Comparative Economic Research, Volume 17, Number 4, 2014
10.2478/cer-2014-0032

JOANNA GÓRNIAK*

Transport Accessibility In Light Of The DEA Method

Abstract

The development of transport infrastructure and increasing the efficiency of transport services are major factors of economic growth. The concept of transport accessibility can be analysed in various aspects. This article focuses on the accessibility of freight transport by road and rail, measured with infrastructure equipment. The primary objective of this study is to determine the efficiency of selected European countries in 2000, 2005 and 2010 in terms of transport accessibility for given expenditures and results. The efficiency will be measured with the Data Envelopment Analysis, which assesses the efficiency with which a given economy transforms expenditures into results. The hypothesis assumes the existence of differences between the efficiency in terms of transport accessibility in European countries and a possibility to increase this efficiency by using the experience of countries with a high efficiency level.

Keywords*: transport accessibility, indicators of infrastructure, efficiency, DEA method*

1. Introduction

The development of transport infrastructure and increasing the efficiency of transport services are major factors of economic growth. The concept of transport accessibility can be analysed in various aspects. This article focuses on

* University of Lodz, Faculty of Economics and Sociology, Department of Logistics

accessibility measured with infrastructure equipment, estimated with equipment indexes of a particular area with road and rail infrastructure. The primary objective of this study is to assess the efficiency of transport accessibility in selected European countries. The assessment is be carried out using the DEA method, which assesses the efficiency with which a particular economy transforms expenditures into results.

Transport infrastructure displays features of national wealth, while its accessibility and efficiency determine the development of each country through socio-economic activities. As a specialist factor, it determines new solutions, compatibility or interoperability, and provides a more stable and decisive basis for achieving competitive advantage (Załoga 2013, pp. 165–166). In addition, a well-developed transport infrastructure contributes to the reduction of the negative results of distance between regions, integrates the domestic market and connects it with markets of other countries and regions, as well as influences economic growth (through the quality and density of the network infrastructure) and reduces income inequality and poverty in a variety of ways (Schwab 2012).

The ongoing processes of globalisation and economic integration pose various challenges for economic policy, forcing policy makers to implement solutions that will improve economic efficiency and, consequently, to increase their competitiveness. The basic condition for the formulation of realistic objectives for transport policy is reliably identifying phenomena that determine the competitiveness of economies. As a result, the transport potential of particular economies is determined by many factors, both social and economic.

As an economic category, transport efficiency compares expenditures and results. The expenditures are all forms of resource consumption in the process of implementing transport policy goals and objectives. The results are benefits ensuing from transport policy implementation into socio-economic practises, e.g. increasing the number of people using transport infrastructure or improving the safety of the transport system. In the transport system, one can indicate the following relations between the incurred expenditures and achieved results (Janecki, Krawiec 2010, p.12):

- expenditures < results: the efficiency of the transport policy is positive
- expenditures = results: no major changes are identified in the transport system
- expenditures > results: the transport policy is not effective

The study covers the years 2000, 2005 and 2010, which were selected for comparison purposes. 25 European countries were selected for the analysis. Due to the lack of data, Cyprus, Malta, Norway, Switzerland and the countries of the former Yugoslavia were not included in the study.

2. The essence and problems of transport accessibility

The transport structure of a particular territorial unit is shaped by many various factors, giving rise to significant differences. The elements differentiating the transport system include, among others:

- geographical location
- degree of urbanisation
- location of industrial and tourist centres
- international co-operation
- level of technical and technological development

To analyse the transport situation, one must use a transport accessibility index, one of the key measures used to assess the transport system in spatial terms. The concept of transport accessibility is one of the key concepts in the planning of transport development in spatial terms. Transport accessibility can be used in various contexts, for example in relation to the transport network, various types of services, as a factor of economic development and competitiveness of the regions, and as a factor in business location (Koźlak 2012, p. 172).

The word "accessibility" is derived from the words "access" and "ability", which means getting access to something. As a result, the term refers to the degree of ease with which the inhabitants of a given area can gain access to goods, services and places of activity (e.g, employment, education, health, etc). The degree of accessibility can be defined as the sum of distances to all other locations or on the basis of the number of direct and indirect connections available with the use of various modes of transport. The starting point for the analysis of transport accessibility is a quantitative and qualitative assessment of transport infrastructure in terms of the density of the network and transport points, capacity or speed limit (Koźlak 2012, pp. 173–174).

Transport accessibility has an impact on the relative benefits of a given region associated with the decisions taken relating to investment locations. As a result, accessibility may be analysed using a variety of indexes (Rosik 2012, pp. 23–24):

- infrastructure-based accessibility - estimated with the use of the indexes of the equipment of a particular area with transport infrastructure, such as the number/density of linear and point objects (road network, railway stations, Park &Ride car parks, airports, etc.)
- distance-based accessibility - physical distance (Euclidean), actual physical distance (road), time distance (travel time, transit time) and economic distance (cost of travel, cost of transport) between the starting point and the

destination, e.g. the average cost of travel to cities above 100.000 inhabitants, the total travel time to the 10 largest cities in Europe

- cumulative accessibility (isochronic accessibility) - measured by assessing a set of destinations available at a given time, with a specified traveling cost or traveling effort, e.g. population available within 15 minutes, number of hospitals available within 1 hour
- person-based accessibility - based on the so-called time geography associated with individual socio-economic characteristics of the participants in the movement in time and space, as measured by the so-called daily paths of life,
- potential accessibility - measured by the possible occurrence of an interaction between the starting point of the travel and a set of travel destinations (one assumes that with the increased time or cost of travel, the attractiveness of the destination decreases, as the traveller is more willing to travel for shorter distances).

In addition, Table 1 shows indexes of transport accessibility divided into groups and types.

Table 1. Transport accessibility indexes

Group indexes	Type of index	Examples of index
Indexes describing the transport infrastructure and supply of services	Indexes of equipment of a region with transport infrastructure	- the length and density of various roads and railways - density of roads and railways weighted with the population - the number of airports and seaports
	Indexes of linear and point infrastructure capacity	- capacity of road, railways, inland waterways - capacity of road junctions, ports and airports of different categories, intermodal terminals
	Indiexes of supply of transport services	- volume of supply - number of arriving/leaving means of transport by mode and direction - number of passenger cars, means of public transport and freight transport by type - transport duration - the cost of transport
	Indexes of susceptibility of infrastructuredamage	- susceptibility of the infrastructure components of the transport corridors to damage due to the geographical location and climate
Indexes of location accessibility expressed in the function of transport time or cost	General	- cities which can be reached within a certain time - average time to reach all European metropolises - daily transport accessibility - potential transportaccessibility - daily accessibility by car or train
	Access to transport infrastructure	- access to the motorway, railway station, airport / seaport

	Access to places of activity	- the average time to reach to the 3 nearest cities over 100,000 inhabitants - time to reach to cities with a population of 200,000 inhabitants - time to reach the nearest Europeanmetropolisby truck - travelling time by air between European metropolises - daily access of European metropolises
Innovative mapping solution	Maps showing relationship between transport and space	- maps showing the time distance - anamorphic spatiotemporal maps and transport costs maps

Source: Koźlak A. (2012) Nowoczesne systemy transportowe jako czynnik rozwoju regionów w Polsce, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk, p. 178.

The essence of complex transport accessibility indexes is the fact that they take into account spatial interactions (i.e. travelling distance, time and cost). One can assume that the attractiveness of a particular region increases with transport accessibility and decreases with the increasing distance, time or cost of travel. It should also be mentioned that regions equipped with rich transport infrastructure are able to attract more investors, compared to the regions which are poor in this respect. Moreover, the development of transport infrastructure and increase of the efficiency of transport services, occurring thanks to the improved efficiency of this particular branch of industry, is one of the important factors of economic growth.

3. Analysis of the efficiency of European countries

Efficiency is the result of activities undertaken as described by the relation between the achieved results and incurred expenditures. The best effects of production, distribution, sales and promotions are the subject of numerous discussions and analyses. One can also talk about the efficiency of an organisation, manager, management, use of possessed resources or undertaken investment projects.

One most frequently considers efficiency when undertaking investment activities and comparing various investment options, looking for one that will bring the best effect. Efficiency is measured using partial, synthetic indexes of resource productivity (labor, capital), and can be identified in terms of ex-post and ex-ante. When calculating ex-ante efficiency, one assesses the expected results with the involvement of particular resources and time. The ex-post efficiency consists of determining the results of specific activities. In general, one uses a ratio analysis to assess efficiency.

The efficiency of entities, undertaken projects, transport systems and processes can be assessed with standard methods used in the analysis and audit of financial statements, the evaluation of their condition and the efficiency of investment undertakings.

In this analysis, the Data Envelopment Analysis (DEA) was used. The DEA classical result-oriented model was applied to obtain the results (Guzik 2009, p. 22). Therefore, if the model is focused on results, the results are maximised while expenditures are reduced. The mathematical programming model takes the following form:

$$\theta = h_i(\mu, \vartheta) = \frac{\sum_{r=1}^{R} \mu_r y_{ri}}{\sum_{p=1}^{P} \vartheta_p x_{pi}} \rightarrow max \qquad (1)$$

with the limits:

$$\frac{\sum_{r=1}^{R} \mu_r y_{ri}}{\sum_{p=1}^{P} \vartheta_p x_{pi}} \leq 1, \mu_r \geq 0, \vartheta_p \geq 0 \qquad (2)$$

where: h_i - the effeciency of object (i = 1, …, n), y_{ri} - results, x_{pi} - expenditures, μ_r - weight corresponding to particular results (r = 1, …, R), ϑ_p - weight corresponding to particular expenditures (p = 1, …, P). If the model is focused on expenditures, one minimises expenditures with a lower limit on the results.

To use the DEA method, one has to meet some important requirements which have an impact on the quality and correctness of the achieved results (Guzik 2009, pp. 27–29):

- the set of objects must be homogeneous or almost homogeneous
- the results and expenditures should be non-negative
- the measurement units should be uniform
- the direction of preferences should be uniform, i.e. the quantity considered to be the result must be defined in a way that enables the positive evaluation of its growth in terms of the purpose of the activity of the analysed objects, while the quantity considered to be the expenditure should be defined in a way enabling one to evaluate its growth in negative terms
- expenditure is a quantity with which at least one result is connected.
- the number of objects should be much larger than the total expenditures and results.

The DEA method has many advantages. For example it gives one an opportunity to study objects described with multiple expenditures and multiple results. Furthermore, DEA does not require very specific information, as opposed to index-based or econometric methods. With this method, one can determine the relationships between global expenditures and global results. Using DEA, one can to determine the efficiency with which a multi-dimensional system of expenditures is transformed into a multi-dimensional system of results. Thanks to DEA, expenditures and results do not need to be expressed in monetary units (Guzik 2009, p. 29).

One should also mention the disadvantages of the DEA method, which is characterised by the results' high sensitivity to atypical data in objects recognised as models. If the model object is an atypical one, the results of the analysis of the efficiency of other objects are considerably less credible. One may also notice a negative impact on the test results of surprising and unstable results in the case of a strong correlation and linear relationships within the results, within the expenditures or between the results and the expenditures. The disadvantage of this method is also the redundancy of the number of efficient objects, especially in its traditional versions, and a poorly-developed theory of nonlinear relationships between the expenditures and the results. Another disadvantage may be the relative nature of the object's efficiency. In the DEA method, efficiency is determined against the background of other objects. As a result, an object with a relatively low efficiency may be considered fully efficient because the other objects are worse. The opposite scenario is also possible (Guzik 2009, p. 30).

4. Characteristics of the analysed objects

This study covered selected European countries in the years 2000, 2005 and 2010, in order to observe changes in efficiency in terms of transport accessibility. The study utilised the mid-year data from the European Commission report "Energy and Transport in Figures 2013". Variables expressed by the dynamics index, which provide information about the changes of a given phenomenon in time, were also applied. In the analysis, five-year time intervals were used. The imperative aim is to determine whether the countries perform implement the transport policy in an efficient way. In the analysis, a set of expenditures (variables characterising the linear infrastructure and means of transport) and results (variables characterising the result in the form of transport work) characterising the freight road and rail transport accessibility were used.

Figure 1. List of expenditures and results in terms of transport accessibility

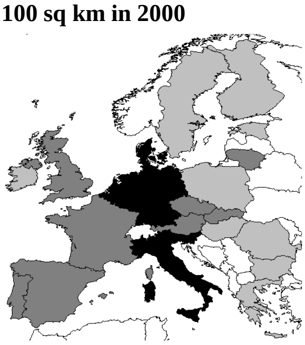
EXPENDITURESS	→	RESULTS
•increases in the road networks **•increase in the number of trucks** **•increases in the rail network** **•increase in the number of freight locomotives**		• increase in road transport work • increase in rail transport work

Source: author's own.

The level of transport accessibility in European countries varies, as different countries are characterised by different economic, social, demographic, geographic and political conditions. In this study, the main attention is focused on the accessibility of freight transport by road and rail. The following variables were chosen to characterise this phenomenon: highway length, railway length, number of motor vehicles (road and rail transport) and transport work. The following maps show density indexes, the automotive indexes and transport work. The darkest colour on the map suggests that the level of the variable in a given country is highest in comparison to other countries. The lightest colour suggests that the level of the variable in a given country is the lowest, compared to other countries (white indicates a lack of data).

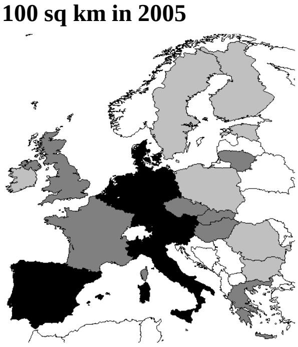
The density of highways in 2000, 2005 and 2010 in the European countries increased, which is a positive phenomenon. Germany, Denmark, Italy and the Benelux countries stand out in terms of this variable.

Figure 2. The density of the highway network in km per 100 sq km in 2000



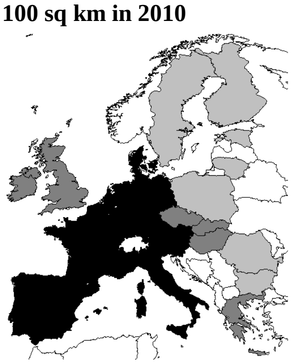
Source: author's own study based on "EU Energy and Transport in Figures 2013".

Figure 3. The density of the highway network in km per 100 sq km in 2005



Source: author's own study based on "EU Energy and Transport in Figures 2013".

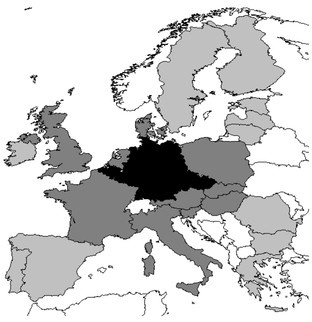
Figure 4. The density of the highway network in km per 100 sq km in 2010



Source: author's own study based on "EU Energy and Transport in Figures 2013".

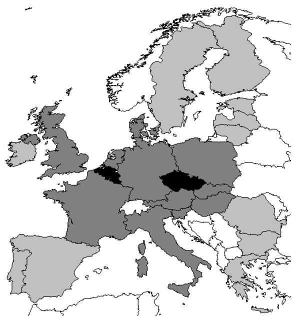
The railway network is the densest in the following European countries: the Czech Republic, Belgium, Luxembourg and Germany. This does not mean that the remaining countries do not use this means of transport. In recent years, rail transport has been gradually developing as an alternative to road transport.

Figure 5. The density of railway network in km per 100 sq km in 2000



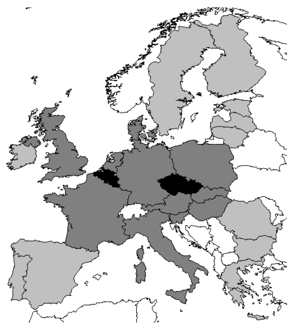
Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 6. The density of railway network in km per 100 sq km in 2005



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

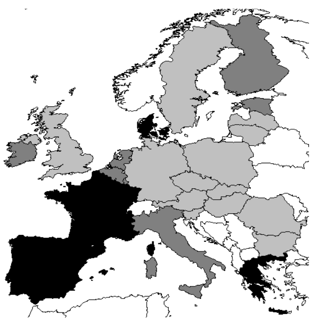
Figure 7. The density of railway network in km per 100 sq km in 2010



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

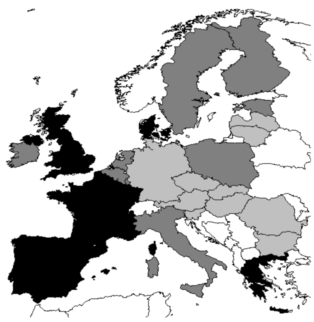
The number of trucks in the European countries has been increasing year after year. The following maps show that France, Spain, Portugal, Denmark and Greece had the highest number of trucks per 100 inhabitants in 2000. Poland, Finland and Ireland could also boast a large number of trucks in 2010.

Figure 8. The number of trucks per 100 inhabitants in 2000



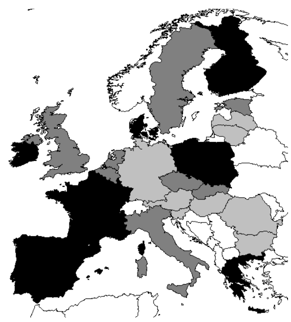
Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 9. The number of trucks per 100 inhabitants in 2005



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

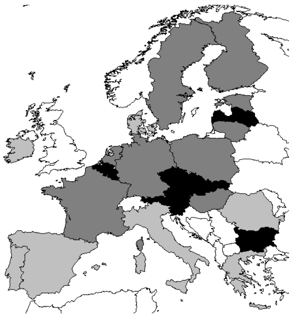
Figure 10. The number of trucks per 100 inhabitants in 2010



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

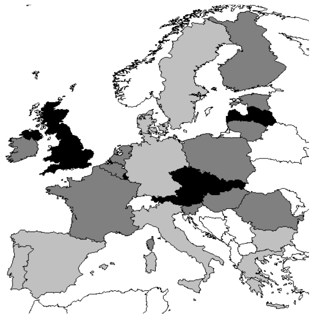
The number of freight locomotives per 100 inhabitants in the analysed time varied. A decrease in this type of rolling stock was observed in Finland, Bulgaria and Latvia, whereas an increase was recorded in Germany and Belgium.

Figure 11. The number of freight locomotives per 100 inhabitants in 2000



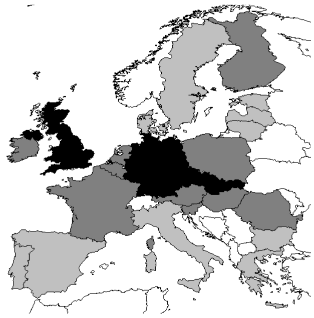
Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 12. The number of freight locomotives per 100 inhabitants in 2005



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

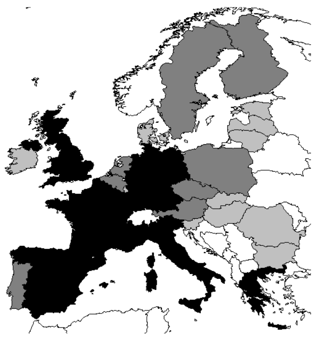
Figure 13. The number of freight locomotives per 100 inhabitants in 2010



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

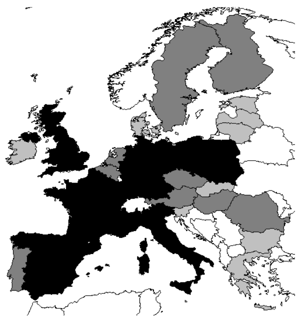
Road transport work in European countries in 2000, 2005 and 2010 has been on the increase. A quite significant increase in the road transport work can be observed in Poland when compared to other European countries. In Austria, on the other hand, a decrease in road transport work in 2010, as compared to 2005, was recorded.

Figure 14. Road transport work (tonne-km) in 2000



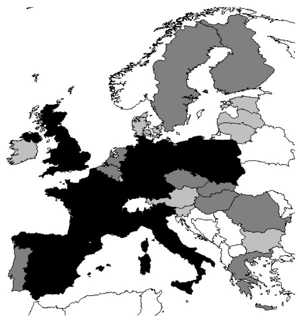
Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 15. Road transport work (tonne-km) in 2005



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

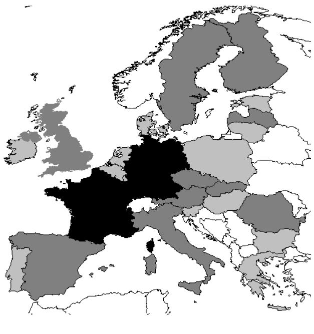
Figure 16. Road transport work (tonne-km) in 2010



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

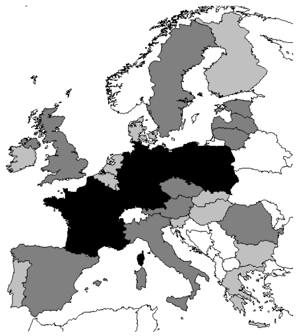
The volume of national railway transport work was much lower than the volume of the road transport work. The highest values were recorded in France, Germany and Poland.

Figure 17. Rail transport work (tonne-km) in 2000



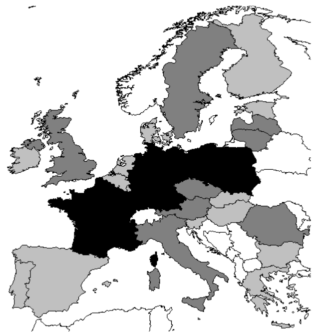
Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 18. Rail transport work (tonne-km) in 2005



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

Figure 19. Rail transport work (tonne-km) in 2010



Source: author's own study based on the "EU Energy and Transport in Figures 2013".

5. Results

The following measures of efficiency for selected European countries in terms of transport accessibility take the values above 1 or the value of 1. Efficient economies achieve the value of 1, which means that they optimally transform expenditures into results. Meanwhile, countries for which the measure of efficiency is higher than 1 are inefficient and do not use their expenditures in an optimal way.

Table 1. Effeciency index in terms of transportaccessibility for the European countries in 2000

COUNTRY	**BE**	**BG**	**CZ**	**DK**	**DE**	**EE**
THETA	1,92149	1,56085	2,16733	1,91551	**1**	**1**
COUNTRY	**IE**	**EL**	**ES**	**FR**	**IT**	**LV**
THETA	1,17233	**1**	1,74375	1,38378	1,58352	**1**
COUNTRY	**LT**	**LU**	**HU**	**NL**	**AT**	**PL**
THETA	**1**	**1**	1,78954	2,01215	1,27303	1,63228
COUNTRY	**PT**	**RO**	**SI**	**SK**	**FI**	**SE**
THETA	2,06738	**1**	1,58318	2,3274	1,84107	1,86904
COUNTRY	**UK**					
THETA	**1**					

Source: author's own study.

Table 1 shows the results of efficiency measurements for the year 2000. Germany, Estonia, Greece, Latvia, Lithuania, Luxembourg, Romania and Great Britain are the countries which effectively used their expenditures in terms of transport accessibility (100% expenditures were transformed into results). The other analysed countries did not use the expenditures to the full extent. The results achieved by Slovakia should have been higher by 133% when its expenditures are taken into account. The results indicate that Slovakia should become similar to Estonia by 59% and to Lithuania by 40% in order to achieve better results. Other countries which did not use their expenditures properly include: Portugal (107%), Czech Republic (117%) and the Netherlands (101%). Ireland came closest to achieving efficiency (its results should have been about 17% higher than its expenditures). Ireland should become similar to Latvia in order to increase its efficiency in terms of transport accessibility.

Table 2. Effeciency index in terms of transport accessibility for European countries in 2005

COUNTRY	**BE**	**BG**	**CZ**	**DK**	**DE**	**EE**
THETA	1,41523	**1**	1,68493	1,44215	**1**	**1**
COUNTRY	**IE**	**EL**	**ES**	**FR**	**IT**	**LV**
THETA	1,98899	**1**	1,38192	1,45524	1,4888	**1**
COUNTRY	**LT**	**LU**	**HU**	**NL**	**AT**	**PL**
THETA	**1**	2,0103	1,41303	1,07874	**1**	1,48117
COUNTRY	**PT**	**RO**	**SI**	**SK**	**FI**	**SE**
THETA	**1**	**1**	1,18177	1,00923	1,55015	**1**
COUNTRY	**UK**					
THETA	1,93599					

Source: author's own study.

Table 2 shows the efficiency indexes for the year 2005. In 2005, the following European countries achieved 100% efficiency in terms of the transport accessibility: Bulgaria, Denmark, Germany, Greece, Lithuania, Latvia, Austria, Portugal, Romania and Sweden. This means that these countries fully used the expenditures intended for transport accessibility, achieving the maximum results. Luxembourg was much below the limit of efficiency. It should have had about 101% higher results at the given expenditures. Luxembourg should increase its efficiency in terms of transport accessibility by becoming similar to such countries as Latvia, Lithuania and Romania. Slovakia almost reached the efficiency level in 2005. The results show that it was only inefficient by 1% in terms of transport accessibility.

Table 3. Effeciency index in terms of transport accessibility for the European countries in 2010

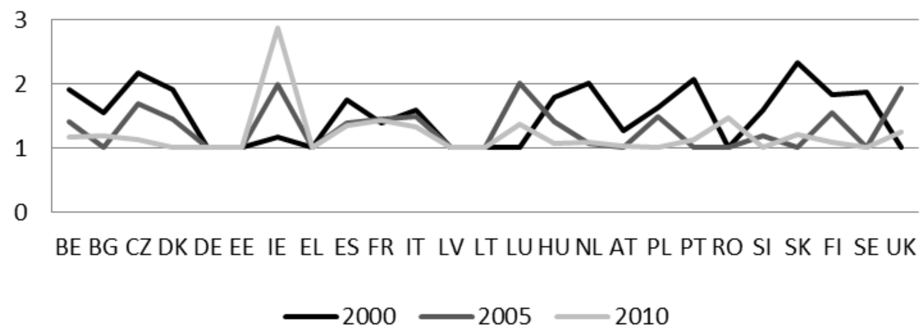
COUNTRY	**BE**	**BG**	**CZ**	**DK**	**DE**	**EE**
THETA	1,17639	1,19048	1,12942	**1**	**1**	**1**
COUNTRY	**IE**	**EL**	**ES**	**FR**	**IT**	**LV**
THETA	2,87868	**1**	1,3545	1,42704	1,33045	**1**
COUNTRY	**LT**	**LU**	**HU**	**NL**	**AT**	**PL**
THETA	**1**	1,36927	1,07197	1,08959	1,02664	**1**
COUNTRY	**PT**	**RO**	**SI**	**SK**	**FI**	**SE**
THETA	1,1237	1,46737	**1**	1,2161	1,08059	**1**
COUNTRY	**UK**					
THETA	1,25618					

Source: author's own study.

Table 3 presents the results of efficiency in terms of transport accessibility in 2010. Countries which efficiently used their expenditures in the transport accessibility in 2010 include Denmark, Germany, Estonia, Greece, Lithuania, Latvia, Poland, Slovenia and Sweden. The least efficient country was Ireland, which should have had 188% higher results than those actually achieved in 2010. The analysis shows that in order to achieve higher efficiency Ireland should become similar by 87% to Poland and by 13% to Greece (the best practises for transport accessibility should be derived from countries such as Poland and Greece). Austria was at the limit of efficiency (its results should have been about 2% higher at the given expenditures). Austria should become similar to countries such as Denmark, Lithuania, Poland and Sweden. Finland was also close to achieving efficiency (8%). In terms of transport accessibility, it should become similar to Germany (by 31%), Lithuania (by 14%) and Sweden (by as many as 52%).

Figure 20 shows the changes in the efficiency index in the selected European countries in 2000, 2005 and 2010. Over the years, one can see that the group of countries characterised by model efficiency of transport accessibility has not increased. One can only notice that some countries were characterised by high efficiency in one analysed period and low efficiency in another analysed period. It should also be noted that in the case of 10 countries, one can observe improved efficiency in terms of transport accessibility. In the case of Romania and Ireland, an increase of the theta value was recorded, and hence there was a deterioration in their efficiency, i.e. usage of expenditures in an inefficient way. It should also be noted that in all analysed years, countries such as Germany, Estonia, Lithuania and Latvia achieved 100% efficiency in terms of transport accessibility. Germany has a very well-developed structure of road and rail networks, so its high efficiency in terms of transport accessibility comes as no surprise. In contrast, Estonia, Lithuania and Latvia are characterised by a poorer transport system. However, the specified countries use their expenditures in the best way. Consequently, their efficiency index is at the level of 1.

Figure 20. Efficiency index of transport accessibility in European countries in the years 2000, 2005 and 2010



Source: author's own study.

6. Conclusions

Differences in the level of the accessibility of freight land transport in European countries are caused by the varying popularity of particular modes of transport. In addition, these countries also vary in economic, geographic, environmental and social terms. The results of the analysis of efficiency in terms of transport accessibility in the European countries can be considered as satisfactory. For most countries, one can see a certain variability in time, which may result from changes in transport policy conducted both by the national governments and by the European Union (of which most of the analysed European countries are members).

The DEA method allows one to reach some interesting conclusions. Therefore, the application of this method in this analysis should be considered justified. The advantage of the DEA method is that there are no requirements regarding the form of the function expressing the relationship between the expenditures and the results. The variables describing the expenditures and results can also have different denominations. A positive aspect of the application of the DEA method are also the results specifying objects to which a particular object should become similar if it wants to increase its efficiency. On this basis, the governments of particular countries may want co-operate in the conducting of transport policy. Countries with high efficiency could prepare a catalogue of good practises in transport operations for countries that would like to improve their efficiency.

References

Charnes A., Cooper W.W., Rhodes E.L. (1978), *Measuring the efficiency of decision making units*, 'European Journal of Operational Research'.

Energy and Transport in Figures 2013, European Commission Report.

Guzik B. (2009), *Podstawowe modele DEA w badaniu efektywności gospodarczej i społecznej*, Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań.

Janecki R., Krawiec S. (2010), *Efektywność i skuteczność polityki transportowej miast i regionów* [in:] Michałowska M. (ed.) *Efektywność transportu w teorii i praktyce*, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice.

Koźlak A. (2012), *Nowoczesny system transportowy jako czynnik rozwoju regionalnego w Polsce*, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk.

Michałowska M. (ed.) (2012), *Efektywność transportu w warunkach gospodarki globalnej*, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice.

Rosik P. (2012), *Dostępność lądowa przestrzeni Polski w wymiarze europejskim*, Instytut Geografii i Przestrzennego Zagospodarowania S. Leszczyńskiego, Polska Akademia Nauk, Warszawa.

Rosik P., Szuster M. (2008), *Rozbudowa infrastruktury transportowej a gospodarka regionów*, Wydawnictwo Politechniki Poznańskiej, Poznań.

Spiekermann K., Neubauer J. (2002), A*ccessibility and Peripherality: Concepts, Models and Indicator*, Nordregio.

Schwab K. (2012), *The global competiveness. Report 2012–2013*, World Economic Forum, Geneve.

Załoga E. (2013), *Trendy w transporcie lądowym Unii Europejskiej*, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin.

Streszczenie

DOSTĘPNOŚĆ TRANSPORTOWA W ŚWIETLE METODY DEA

Rozwój infrastruktury transportu i wzrost sprawności obsługi transportowej jest jednym z istotnych czynników wzrostu gospodarczego. Pojęcie dostępności transportowej można rozpatrywać w różnych aspektach. W niniejszym artykule skupiono uwagę na dostępności towarowej drogowej i kolejowej mierzonej wyposażeniem infrastrukturalnym. Podstawowym celem opracowania jest określenie efektywności wybranych krajów Europy w 2000, 2005 i 2010 roku pod względem dostępności transportowej przy danej liście nakładów i rezultatów. Badanie efektywności zostanie przeprowadzone na podstawie analizy DEA (ang. Data Envelopment Analysis), której przedmiotem jest ocena efektywności, z jaką dana gospodarka transformuje posiadane nakłady na wyniki. Hipoteza zakłada, że istnieją różnice pomiędzy efektywnością pod względem dostępności transportowej w krajach europejskich oraz możliwe jest podniesienie analizowanej efektywności poprzez wykorzystywanie doświadczeń krajów, które charakteryzują się wysokim poziomem efektywności.

Słowa kluczowe: *dostępność transportowa, wskaźniki infrastruktury, efektywność, metoda DEA*