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THE ROLE OF THE TRANSPORT SYSTEM IN STIMULATING ECONOMIC AND SOCIAL DEVELOPMENT

Abstract

The importance of transport for economic development results from its multilateral links with different forms of human activity. So far, the focus has been on the impact of investments in the transport infrastructure on economic growth, whereas the importance of other elements of the transport system has been overlooked. In this article the concept and components of the transport system have been analysed, indicating the important role of the soft transport infrastructure and innovation. The main objective of the article is to analyse the role played by transport in the modern economy and indicate the mechanisms affecting the socio-economic development.

Keywords: transport system, transport infrastructure, economic growth

Introduction

The importance of transport for economic development results from its multilateral links with different forms of human activity. The interrelations between transport and economic growth are complex as the causative mechanisms are difficult to determine, and there are many feedbacks. In most theories the occurrence of positive effects of the transport infrastructure development has been noted, nevertheless, there is no consensus as to the direction and force of these effects.

The innovative and effective ways in which transport operations respond to the challenges of integrated, very rapidly changing manufacturing systems and consumption can be best understood in the context of the system. The transport system allows providing transport services for the environment which is the socio-economic system of a specific area – from local territorial units (e.g. towns and cities), through the transport systems of regions and countries, up to the continental and world scale.

The main objective of the article is to analyse the role played by transport in modern economy and indicate the mechanisms affecting the socio-economic development and its links with modern factors of development. For this purpose, the relevant literature has been reviewed and an attempt has been made to create a model presenting the influence of various transport system components on the socio-economic development.

The top-down approach has been applied in the article. Section 1 offers a brief overview of approaches to research the relations between the transport system and the economic development, as well as presents methods for analysing these relations. In Section 2, the interdependencies of transport and economic growth in recent years are shown. Section 3 is devoted to defining the transport system and its components. It is emphasized that besides the physical transport infrastructure, other elements of transport systems are also significant. In the last section, the impact of the transport system on the socio-economic development is presented. Special attention is paid to the influence of transport on other sectors through transport costs, the labour market and the participation of transport in the diffusion of knowledge and innovation.

1. Literature review

The role of transport in the distribution of economic gains between regions and countries is a topic that has received renewed interest in recent years. This interest is reflected especially in the literature relating to the endogenous growth theory, on the one hand, and economic geography, on the other hand. Both the theoretical and empirical literature shows that investment in the transportation infrastructure and changes in the accessibility patterns affect the regional development and the spatial distribution of economic activities. Standard general growth theory references can be found in the studies conducted by Aghion and Howitt (1998) and Barro and Sala-i-Martin (1995). In their opinion, the role of public investment in the infrastructure has a great potential for influencing the long-term growth rate, when private investment productivity increases. In the studies of Agénor (2004) and Agénor and Moreno-Dodson (2006) the model of several channels through which the infrastructure may affect growth is presented. Three “conventional” channels are: a direct productivity effect on private production inputs, a complementarity effect on private investment, and a crowding-out effect on private spending through the financial system. They have also mentioned several additional channels such as: an indirect effect on labour productivity, an effect on adjustment costs associated with private investment, an impact on the durability of private capital, as well as an effect on education and health outcomes. In newer studies Agénor (2013) argues that transport services facilitate innovation and technological upgrading by reducing the fixed cost of producing new varieties of intermediate inputs. Hence, at the theoretical level, the impact of the transport infrastructure on economic growth can be modelled as having an effect on any given measure

of output directly as a production factor and indirectly by influencing the total factor productivity (TFP).

Economic geography models consider location patterns to be a result of the interplay between agglomeration and dispersion forces. The infrastructure has important influence on the location of economic activity and population centres. The new economic geography (NEG) and the theory of agglomeration economics emphasises the additional productivity gains made possible through agglomeration in large urban areas (Fujita, Krugman, Venables, 1999). Krugman (1991) has found that by reducing the cost of transporting goods between locations improvements in the transport infrastructure can promote trade, increase competition and facilitate specialisation in economic activities.

Empirical macroeconomic analyses of transport infrastructure productivity have been carried out in European countries, the United States, Japan, and in developing countries, such as India and Mexico. The usefulness of the obtained results is an open question in the context of two serious disadvantages of the macroeconomic models. Firstly, there are shape differences and conflicts between these models on the magnitudes and direction of economic impacts of the infrastructure. Secondly, they provide insufficient information on the linkages between transport improvements and the broader economy (Lakshmanan, 2011).

By contrast, the microeconomic approach (mainly Cost-Benefit Analysis) is more transparent because it can describe: (a) the direct time and cost savings from transport improvements, (b) the indirect impacts of these cost and time savings in the form of lower assembly costs in production and gains from logistical reorganization, and (c) the associated costs including external costs. Nevertheless, this approach is deficient in taking into account network effects or the equilibrium effects of transport improvements on transport-using sectors in the broader economy (Lakshmanan, 2011). It is necessary to improve the existing CBA methodology in order to capture most accurately indirect effects, especially wider economic effects (Borkowski et al., 2014).

The empirical evidence suggests that benefits of transport infrastructure improvements tend to be concentrated near the infrastructure projects. This is consistent with the views that a new transport infrastructure reduces inter-regional disparities but can widen intraregional ones depending on access to the high quality transport infrastructure such as motorways. However, the impact of the transport infrastructure on the spatial development has been difficult to verify empirically. The reason for this may be that in countries with an already highly developed transport infrastructure further transport network improvements bring only marginal benefits. The conclusion is that transport improvements have strong impacts on the regional development only where they result in removing a bottleneck (Biehl, 1999; Fürst, Schürmann, Spiekermann, Wegener, 2000).

As the literature review has shown, the vast majority of research on the impact of transport on the economy focuses on the effects of the transport infrastructure development. The author would like to note that other elements of the transport system can have a positive impact on the economy.

2. General interdependencies of the transport and economic growth

The interdependencies between the demand for transport and the socio-economic development have been the subject of many research studies which indicate a strong correlation. Nonetheless, doubts are raised by the direction of causality. This applies both to the transport of people and freight (eds. Button, Hensher, 2005). The progressing globalization of production and the related supply chains are the reason for the growing demand for transport. The economic growth brings a greater division of labour and spatial specialization, and this requires better coordination and efficiency of flows of people, freight and information. The number of trips for business and private purposes increases in the passenger transport. The growing income of households generates greater demand for transport for leisure or shopping purposes. Improvement of the transport system performance is one of the conditions for continued growth of productivity in business, leading to the development of regions. There are two-directional interrelations between transport, the conditions of its infrastructure and economic development (Koźlak, 2007):

- the socio-economic development, stimulated by various factors, such as the technological progress and the increasing quality of human capital, forces the transport performance and its qualitative characteristics to be adapted to meet the demand;
- the development of the transport infrastructure and the growing transport service efficiency owing to improved operational efficiency in this sector is one of the important factors of economic growth.

It can be said that freight transport is a “mirror” of the economy where changes in the production volume, its spatial distribution as well as changes in the substantive structure of this production can be seen. The basic trends in the GDP growth rate, the freight and passenger transport volumes between 1995–2015 in the EU-28 countries were analysed to demonstrate the interrelation between the development of transport and economic growth. The results of this analysis are shown Figure 1.

The formation of curves on the graph confirms that the growth rate is similar for all the variables, although it did happen that in some years the freight transport growth rate was higher than the economic growth rate (which is particularly visible in 2004, after the EU enlargement by ten countries). And the global recession resulted in greater restrictions in trade than in production volumes what translated into a much larger decrease in transport operations than in GDP in 2008–2009. A similar situation took place in 2012, when the falling GDP was accompanied by an even greater decrease in the transport performance.

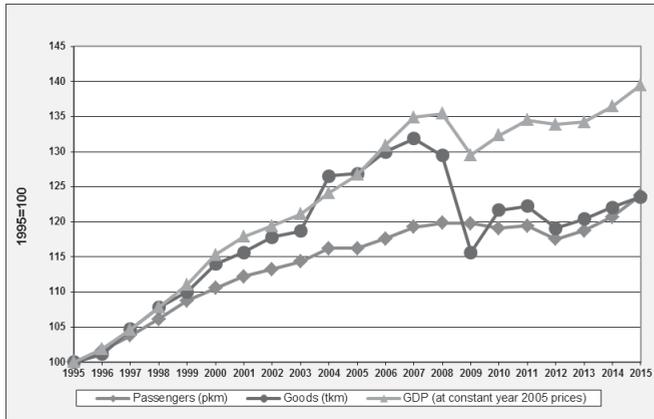


Figure 1. Passenger and freight transport volume and GDP growth rate in EU-28 in 1995–2015
Source: (European Commission, 2017)

3. Considerations on the transport system concept and components

The transport system can be considered from many points of view and it can be defined differently depending on the purpose and object of research. The transport system performance considered as a whole comprising various components is one of the basic issues of transport economics. The system seen from the outside is a whole, however, when it is examined from the inside it is a collection of items that are in specific relationships with one another, creating a system feedbacks (Grzywacz, Burnewicz, 1989). Various subsystems and components can be separated in the transport system also in economic terms.

In the Polish transport economics literature, the transport system definition has been the subject of detailed analysis. Tomala (1966, p. 73) has approached the transport system from the perspective of the general theory of systems and according to him: “a transport system is a set of objects (road network, transport investments, transport processes in all modes of transport), including the relations between these objects and between their attributes which are used by the transport policy being a link combining and coordinating the transport system into one whole”. Grzelakowski, Matczak and Przybyłowski (2008, p. 8) have stated that the transport system “[...] consists of a transport infrastructure and transport capacity network along with a system of masses of freight and streams of passengers using this network in a given time”. On the other hand, Liberadzki (2008, p. 98) defined the transport system very broadly, as “[...] all technical, human and organizational resources employed to provide transport services”. This means that there is an interaction of people and technical resources in organizations and institutions in the processes of provision of transport services.

The technological progress introducing a new quality to transport systems and the growing importance of information are the reason why this new dimension is increasingly often emphasized when transport systems are defined. For example,

Button and Hensher (2001) have noted that a transport system can be perceived as a combination of physical and information resources needed to conduct transport activities.

Due to the fact that the transport system is defined in so many different ways, the analysis of its impact on the socio-economic development used an approach in which the transport system components are: the linear and nodal infrastructure, means of transport, capital and information infrastructure, subsystems of organization and management, logistics systems, institutions, legal regulations, transport policy and providers of transport, forwarding and logistics services, which is schematically shown in Figure 2.

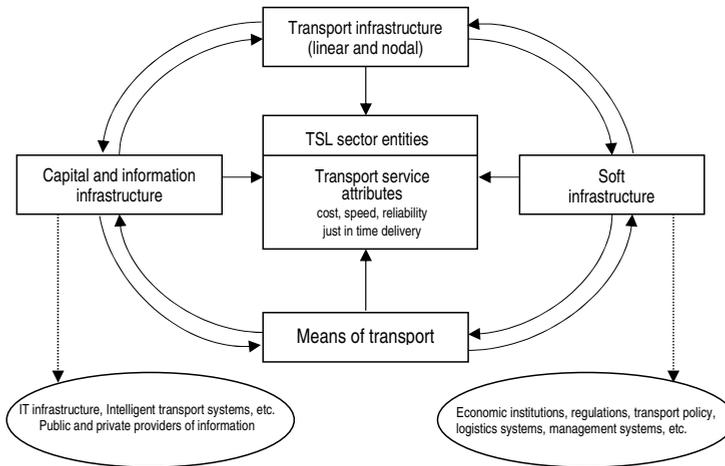


Figure 2. Transport system components

Source: (own study based on Lakshmanan and Anderson, 2002)

The provision of transport services is based on a specified base of material resources, and also on the qualifications and skills of people involved in the implementation of transport processes. Nonetheless, the quantity, quality and variety of transport services are determined jointly by all the transport system components: the technologies used in vehicles, the physical transport infrastructure, the soft infrastructure and the information infrastructure, the organization of the supply of services and interactions between them.

A discussion about improving the transport system is typically focused on vehicles and the hard infrastructure as sources to improve its quality. It is only recently that two other component have been considered as a factor of progress in transport: the soft infrastructure of the transport system and the complementary information capital and its infrastructure. The soft infrastructure includes economic institutions, regulations, policies, business logistics systems, the transport management knowledge base, etc. Although the soft infrastructure is much less “visible” than its physical counterpart, it facilitates the efficient and coordinated use of vehicles and the infrastructure.

Over the past two decades, there have been many changes in the soft infrastructure. A significant role in these changes is played by the public sector, mainly by changing the economic institutions and economic incentives aimed at promoting the overall growth in the transport sector. The policy of deregulation and liberalization of transport has led to the development of competition between enterprises and transport branches. One of the consequences has been a decrease in transport costs. Another change has been the creation of a new economic environment, which is intended to provide incentives for transport companies in respect of innovation. In addition, improved operational efficiency in the provision of services has been seen through the promotion of intermodal transport and intelligent transport systems by the public sector. In response to the economic, technical and political evolution, enterprises develop innovative logistics solutions that support the entire freight sector.

An important role in increasing the capacity and functionality of transport, equipment and the transport infrastructure is played by information technologies. These include a wide range of devices, functions and tools used to download, process, transmit and deliver information important to transport operators and travellers. They strengthen the ability of transport enterprises and logistics operators to respond quickly and flexibly, improve efficiency, and enable innovation to improve the quality and process of providing services (Kozłak, 2012).

An important role in the hard infrastructure group is played by the transport infrastructure. The transport infrastructure is one of the four of the economic infrastructure subsystems. Some authors limit the concept of the transport infrastructure to the technical infrastructure. Piskozub has presented a functional approach and defined the transport infrastructure as a set of linear and nodal objects permanently connected to space whereby transport of freight and people, change of the means of transport, storage and other activities occurring in the transport process are possible (Piskozub, 1979). Stough et al. (2002) call such understanding of the infrastructure traditional and in the transport infrastructure they have included such physical objects such as roads, railways, ports and port terminals, airports, facilities and networks within which they operate. At the same time, they believe that in addition to these “traditional” elements, the transport infrastructure should also include institutions and organizations which manage it, support logistics and operational activities.

Most of the research conducted so far has focused on the economic effects of investments in the transport infrastructure. These investments are both a demand and supply stimulus for economic growth, contributing to the economic transformation of regions and urban areas. The development of transport infrastructure can take two basic forms (OECD 2003):

- investments increasing the quantity of infrastructure facilities (e.g. by building a completely new motorway, access railway lines to airports) or significantly improving its quality (by widening roads, increasing their resistance to pressure and even by repairing and maintaining the existing infrastructure facilities);
- investments contributing to a more efficient use of the existing transport infrastructure by making better use of its capacity – optimizing the traffic organization

through intelligent transport systems, improved traffic management, or charging users with the full infrastructure costs.

Investments in the transport infrastructure are necessary to reduce transport costs.

4. Impact of the transport system on socio-economic development

4.1. Introduction to research on the transport system significance for socio-economic development

Most of the recent theoretical analyses have concerned the impact of investments in the transport infrastructure on the economic development. These investments are both a demand and supply stimulus for economic growth, contributing to the economic transformation of regions and urban areas. The benefits and costs of the transport infrastructure development have been considered on a different spatial scale: at international, national, regional and local levels. In addition, the impact of infrastructure investments on improving the productivity and economic development of regions has been analysed at the level of the entire economy, markets and enterprises.

According to economic theories, investments and productivity growth are a prerequisite for long-term economic growth. Since the days of Rosenstein-Rodan and Hirschman, investments in the transport infrastructure have been considered a stimulus for economic growth. Transport investments contribute to the economic growth directly by increasing the public capital resources. In addition, transport can contribute to the economic growth also indirectly. Improved transport services as a by-product of transport companies contribute to greater efficiency due to the benefits of improved availability, market development and changes in the business structure, and the growth of their productivity translates into benefits for the economy as a whole. Improving the transport performance means that the economy can more efficiently use other factors of production to increase production, or that the same level of production will require fewer resources. The impact of transport on the processes taking place in the sphere of production and exchange of goods is most visible in the developing countries with the most rapid GDP growth rate (Koźlak, 2012).

The effects of transport investments are observed also at the level of markets, i.e. the mesoeconomic level. Transport has different meaning for different sectors of the economy, where market players enter into specific interactions with the transport-forwarding-logistics sector. The study of the impact of transport on the economic development must therefore take into account the market situation in which transport services are provided (e.g. competition model), the relationships taking place between transport activities and the location of other types of activity, location of settlements, workplaces, sources of supply and markets (Vickerman, 2008).

Investments in the transport system, particularly in the infrastructure, generate both direct and indirect effects. The first category is relatively easy to identify

and measure because it is associated with cash flows. It includes such effects as savings on vehicle operating costs, time savings, reduction in the frequency and severity of accidents, increased convenience and quality of service, intermodal benefits. The second group of effects that stimulate economic activity, increase productivity, relocate businesses, increase competitiveness is hard to assess because they often need to be monetized first.

Indirect impacts of transport infrastructure investments occur outside the transport sector. They can cause a redistribution or reallocation of resources, more efficient use of resources, entry or exit of firms as well as environmental effects. Such impact, additional to direct benefits, has been to some extent captured as part of conventional transport appraisal and it is called wider economic impact (WEI). According to Betancor, Hernández and Socorro (2013) wider economic impact can include:

- a) Regional effects. They focus on modification the flows between two regions and their economic performance, which will crucially depend on the mobility of production factors;
- b) Effects on labour markets. These effects focus on the mechanisms that function in those markets when transport costs are reduced;
- c) Agglomeration economies – focus on how improved transport can encourage increased concentration (agglomeration) or specialisation of economic activity thereby enabling increased efficiency from economies of scale;
- d) Imperfect competition – focus on how improved transport can increase output in imperfectly competitive markets.

In the literature, the analysis of response of enterprises using transport to the improved quality of the transport infrastructure and services is usually very general. Owing to the investments in the transport infrastructure and the improved quality of services it is possible to reduce costs and increase the availability of various players on the market – suppliers, labour resources and customers, ensuring the development of different markets and their integration. Nonetheless, multilevel dependencies which consequently lead to the economic growth of countries and regions should be noted. These dependencies combine a variety of market mechanisms, technical and structural processes that interact with each other and lead to an increase in productivity in the economy. Transport investments facilitate the trade exchange and the flow of labour resources, whereby they play an important role in reducing regional disparities and improving the competitiveness of regions. They also influence the growing efficiency of production and processes of distribution, they create economies of scale, deepen specialization of production and have an impact on the development of logistics systems and reduce their costs. Consequently, the positive stimuli from improvement in the transport performance result in the growing productivity of economic activities, *GDP per capita* in the region and regions become more attractive for potential investors. The concept of the impact of investments improving different components of the transport system on the economy of the region is shown in Figure 3.

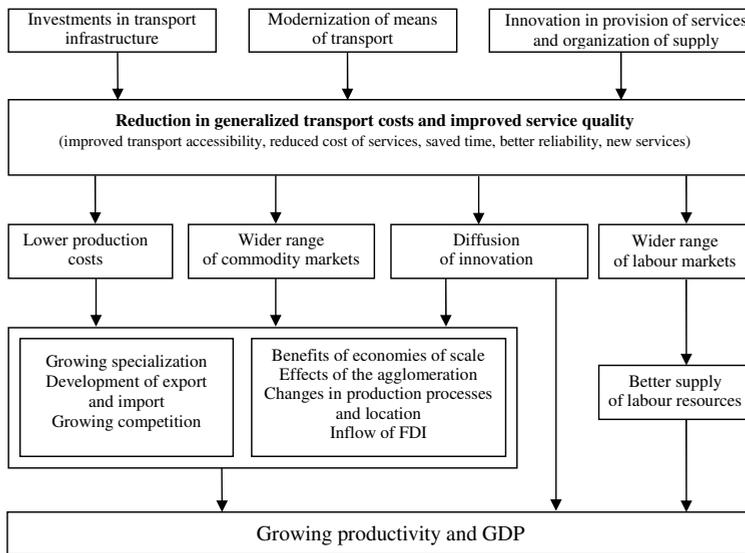


Figure 3. Model of impact of changes in the transport system on the economy of regions
Source: (own elaboration)

Further, the article will outline the impact of the transport system on the economy and society through transport costs, the impact on the knowledge economy and the labour market.

4.2. New approach to transport costs

Theoretical considerations show that the main mechanism whereby economy is affected by transport are its costs. Transport costs are a major determinant of spatial interactions such as trade, tourism, travel for business, educational and private purposes and migrations of the population (Rietveld, Vickerman, 2004). A new approach to this issue is the increasingly frequent substitution of financial costs of transport related to covering a distance by the so called generalized costs. The generalized transport costs comprise financial costs, costs of lost time, hindrances, discomfort, and other items that can be perceived by users as costs. Prud'homme (2003) has indicated four ways to reduce the generalized transport costs: the development of infrastructure, upgrading of vehicles, organizational changes due to liberalization and the use of more cost-effective ways of transport. The generalized transport costs strongly depend on the quality of the infrastructure and are as a rule included in the transport accessibility assessment.

Regardless of the direct financial costs of transport, time is becoming an increasingly important dimension of transport as enterprises and consumers show growing willingness to pay for fast transport. The costs of transport are a component of the transaction costs related to covering a distance that can be measured directly. Quicker access to suppliers and customers, and the flow of goods reduces the transaction costs of the trade exchange. For this reason many

economists are of the opinion that the primary benefit of transport investments is shortening the time of business transactions and the time needed for direct meeting of people involved in the economic activity. McCann and Shefer (2004) believe that if the nature and extent of spatial transactions of enterprises has changed over the past decades, one should shift from models based solely on reducing the cost of transport to models including also the benefits of shortening the time of transport and costs of obtaining and sending information. One of the ways to expand the “spatial” cost analysis may be to consider logistics costs which include all inventory management costs, the costs of time required to cover the distance as well as the associated costs of transport services.

Reduction in the transport costs is possible owing to various types of improvements resulting from infrastructure investments, more efficient transport management, and increased transport innovation. These actions have an effect on (SACTRA, 1999):

- the increased efficiency of production by lowering its costs,
- reorganization and rationalization of production, distribution and location of activities,
- reduction of labour costs by increasing the coverage of labour markets and access to labour resources with more diverse competencies,
- stimulating the inflow of new production investments,
- enabling the development of new types of activities,
- improvement in the spread of knowledge and innovation.

The efficiency of production can be increased by reducing the costs of transport and through changes in the organization of the supply, production and distribution processes. Not all types of business activity are equally sensitive to the costs of transport. It depends on the share of transport costs in the total cost of the product or service. Hence, the importance of transport as an input in production can vary considerably depending on the sector and the company. Therefore, to anticipate the effects of investment in the transport infrastructure in specific areas, it is necessary to analyse the share of transport costs in the value of production, the level of sensitivity to the transport costs of economic activity in the region and the behaviour of businesses in terms of location.

Reorganization of many processes, organizational changes and additional cost savings can be achieved by improving the transport performance in addition to a reduction in costs. One of the fundamental changes resulting from improved transport performance and lower costs is the reorganization of logistics systems resulting from the need to optimize inventory costs.

4.3. Participation of transport in diffusion of knowledge and innovation

The present development is based on knowledge and swift implementation of innovation. New information and communication technologies are not an exact substitute of transport. Some knowledge in digital form can be transmitted via ICT devices over long distances, although it is often impossible, therefore, transport,

which enables direct interpersonal contacts, is essential. It can be assumed that a well-functioning transport system may affect the development of innovation through:

- diffusion of knowledge,
- stimulation of technology transfer,
- introduction of new products and services to new markets,
- indirectly by attracting foreign investment.

Knowledge is an intangible asset and its diffusion comes under the special rules. While material goods must be physically transported, knowledge can be disseminated either by physical transport (people, books or saved digital data) or by telecommunication. Much depends on the type of knowledge. While codified knowledge can be diffused both by transport and telecommunication, tacit knowledge can be exchanged only during direct personal meetings. The transaction costs of knowledge acquisition incorporate the accessibility of this knowledge.

Assuming that a significant part of the relevant and specific knowledge is linked to individuals and their location, the spatial accessibility of these people determines the transport costs necessary to gain this knowledge. The short geographic distance facilitates the flow of knowledge, however the intensity of direct interpersonal contacts decreases, when the distance between them increases. The accessibility of tacit knowledge is an important factor, which determines the location of innovative activity. This accessibility depends on the distance to people who possess knowledge, their mobility and the quality of the transport system.

The relationships between companies, also in the field of technology cooperation, depend on individual mobility because some of the knowledge flow can refer to hidden knowledge, which is forwarded through personal contacts. Especially, the mobility of highly skilled workers is important. It is therefore possible to assume the existence of positive causal relationships between the quality of the transport infrastructure between regions and the interregional exchange of knowledge. In this case, improving the transport infrastructure favours both market and non-market interactions.

A well-developed transport system and good accessibility are factors that increase the investment attractiveness of an area and attract foreign direct investment (FDI). Foreign direct investment is an increasingly important dimension of international economic integration and diffusion of innovation. The spillover effects of FDI are reflected in the increase in productivity in domestic companies. These effects can occur in different forms, such as introduction of new technologies, working methods and management skills, but they have one common characteristic – they lead to increased productivity.

4.4. Interaction of transport and labour market

Transport system investments and improved service performance can reduce costs or shorten the commuting time, so people are willing to commute from more distant locations, but at the same time the generalized cost (the cost of travel plus the cost of time spent on commuting). This leads to an increase in the job search area

and extension of labour markets. Such a situation contributes to greater competition on the local or regional labour market from potential employees from other areas.

The impact of lower commuting costs can cause migration to the region in search of higher real income due to lower property prices or better living conditions. The enlargement of the local supply of labour can exert pressure on wages and increase unemployment. At the same time, property prices can rise, resulting in lower real wages. Any changes in real wages influence the unit labour costs in enterprises and their competitiveness and are a factor determining their demand for labour. A further feedback is that an increase in the number of people commuting can lead to congestion and thus reduce the initial benefits of improved transport performance.

This complex set of interactions clearly shows how the final effects of transport investments depend on the different behaviour on both the labour market and the housing market. These findings are important because they show that the improvement of transport performance between areas of labour markets can affect both the decisions about commuting and migration, which depend on the relative condition of the labour and housing markets.

Conclusions

The main general conclusion from the above considerations is that the impact of transport on the socio-economic development should be considered more broadly than only through the prism of the physical infrastructure development. An equally important factor is the efficiency of the whole transport system whereby the functioning of enterprises and the economy as a whole can be improved. Better efficiency is due to the development of the transport infrastructure, the use of modern rolling stock, intelligent transport systems, ICT systems in enterprises, high quality human capital, etc. Different measures undertaken as a result of the transport policy can be crucial for achieving success in improving the transport system. The investment in every transport system component should lead to a reduction of generalized transport costs and improved service quality. Such effects in the transport sector influence the emergence of measurable benefits in other sectors and through different markets (goods, services, labour, housing and other properties) lead to higher productivity.

An efficient transport system influences the growth of economic activation, development of production, trade, tourism and all kinds of services, greater mobility of the society, and as a result, it is one of the factors stimulating the socio-economic development. The role of transport is very important in maintaining international economic, political and social relations and improving the cohesion of regions. On the other hand, when the importance of transport (transport accessibility) in the diffusion of knowledge and innovation, the development of human and social capital is recognized, the transport factor of modern socio-economic development can be considered as modern, enabling intensive and qualitative development. Analyses of the impact of transport on the development of regions should also take into account negative externalities.

The general tendency to lower the transport costs has contributed to the fact that enterprises which generate demand for freight transport have become less sensitive to its costs, which, together with the development of the world trade and the supply chains is the reason why solutions requiring greater use of transport, especially road transport are chosen increasingly often. In the developed European countries the growing demand for transport results, to the largest degree, from courier services, transport of waste, building materials, industrial products and agricultural commodities. The increase in the road freight transport performance is mainly due to the increase in the average distance of transport.

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