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CONVERGENCE OF ROAD INFRASTRUCTURE AS ELEMENT OF LOGISTIC DEVELOPMENT OF COUNTRY

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Abstract: The development of density of national roads and the highways is one of basic directions of development of logistics in Poland. Present situation is far from observed in different developed countries European. In last years the fast development of density of roads in Poland was perceived. In this paper, using the measure of convergence, the test of verifying the proper direction of development of road infrastructure in Poland was undertaken.
Key words: road infrastructure, the highways, β convergence.

1. Introduction

In the early nineties in the U.S. CLM (Council of Logistics Management), the definition of logistics has expanded and characterized as a process of planning, implementation and control, effective and efficient flow and storage of raw materials, semi-finished and finished products, services and use of information from production to the customer, according to his expectations [1].

"The Challenge" of logistics is similar for all companies, the idea is to give companies the methods and means to gain market advantage to reduce costs and increase benefits of good quality products and services. Strong competition between the companies means that many of them attach greater importance to the quality of produced goods and services, rather than to increase the cost of distribution. This is due to logistics strategy, the objective should be to determine – what would be the difference in income as a result of increase of quality of logistics product, i.e. good or services.

2. Meaning of roads in logistics

In spatial terms, logistics activities are arranging the logistics chain according to configuration of logistics network in the area of a city, region or between regions [1]. At this point, the issue of infrastructure for contact between the chain links should be mentioned. In Polish conditions, but also in many other European countries, transport between market participants at the national level is mostly determined by the road infrastructure. By the end of the 80 the majority of transport, especially of raw materials, had been processed by the railway. In times of transition and privatization on the one hand, and poor management combined with negligence in the maintenance of rail traffic – on the other, have led to the present conditions. Lack of proper management, restructuring and adjustment to new market conditions made railway to lost much of its former importance.

It is known that the role of the logistics system in a company or between companies in the logistics chain is the development of such technological and economic foundations of

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the system to give the recipient, a supply of desired product, i.e. expected product or service in the required amount and type, at the right time and place. In this respect, railway, as a cargo mean of transport is far worse than other land means of transport – cars. Economic growth, which is a permanent expectation of the public with respect to the economy, shows transportation needs emerging in increasingly diverse forms arising from:

- increased social mobility and public transport,
- development of the world economy, international division of labor,
- globalization and integration processes of economy and society,
- amount and range of information flowing in working society,
- consumer demand for different forms of leisure time activities,
- emigration in search of work.

In this regard, road transportation seems to be a perfect solution. In terms of freight, many benefits can be observed, which are high mobility, ability to choose a size depending on the size of the load, load division opportunities on smaller parts, the short duration of any change or re-routing decisions. The disadvantage is reduction of the unit capacity and dramatically higher cost in case of large orders in comparison with other modes of transport [2]. Additionally, energy consumption and harmful impact on the environment are other disadvantages [3]. Generally, road transportation is currently the most common type of transport on national and local levels. There is no doubt that it also plays a significant role in international cargo, especially in the case of consignments of short delivery, or directed to inaccessible places without airports and rail routes. What's more, road transportation can also be used as a component of maritime transport and rail. Loads are packaged in cars that are transported by other means of transport on a certain stage of the delivery. In this aspect, the state of roads, both in terms of capacity, quality of surface as well as the development of road network for transport in every possible place are critical to the on-time delivery.

3. Role of highways and national roads

Road infrastructure consists of highways, national, local and city roads. City roads are a natural network of connections between residents in urban areas. Their length and amount is equivalent to local needs and their condition a result of local investments [4]. In practice, we find that richer cities, towns, villages, have a better quality roads and at the same time increased demand from businesses for their bandwidth. In the economically weak villages – also due to low business activity – roads usually are worse. From this point of view, considering the local conditions of road transport with regard to organization of transport appears to be meaningless. A completely different role, however, play municipal, countries and international roads – mainly highways. They are the carriers of development as railways used to be in the past. Thanks to an adequate network of roads and highways transportation in today's economic reality can be organised. These roads can be classified to linear infrastructure. Additional elements are: infrastructure point, which is composed of spatially separated objects for stationary use of passengers (bus stations, bus stops) and cargo (reloading facilities, stations, yards, points of loading); transport infrastructure of road transport which also includes technical stations and material and technical supply stations for cars.

Polish road network is a 3–4-times less concentrated than in Western Europe and unevenly distributed. Length of roads in recent years have significantly increased, and the increase is still progressing, but the condition leaves much to be desired. Specific major difficulties for transport creates:

- high level of depreciation, resulting in poor quality of surface, which is due to reduced spending on routine maintenance which fails to ensure safety;
- low share of roads with a higher standard.

Polish state of road infrastructure causes many negative effects such as:

- increase the risk of road safety;
- congestion;
- much longer journey than on roads with higher quality, causing the need to increase the number of drivers, even at the national level crossings (in conjunction with the rules on drivers' hours);
- higher costs of transport.

The majority of Polish roads include mixed traffic: trucks, cars, tractors, bicycles, etc., which severely limits their capacity and creates a safety hazard [5, 6].

Therefore, in view of the development of long-term development strategy for land transport in Poland, it seems important to investigate the existence of some kind of convergence in this area. Road systems in economically developed countries can serve as patterns worthy of imitation. In terms of comparability, it is not the length of the road network which should be taken into account, but the type of road related to a reference variable, which in this case should be the area of XX the country.

At the end of 2010, the hard surface roads accounted for 67.4% of all roads in Poland. The total density of hard surface roads was 87.6 km per 100 km^2 [7].

Length of paved roads in Poland in 2000–2010 increased by 9.6%, while GDP grew by 46.1%. Given that the number of motor vehicles increased by 63.3%, too slow development of roads in the country should be noted. The result is 84 vehicles per 1 km of roads in Poland in relation to 54 in the EU-27 [8]. Size of road transport in 2010 in Poland amounted to 1,588 thousand tons, which accounted for 58.1% of the total tonnage of cargo in Poland [9]. If we convert it to km, this figure reaches 82.9% of the total transport in Poland. Forecasts for future show a small but steady increase in these indicators. To analyze changes in the number of cars each group in recent years, their numbers in the base year (2001) was treated as "1" and the subsequent amendments are assigned proportionally.

We also see a dynamic change in the number of cars in Poland (Figure 1). In the years 2001–2011 the number of newly registered passenger cars has doubled and even tripled in the case of tractors. The average rate of increase in the number of registered heavy vehicles over 3.5 tonnes was in those years only 1.6%, while for tractors, this increase was 11.9% per year. The total number of trucks and tractors in 2011 exceeded 3 million, and is almost five times higher than in 1980. Number of tractors alone in 2011 amounted to 238,665.

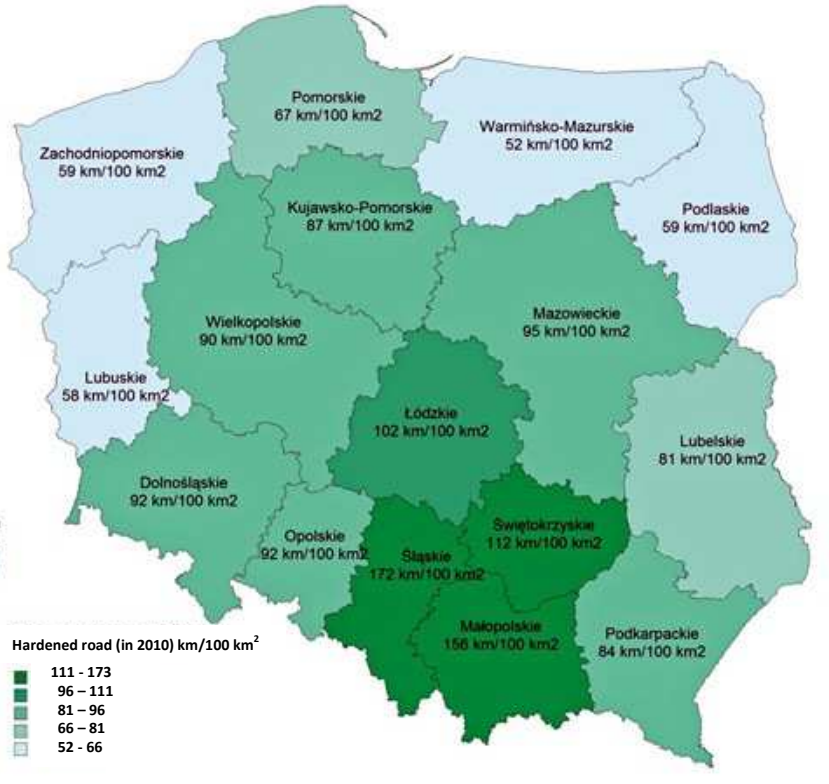

Figure 1. The total density of hard surface roads in Poland in 2010 [km/ 100 km^2]
Source: GUS. Transport – wyniki działalności w 2010 roku. Warszawa 20101

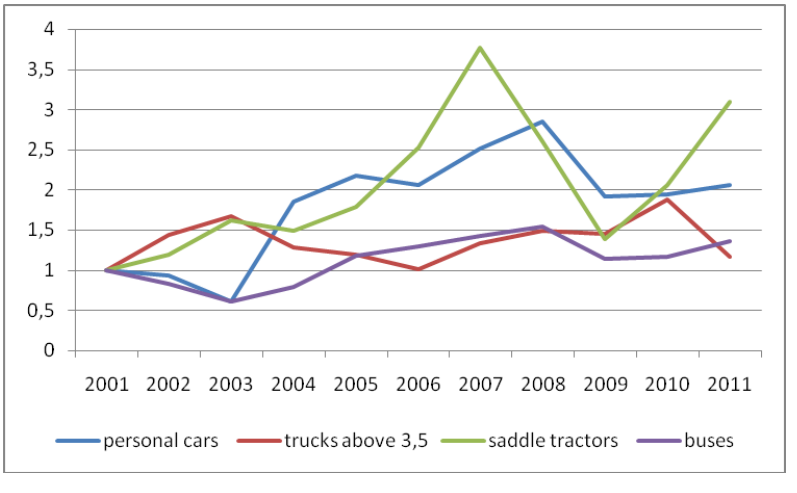

Figure 2. The change of number of cars in Poland in years 2001–2011 according to types
Source: own calculations based on the survey: Transport drogowy w
Polsce wybrane dane RAPORT ZMPD 2012, Warszawa marzec 2013

Similarly, the dynamic growth in Poland in relation to the number of trailers and semi-trailers used in road transport (Figure 2) has been observed. Number of trailers with a capacity of over 15 tons, registered in Poland in 2011 was 13,075, while the number of semi-trailers with a capacity exceeding 25 tonnes 198,438.

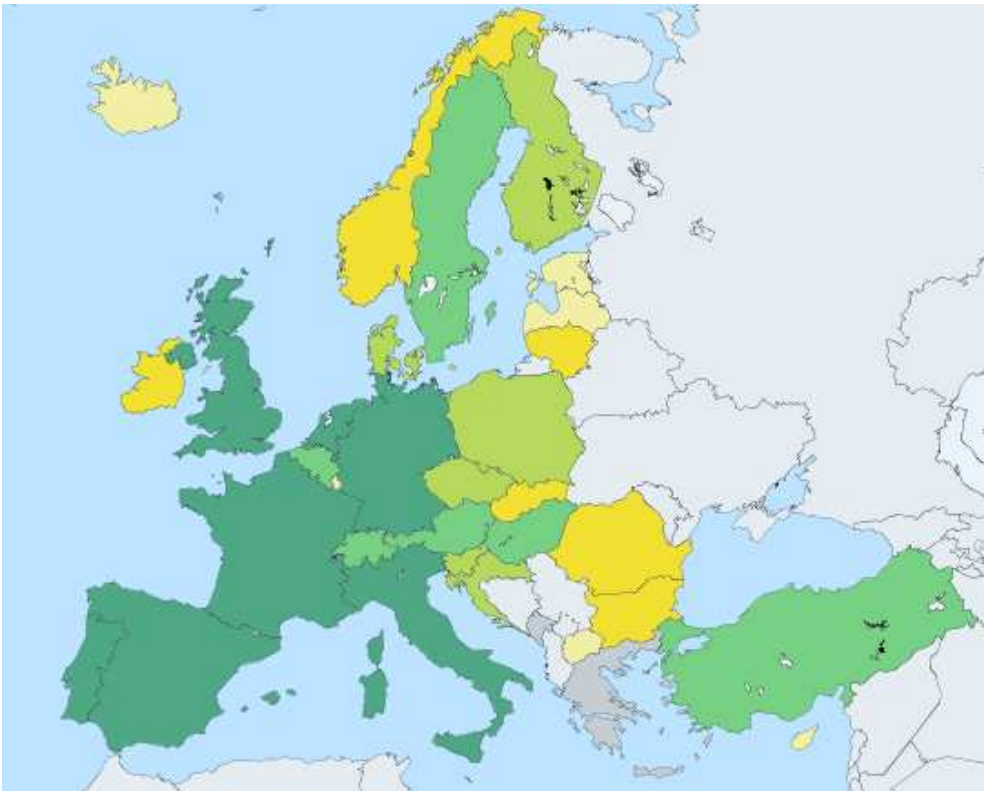

Figure 3. The length of highways in countries of European Union in year 2011 or last possible
Source: EUROSTAT

As one can see, the increase in the number and tonnage of freight transport in Poland in recent years is undeniable. Its development may, however, be slowed down if one notices adverse changes in line-level infrastructure. Therefore, an attempt to analyze the convergence length of roads in the European Union was taken.

In the study the data from EUROSTAT have been used. Data refer to the network of national roads and motorways in the European countries. To allow comparison of development of the road network, their length was referred to the area of each country. The base initially involved 27 countries, however, in the case of Malta, Latvia and most of the surveyed years in Greece, data on existing highways are not available there.

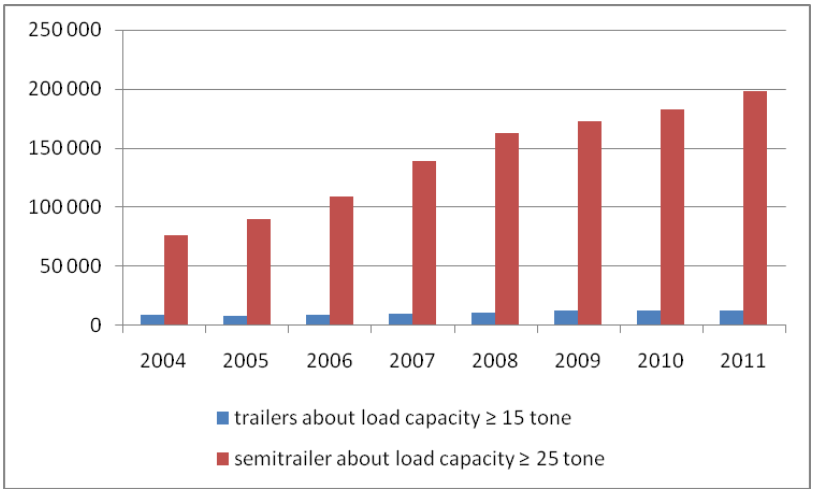

Figure 4. The number of registered weight trailers and the semitrailers according to chosen load capacity in years 2004–2011
Source: own calculations based on the survey: Transport drogowy w Polsce wybrane dane RAPORT ZMPD 2012, Warszawa marzec 2013

4. Measurement of convergence the length of motorways in respect of areas for European Union countries

Comparing particular countries in terms of selected economic categories different methods can be used. The most popular and most commonly used are the ones which apart of a typical comparisons suggest a possible convergence of the economic category (or divergence) and its strength. These features are provided by a model of unconditional convergence [10]:

$$\frac{1}{T}(\ln y_{i0+T} - \ln y_{i0}) = \alpha - \left[\frac{(1-e^{-\beta T}}{T}\right]\ln(y_{i0}) + \varepsilon_{it},, \tag{1}$$

where

y_{i0+T} and $\ln y_{i0}$ – adequately investigated category i-th (i = 1, ..., N) of the region in the final and initial year,
T – the number of years for which a growth rate is calculated (t = 1, ..., T),
β – parameter in determining the rate of convergence,
ε_{it} – random component.

Convergence occurs when the parameter θ has the following features: is statistically significant and at the same time a negative value. Its speed is determined by the value of the parameter β.

In the case of surveys covered by this study data on the length of motorways in respect of areas for European Union countries were taken into account. Furthermore, the survey was carried out from three perspectives: all EU countries, the first 15, the new 12, the first 15 and Poland. The results are presented in the following table.

Results presented in Table 1 indicate that β convergence across the Union and 15may be considered significant. Similar conclusions apply to both the observation of longer and shorter horizon. It can therefore be concluded that the EU countries aim at a general direction designed to develop the road network. Extend trial by Poland makes the result worse. This may be a prove that the growth rate of extension of the motorway network in Poland is too slow. However, when analyzing the situation for the last 10 years we have seen a marked acceleration, as evidenced by an almost identical factor of β-convergence. Also, change for 12 goes in the right direction, although it still is significant. Relatively speaking, the growth rate of the length of motorways in the European Union is falling, while in the new 12 increases, especially in countries such as Poland. This is understandable, because in some countries, the number/length of motorways has already reached a level of saturation and their further development is associated perhaps with new strategies but does not determine the operation of the communication system at the appropriate level.

Table 1

Results of estimation β convergence for the length of motorways in country's conception in 1990–2010 years

Conception (group)	**Estimations of parameters for separate take-off years**					
	21-years			10-years		
	β	θ	p	β	θ	p
UE (27)	1,98%	–4,116	0,000	2,07%	–3,270	0,004
UE (15)	3,11%	–4,723	0,000	2,49%	–2,564	0,025
UE (15) + PL	2,71%	–4,562	0,001	2,42%	–2,998	0,010
UE (12)	0,92%	–1,185	0,270	2,02%	–1,690	0,129

Source: own calculations based on the EUROSTAT survey

5. Conclusions

For countries such as Poland, motorway network development is a kind of communication "to be or not to be" in comparison with neighboring developing countries. Especially in the geographical location where the east side are a "bulwark of Europe" and profit from transit through Poland can be disproportionately high in relation to their investment. Despite the rapid growth of the automotive fleet size, the improvement of the quality resulting mainly from existing legislation and more stringent control, the development of road infrastructure still seems to be insufficient. The acceleration in recent years, due in part to the organization of Euro 2012 is not yet able to make up differences that occurs during the transition. Although direction is proper, its growth rate appears to be too small.

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