* 1976. 43, 217-235;
- 10.Émile Quinet, Roger William Vickerman (2004). Principles of transport economics, Edward Elgar Publishing, Inc. 389;
- 11.Fujita M., Mori T. Structural stability and evolution of urban systems *Regional Science and Urban Economics.* 397;
- 12.Geurs K. T., B. van Wee. Accessibility evaluation of land-use and transport strategies // *Journal of Transport Geography.* Volume 12. 2004, 127–140.
- 13.P. Rietveld, P. Nijkamp. Transport and regional development *VrijeUniversiteit, Faculteit der EconomischeWetenschappen en Econometrie,* 1992, 21;
- 14.Yarroq G.K. Welfare Losses in Oligopoly and Monopolistic Competition *J. Industr. Econ.* 1985. 33., 515-530

ЛІТЕРАТУРА

1. Бутирська І. В. Інфраструктурне забезпечення регіонального розвитку : проблеми та шляхи їх вирішення : монографія. – Чернівці: Книги – XXI, 2006. – 238 с
2. Іксарова Н. О. Транспортна інфраструктура як компонент економічної безпеки України / Н. О. Іксарова // Економічний простір. – 2010. – №36. – С.55–61
3. Кругман П. Пространство: последний рубеж // Пространственная экономика. 2005. № 3. – 121-126 с.;
4. Леонтьев В. Межотраслевая экономика: пер. с англ. / В. Леонтьев. – М.: Экономика, 1997. – 480 с.
5. Прайгер Д. Транспортная инфраструктура Украины: состояние и проблемы посткризисного развития / Д. Прайгер // Экономика Украины – 2011.– №5. – С. 23-26.
6. Ткаченко Н. Ю. Транспортна інфраструктура: сутність, функції та роль у забезпеченні економічних процесів/ Н. Ю. Ткаченко // Вісник ДонДУЕТ. Сер. Екон. науки. – 2006. – №4 (32). – С.56-61.
7. Шлихтер С. Б. География мировой транспортной системы. Взаимодействие транспорта и территориальных систем хозяйства. – М., 1995. – 158 с.
8. Cervero Robert. Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century. WORKING PAPER. UCB–ITSVWP –2005 – 3. – August, 2005. – 38 p.
9. Dixit A. K., Stiglitz J. E. Monopolistic Competition and Optimum Product Diversity // Amer. Econ. Rev. 1977. 67. P. 297–308; Spence A. M. Product Selection, Fixed Costs and Monopolistic Competition // R. Econ. Stud. 1976. 43. P. 217-235
10. Émile Quinet, Roger William Vickerman (2004). Principles of transport economics, Edward Elgar Publishing, Inc. – P. 389
11. Fujita M. Structural stability and evolution of urban systems / M. Fujita, T. Mori // Regional Science and Urban Economics. – С. 397
12. Geurs K. T., B. van Wee. Accessibility evaluation of land–use and transport strategies // Journal of Transport Geography. – Volume 12. – 2004. – P. 127-140.
13. P. Rietveld, P. Nijkamp. Transport and regional development // Vrije Universiteit, Faculteit der Economische Wetenschappen en Econometrie, 1992 – P. 21
14. Yarroq G. K. Welfare Losses in Oligopoly and Monopolistic Competition // J. Industr. Econ. 1985. 33. P. 515-530