

Modeling and Trends of Road Transport Development in Eastern European Countries

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Abstract

Road transport occupies the largest share in domestic and international transport. It is of key importance for the development of the economy, forasmuch as it provides the livelihood of the population, the development of the national economy, the possibility of establishing foreign economic relations. The purpose of the research is as follows: analysis of the current state of functioning of the road transport sector in Eastern Europe and identification of key problems and trends in its development. Research methods: Methods of grouping, comparison and generalization, correlation analysis have been used to identify the dynamics of the main indicators of road transport in Eastern Europe. The method of correlation-regression analysis has been applied to determine the impact of increasing the length of roads on the turnover of the road freight transport and the number of employed population in this area. Results. It has been found that the increase in the employed population by 96% and increase in revenues from transportation and storage of goods, postal and courier services (turnover of the road freight transport - in the original language) in the field of road transport by 82% is explained by the change in transport infrastructure capacity by increasing length of highways. According to the correlation analysis, it has been revealed that there is a high direct dependence between the length of roads and increased revenues from transportation and storage of goods in the field of road transport, as well as between the length of roads and increasing employment in this area.

Keywords: Road Transport, Transport System, Road Transport Infrastructure Eastern European Countries, Economic Development.

1. Introduction

Road transport is of great importance in the social-economic development of the country, forasmuch as it affects the level of economic growth and quality of life. Expansion of transport infrastructure is a tool for creating favorable conditions for economic development, new jobs, promoting the improvement of the structure of social production, expanding trade opportunities, strengthening the integration of countries, as well as establishing international relations. Consequently, the development of the transport industry is especially important in integration

associations, the main purpose of most of which is to ensure the free movement of goods, services and labor. Therefore, it is relevant to study trends and problems in the development of road transport in Eastern Europe (according to United Nations section): Bulgaria, the Czech Republic, Poland, Romania, Hungary, Slovakia, Moldova, Belarus, Ukraine, Russia. Although these countries have social-economic disparities, their geographical proximity, common economic ties, harmonization of activities in the sphere of motor transport, respectively (Akimova et al., 2020) make it possible to form a full picture of dependence of road transport development (primarily, the ability to create jobs and improve financial results) from the expansion of road transport infrastructure.

2. LITERATURE REVIEW

Much attention is paid to various aspects of road transport development and its economic significance in the economic literature. Transport policy has always been a powerful tool for influence on the social-economic development of countries or regions (Pucher and Buehler, 2005), directly or indirectly influencing the economy. The direct impact of road transport development is related to the formation of logistics links, ensuring access to international markets and increasing the domestic market for goods and labor mobility, saving time and reducing business costs for the delivery of goods (Farhadi, 2015). Indirect consequences of the development of the motor transport system and infrastructure (Mohmand et al., 2016) contribute to the development of industries that supply goods and services, increasing their investment attractiveness. In general, researchers (Arvin et al., 2015) identify three key effects of transport road infrastructure for economic growth, namely: increasing overall labor productivity; promoting technology transfer in the economy; enhancing the profitability of transport-related enterprises, both by increasing their sales and by reducing costs through production and / or delivery.

In the last decade, the development of road transport, as well as other modes of transport, is

increasingly considered in the context of sustainable development of the society (Wang et al., 2018), focusing on the impact of transport on economic processes and the society, environment and overall quality population's life (de Gennaro et al., 2016). Moreover, the priorities for the development of transport, taking into account the environment and safety, are outlined not only in scientific papers, but also in the policy of highly developed countries, including EU (Horizon 2020, 2020).

There is dependence between the economic development of the country and the possibility of forming a road transport system. This is evidenced by the example of the countries of EU (Cigu et al., 2019), which showed that countries with higher GDP have more developed infrastructure. However, countries with lower levels of economic development, which are in the transitional stage of adaptation to EU norms and standards, are characterized by an insufficient level of modernization and development of the transport system. This primarily applies to Eastern European in contrast to Western Europe countries which have greater potential for development and will show faster rates of road transport development, particularly in the areas of freight and road transport infrastructure (Giannopoulos, 2005).

Given this complexity and multifaceted nature, scientists pay considerable attention to the issue of road transport development in the countries of the Eastern European region. The focus of the research, in addition to the analysis of economic opportunities for road transport, involves various aspects of this area. For instance, the scientific work of Stojanović (2017) is aimed at studying the problems of estimating the share of freight transportation by own transport in Europe. Laioua et al., (2017) highlights the issue of road safety in the countries of Southeast Europe, namely: Italy, Greece, Romania, Bulgaria, Hungary, Slovenia. In particular, the scholar raises the issue of lack of complete data on the causes of road accidents and a fairly high mortality rate on the roads. Opportunities for the functioning of the transport sector and the development of logistics infrastructure in some Eastern European countries are the subject of research of Macioszek (2017), Ovchar and Holubka (2018), Pugachev (2018).

Thus, the problem of the functioning of road transport is widely reflected in scientific publications in the form of cases and empirical investigations. Nevertheless, the issue of analysis of complex problems and trends in road transport in the Eastern European region remains relevant and open for further research, especially taking into consideration the globalization processes and strengthening the economic development of Eastern Europe.

3. METHODS

In order to achieve the purpose of the research, the basic objectives lie in empirical testing the null hypothesis concerning the fact that there is no relationship between the development of transport infrastructure and indicators of motor-vehicle transport development, namely: the number of employed people and financial indicators in the field of cargo transportation carried out by road. An alternative hypothesis lies in the fact that there is a direct close link between the expansion of road transport infrastructure (increasing the length of roads) and the number of people employed in road transport, as well as between the turnovers of the road freight transport.

The method of correlation-regression modeling of dependence between the indicators of the functioning of road transport has been applied in order to determine the outlined driving factors of its growth. Correlation analysis has made it possible to determine the density of the relationship between the factors using the correlation coefficient (r) with a statistical error of 5% ($p = 0,05$). The correlation coefficient can take values from -1 to +1. A positive value of r indicates a direct dependence between the factors, and a value of $r > 0.8$ indicates a very close relationship between the studied features. Regression analysis has revealed dependence between the length of roads and revenues from transportation and storage of goods in the field of road transport, as well as between the length of roads and the number of people employed in this area.

Eastern European countries have been selected for analysis, namely: Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovakia, Belarus, Russia, and Ukraine, where road transport is still in the development stage; it is characterized by different growth dynamics. The analysis of indicators of Eastern European countries will make it possible to form a holistic picture of the motor transport industry in the region and to reveal key dependencies between the factors of its development. The data of Belstat (2020); Rosstat (2020); Cross (2020); Eurostat (2020) constitute the statistical basis for the analysis of the dynamics of motor performance in EU and prove an alternative hypothesis.

4. RESULTS

In the countries of the Eastern European region, the main indicators of road transport development are growing. For example, revenue from transportation and storage of goods (including postal and courier services (turnover of the road freight transport)) in the automotive sector increased by 20 - 54% depending on the country is indicative in terms of the growth in the economic efficiency of road transport (see Fig. 1).

Poland is the leader among the countries of the Eastern European region in terms of revenue from road transport services. Its indicators are about three times higher than the indicators in the Czech Republic and Romania,

almost 5 times higher than the indicators in Hungary and more than 7 times higher than the indicators in Bulgaria and Slovakia.

Figure 1 Dynamics of turnover of the road freight transport of Eastern European countries in 2013-2017, million euro

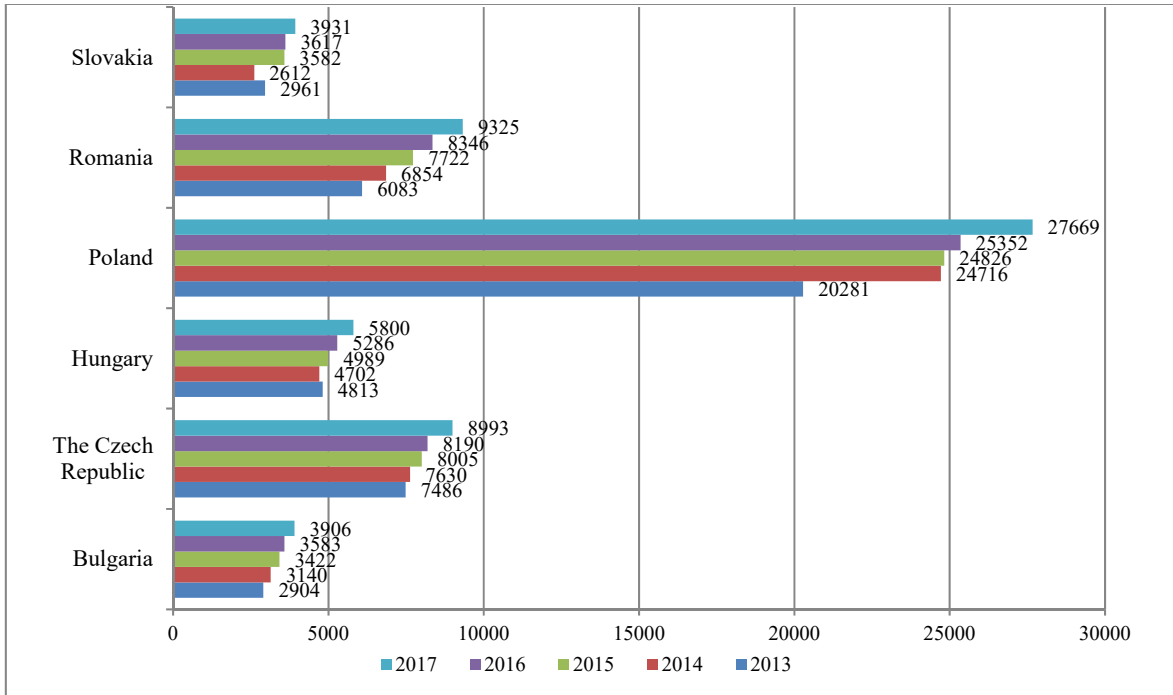


Table 1
INPUT PARAMETERS OF THE MODEL OF CORRELATION BETWEEN THE INDICATORS OF THE FUNCTIONING OF ROAD TRANSPORT IN THE COUNTRIES OF EASTERN EUROPE

Country	Length of highways, thousand km	The share of road transport by road in the total volume of traffic, %	Number of employed population in motor transport, thousand people	Turnover of the road freight transport, mln. euro
Bulgaria	19,86	56,6	72,2	3906,0
Czech Republic	130,68	73,1	129,6	8993,0
Hungary	210,82	66,1	78,5	5800,0
Poland	423,94	76,0	384,4	27669,0
Romania	86,1	42,4	155,1	9325,0
Slovakia	44,5	63,5	48,0	3931,0
Belarus	102,4	37,9	188,8	-
Russia	1507,8	67,0	3111,4	-
Ukraine	163,1	60,4	456,8	-

Table 2
CORRELATION BETWEEN INDICATORS OF FUNCTIONING OF ROAD TRANSPORT
($p < 0,05, n = 9$)

	Length of highways, thousand km	The share of road transport by road in the total volume of traffic,%	Number of employed population in motor transport, thousand people	Turnover of the road freight transport, mln. euro
Length of highways, thousand km	1,000	0,330	0,980	0,910
The share of road transport by road in the total volume of traffic,%	0,326	1,000	0,210	0,470
Number of employed population in motor transport, thousand persons	0,980	0,214	1,000	0,990
Turnover of the road freight transport, mln. euro	0,906	0,466	0,995	1,000

The positive impact of transport infrastructure development on economic efficiency indicators of the industry is confirmed by the results of pairwise correlation analysis (see Table 1 and 2).

The results show a high degree of relationship between increasing road length and turnover of road freight

transport in road transport infrastructure ($r = 0.91$ at $p < 0.05$) and an increase in the number of employed people in this area ($r = 0.98$ with $p < 0.05$). At the same time, there are interrelations between the indicators of road transport (See Fig. 2): the number of employed people in the field of road transport and turnover of road freight transport ($r = 0.99$ at $p < 0.05$).

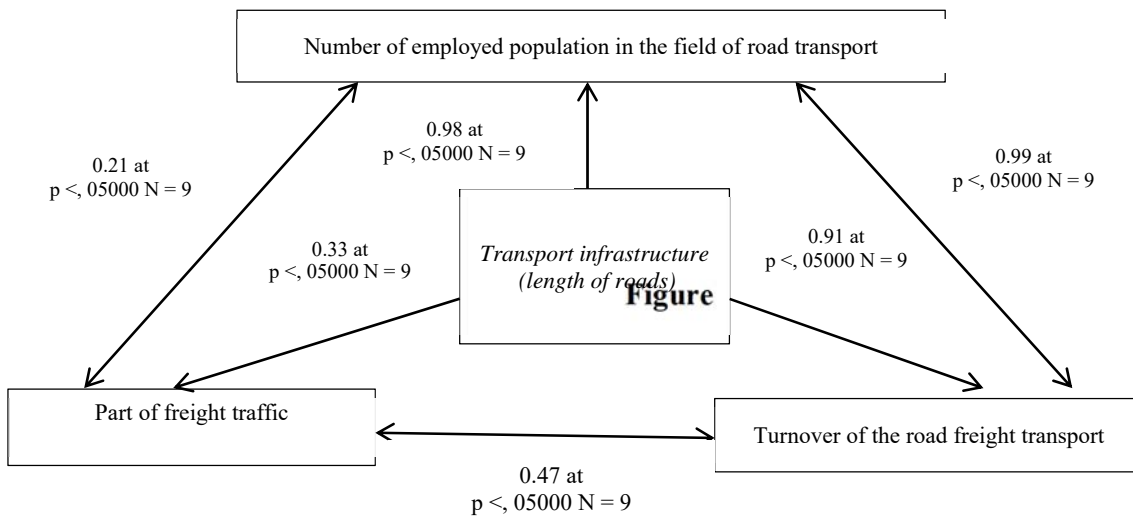


Figure 2 The impact of transport infrastructure development on the performance indicators of road transport

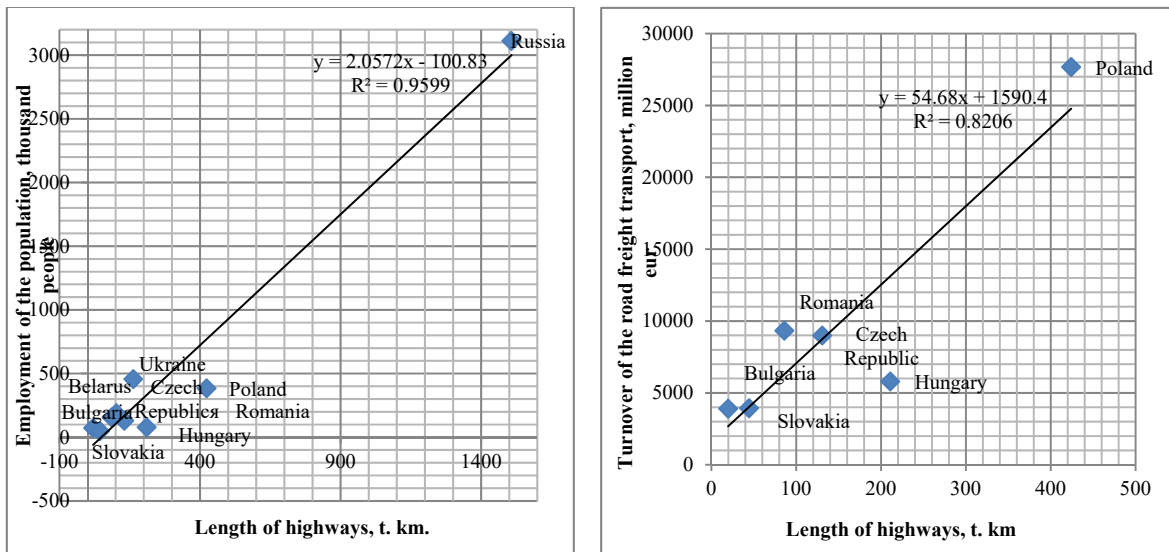


Figure 3 Correlation between key indicators of transport infrastructure development and road transport functioning in the countries of Eastern Europe

The analysis of certain correlations between these indicators showed a direct linear interrelation between the length of roads and turnover of road freight transport and the number of people employed in road transport (See Fig. 3).

Countries with a wider automotive infrastructure network (Poland, Romania, the Czech Republic, Hungary, Russia, Ukraine) are characterized by a larger number of people working in the field of motor transport, as well as a larger volume of motor transport services.

The validity of the detected dependence is confirmed by the results of constructing a linear regression between these factors. They make it possible to display the interrelation between the length of roads and the turnover of the road freight transport:

$$\text{Turnover of the road freight transport} = 1590,4 + 54,68 * \text{Length of roads} \quad (1)$$

On the other hand, the interrelation between the length of roads and the number of people employed in motor transport is as follows:

$$\text{Number of employed populations} = -100,83 + 2,0572 * \text{Length of roads} \quad (2)$$

Herewith, the value of the coefficient of determination in the model indicates that it explains 82% of the relationship between turnover of the road freight transport and the length of roads. This indicates to the fact that despite the high impact of the latter factor, there are still

factors influencing the volume of revenues from freight transport in the field of road transport. They are not included in the regression model, for instance, the cost of transportation services and the volume of freight transportations performed. The reliability of the model is confirmed by the fact that its independent factor and the model equation are statistically significant, as indicated by $t \text{ Stat} = 4,278 > 2,276$ and $F \text{ criterion} = 18,298 > 7,709$. According to another linear regression model, it has been found that the increase in the length of roads in Eastern Europe by 96% explains the variation in the number of people employed in motor vehicle transport. Along with this, the independent change of the model and the equations of the model are statistically significant: $t \text{ Stat} = 4,278 > 2,276$; $F \text{ criterion} = 18,298 > 7,709$.

5. DISCUSSION

The availability of theoretical and practical investigations on various issues of road transport development indicates the importance of this problem for economics. Modern scholars focus on the development of the transport sector in the context of sustainable development. However, most economists study the general dynamics of road transport development and its impact on the economy as a whole. For instance, for more than two decades, scientists have focused on the analysis of impact of transport road infrastructure on macroeconomic indicators of countries (Farhadi, 2015; Mohmand et al., 2016; Cigu et al., 2019, etc.), primarily on gross domestic

product through increasing the efficiency of transportation of people and cargos (goods, resources, etc.), increasing labor productivity, institutional influence and government regulation.

A lot of scientific works (Giannopoulos, 2005; Vilmos, 2017; Pugachev et al., 2018, etc.) raise the issue of problems and challenges of road transport development in different countries. Their investigations are mainly based on revealing trends in changes of functioning of road transport, review of regulations governing the activities of motor vehicle transport in individual countries, as well as the authors' own assumptions, often not confirmed by analytical calculations.

Therefore, we consider that conducted studies are of a generalized nature. In contrast to the investigations outlined, our research is focused on identifying the direct impact of the development of the road transport infrastructure (length of highways) on the social-economic indicators of the industry (the number of employment and the turnover of the road freight transport). Moreover, as it has been noted by Arvin et al. (2015), direct and indirect effects on the economic growth of the industry, and, hence, the national economy are achieved due to the expansion of the road transport infrastructure. In addition, the evidence of the research conducted is reflected in the results of econometric modeling, which makes it possible to obtain sound conclusions. It should also be noted that there were some difficulties connected with the impossibility of a full analysis of data on the development of road transport in the countries of Eastern Europe. The statistics on the functioning of the industry in the Eastern European EU member states are unified, however, in the post-Soviet countries, the statistics of vehicles according to EU standard are almost not kept. At the same time, this problem did not significantly affect the representativeness and statistical significance of the analyzed indicators and made it possible to obtain the reliable research results.

6. CONCLUSIONS

Analysis of the dynamics of indicators of the functioning of road transport in the countries of Eastern Europe has revealed positive trends. After all, both the number of the people employed in the sphere of motor vehicle transport and the turnover of the road freight transport are growing; the motor transport logistics infrastructure is expanding due to the increase in the length of roads of different significance.

The correlation-regression modeling of the impact of the road transport infrastructure's expansion on the financial indicator and the number of people employed in road transport in Eastern European countries has been conducted. This modeling has proved the fact that the growth of turnover of the road freight transport by 82% depends on the increase in the length of roads and by 18% -

on the influence of factors that are not included in the regression model, such as freight and the cost of transportation services.

Along with this, it has been established that the increase in the length of roads in the countries of Eastern Europe by 96% explains the increase in the number of employed people in road transport infrastructure. Thus, the importance of the development of transport infrastructure for employment and financial results of the industry in general has been confirmed.

Further investigations should be directed at studying the impact of road transport development on the social-economic growth of the countries of Eastern Europe, as well as at systematizing countries by factors of such growth.

References

- [1] Akimova, L., Khomiuk, N., Bezena, I., Lytvynchuk, I., Petroye, O. (2020). Planning of socioeconomic development of the territories (experience of European Union). *International Journal of Management*, 11 (4), 638-646.
- [2] Akimova, L., Litvinova, I., Ilchenko, H., Pomaza-Ponomarenko, A. and Yemets, O. (2020). The Negative Impact of Corruption on the Economic Security of States. *International Journal of Management*, 11 (5), 1058-1071.
- [3] Arvin, M.B., Pradhan, R.P., Norman, N.R. (2015) Transportation intensity, urbanization, economic growth, and CO2 emissions in the G-20 countries. *Utilities Policy*, 35, 50-66. <https://doi.org/10.1016/j.jup.2015.07.003>.
- [4] Belstat (2020). Transport in Belarus. Retrieved from: <https://www.belstat.gov.by/ofitsialnaya-statistika/realny-sector-ekonomiki/transport/>.
- [5] Cigu, E., Agheorghiesei, D.T., Gavriluta (Vatamanu), A.F. and Toader, E. (2019) Transport Infrastructure Development, Public Performance and Long-Run Economic Growth: A Case Study for the EU-28 Countries. *Sustainability*, 11 (67). <https://doi.org/10.3390/su11010067>.
- [6] De Gennaro, M., Paffumi, E., Martini, G. (2016) Big Data for Supporting Low-Carbon Road Transport Policies in Europe: Applications, Challenges and Opportunities. *Big Data Research*, 6, 11-25. <https://doi.org/10.1016/j.bdr.2016.04.003>.
- [7] Eurostat. (2020). Transport – Overview. Retrieved from: https://ec.europa.eu/eurostat/databrowser/view/road_if_motorwa/default/table?lang=en.
- [8] Farhadi, M. (2015) Transport infrastructure and long-run economic growth in OECD countries.

- Transportation Research Part A: Policy and Practice*, 74, 73-90. <https://doi.org/10.1016/j.tra.2015.02.006>.
- [9] Giannopoulos, G.A. (2005) Main transport challenges in South Eastern Europe, after enlargement. *European Transport/Trasporti Europein*, 30, 3-13.
- [10] Horizon 2020 (2020) Work Programme 2018-2020. European Commission Decision C 6320 of 17 September 2020. https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-cc-activities_en.pdf.
- [11] Laioua, A., Papadimitrioua, E., Yannisa, G., Road, A. (2017) Road safety data and information availability and priorities in South-East European regions, *Transportation Research Procedia*, 25, 3703-3714. <https://doi.org/10.1016/j.trpro.2017.05.221>.
- [12] Macioszek, E., Staniek, M., Sierpiński, G. (2017) Analysis of trends in development of freight transport logistics using the example of Silesian Province (Poland) – a case study. *Transportation Research Procedia*, 27, 388–395. <https://doi.org/10.1016/j.trpro.2017.12.026>.
- [13] Mohmand, Y.T., Wang, A.H., Saeed, A. (2016) The impact of transportation infrastructure on economic growth: Empirical evidence from pakistan. *Transportation Letters*, 9, 63–69. <https://doi.org/10.1080/19427867.2016.1165463>.
- [14] Ovchar, P., Holubka, S. (2018) Financial aspects of national automobile transport development. *Financial and credit activities: problems of theory and practices*, 1 (24), 95–103. <https://doi.org/10.18371/fcaptp.v1i24.128339>.
- [15] Pucher, J., Buehler, R. (2005) Transport policies In Central and Eastern Europe. *Handbooks in Transportation*, Button, K. and Hensher, D. eds., Elsevier Press, London, 725-743. Retrieved from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.414.564&rep=rep1&type=pdf>.
- [16] Pugachev, I., Kulikov, Y., Yarmolinsky, A. (2018) Current trends in development of the transport infrastructure of large cities of the Far East, Russia. *Transportation Research Procedia*, 36, 622-626. <https://doi.org/10.1016/j.trpro.2018.12.144>.
- [17] Rosstat. (2020). Transport in Russia. Retrieved from: <https://rosstat.gov.ru/folder/23455>.
- [18] Stojanović, B. (2017) Road freight transport outsourcing trend in Europe – what do we really know about it? *Transportation Research Procedia*, 25, 772-793. <https://doi.org/10.1016/j.trpro.2017.05.457>.
- [19] Ukrstat (2020) Transport in Ukraine. Retrieved from: http://www.ukrstat.gov.ua/operativ/operativ2005/tz/tz_rik/tz_u/ts_u.htm.
- [20] Vilmos, O. (2017) Transport policies in Hungary - historical background and current practice for national and regional level. *European Transport Research Review*, 2, 1-14. <https://doi.org/10.1007/s12544-017-0236-x>.
- [21] Wang, L., Xue, X., Zhao, Z. and Wang, Z. (2018) The Impacts of Transportation Infrastructure on Sustainable Development: Emerging Trends and Challenges. *International Journal of Environmental Research and Public Health*, 15, 1172. <https://doi.org/10.3390/ijerph15061172>.