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RELATIONSHIP BETWEEN TRANSPORT INFRASTRUCTURE EXPENDITURES AND COSTS AND TRANSPORT INDICATORS - AN OVERVIEW OF EUROPEAN AND UKRAINIAN SITUATION

Lidia Savchenko. «Relationship between transport infrastructure expenditures and costs and transport indicators - an overview of European and Ukrainian situation». *Quality of transport infrastructure determines the quality of the provision of services for the transportation of goods and passengers. The infrastructure sector is a guarantee of efficiency, mobility and uninterrupted economic activity. However, the high quality of the transport infrastructure implies significant and long-term investments. According to a McKinsey research report, to support sustainable economic growth in the world in line with forecasts for 2030, it is necessary to cover the need for additional investment of $ 3.3 trillion annually, equivalent to 3.8% of world GDP.*

The purpose of this work is to analyze the existing European approach to assessing transport infrastructure expenditures and costs, their impact on transport performance at the country level, as well as trends in Ukrainian policy regarding the support and development of road infrastructure.

Transport infrastructure costs include the investment in new infrastructure, the cost of upgrading the existing infrastructure, the cost of maintaining the infrastructure, and the operating costs to enable the use of the transport infrastructure. Directive 2011/76 / EU prescribes that the weighted average infrastructure charges should be linked to construction costs, as well as the costs of operation, maintenance and development of the corresponding infrastructure network.

The official Eurostat data of investment and O&M costs of transport infrastructure based on the citizenship principle was taken for this study, namely:

- the number of ton-kilometers traveled per year;

- the volume of investments in road infrastructure per year;

- the amount of funds for the maintenance of road infrastructure per year.

The indicators were taken for countries of the EU for which statistics were available for 2016 and 2019. According to the study, the effect of investments in transport infrastructure is strongly manifested both in the same year and affects subsequent years in terms of the volume of annual transport work. That is, an increase in investment in road infrastructure clearly has a positive effect on the volume of transport work performed. On the other hand, the volume of investments in the EU infrastructure brings a much greater positive effect than funds for road maintenance.

Thus, the experience of developed countries shows a positive relationship between investment in the maintenance and construction of transport infrastructure and economic performance of the state. Part of the research was devoted to the study of the impact of investments in road infrastructure of Ukraine on the example

of the global Ukrainian infrastructure project "Big Construction". It is projected that in 2024, thanks to road works under the Big Construction, Ukraine's GDP will be 4.4% higher than GDP in 2020. But, as the research shows, good transport infrastructure is a necessary, but not a sufficient condition for growth. "Big Construction" project in Ukraine does not show any positive effect on the volume of performed internal transport work now. The reasons may lie both in more long-term effect from improving the infrastructure, and in the facts of corruption and theft of funds allocated for the project.

***Keywords**:* road transport, road infrastructure, infrastructure expenditures and costs, transport indicators, infrastructure investment, correlation, "Big Construction" project.

Лідія Савченко. " Зв'язок витрат на транспортну інфраструктуру та транспортних показників - огляд європейської та української ситуації ". *Якість транспортної інфраструктури визначає якість надання послуг із перевезення вантажів та пасажирів. Інфраструктурний сектор є гарантією ефективності, мобільності та безперебійної економічної діяльності. Проте висока якість транспортної інфраструктури передбачає значні та довгострокові інвестиції. Згідно з дослідницьким звітом McKinsey, для підтримки сталого економічного зростання у світі відповідно до прогнозів на 2030 рік необхідно покривати потребу в додаткових інвестиціях у розмірі $3,3 трлн щорічно, що еквівалентно 3,8% світового ВВП.*

Метою даної роботи є аналіз існуючого європейського підходу до оцінки витрат на транспортну інфраструктуру, їх впливу на транспортну ефективність на рівні країни, а також тенденції української політики щодо підтримки та розвитку власної дорожньої інфраструктури.

Витрати на транспортну інфраструктуру включають інвестиції в нову інфраструктуру, витрати на модернізацію існуючої інфраструктури, витрати на утримання інфраструктури та експлуатаційні витрати, необхідні для використання. Причому, Директива 2011/76/ЄС вимагає пов'язувати середньозважені платежі за інфраструктуру з вартістю будівництва, а також з витратами на експлуатацію, технічне обслуговування та розвиток відповідної інфраструктурної мережі.

Для цього дослідження було взято офіційні дані Євростату про інвестиції та витрати на експлуатацію та технічне обслуговування транспортної інфраструктури, а саме:

- кількість тонно-кілометрів, пройдених протягом року;

- обсяг інвестицій у дорожню інфраструктуру на рік;

- обсяг коштів утримання дорожньої інфраструктури на рік.

Показники взяті для країн ЄС, за якими була наявна статистика за 2016 та 2019 роки. Згідно з дослідженням, ефект від інвестицій у транспортну інфраструктуру сильно проявляється як у тому ж році, так і впливає на наступні роки за обсягом річної транспортної роботи. Тобто збільшення інвестицій у дорожню інфраструктуру однозначно позитивно впливає на обсяг виконуваної транспортної роботи. З іншого боку, обсяг інвестицій в інфраструктуру ЄС приносить набагато більший позитивний ефект, ніж кошти на утримання доріг.

Таким чином, досвід розвинених країн показує позитивний зв'язок між інвестиціями в утримання та будівництво транспортної інфраструктури та економічними показниками держави. Частину дослідження було присвячено вивченню впливу інвестицій у дорожню інфраструктуру України на прикладі глобального українського інфраструктурного проекту «Велике будівництво». Прогнозується, що у 2024 році завдяки дорожнім роботам у рамках «Великого будівництва» ВВП України буде на 4,4% вище за ВВП 2020 року. Але, як показують дослідження, хороша транспортна інфраструктура є необхідною, але не достатньою умовою зростання. Проект «Велике будівництво» в Україні в даний час не надає позитивного впливу на обсяг внутрішніх

транспортних робіт. Причини можуть бути як у довгостроковому ефекті від поліпшення інфраструктури, так і в фактах корупції та розкрадання коштів, виділених на проект.

Ключові слова: автомобільний транспорт, дорожня інфраструктура, інфраструктурні витрати, транспортні показники, інфраструктурні інвестиції, кореляція, проект «Велике будівництво».

Лидия Савченко. Взаимосвязь затрат и расходов на транспортную инфраструктуру и транспортных показателей - обзор европейской и украинской ситуации". *Качество транспортной инфраструктуры определяет качество оказания услуг по перевозке грузов и пассажиров. Инфраструктурный сектор является гарантией эффективности, мобильности и бесперебойной экономической деятельности. Однако высокое качество транспортной инфраструктуры предполагает значительные и долгосрочные инвестиции. Согласно исследовательскому отчету McKinsey, для поддержки устойчивого экономического роста в мире в соответствии с прогнозами на 2030 год необходимо покрывать потребность в дополнительных инвестициях в размере $3,3 трлн ежегодно, что эквивалентно 3,8% мирового ВВП.*

Целью данной работы является анализ существующего европейского подхода к оценке расходов и затрат на транспортную инфраструктуру, их влияния на транспортную эффективность на уровне страны, а также тенденции украинской политики в отношении поддержки и развития дорожной инфраструктуры.

Затраты на транспортную инфраструктуру включают в себя инвестиции в новую инфраструктуру, затраты на модернизацию существующей инфраструктуры, затраты на содержание инфраструктуры и эксплуатационные расходы, необходимые для использования транспортной инфраструктуры. Директива 2011/76/ЕС предписывает увязывать средневзвешенные платежи за инфраструктуру со стоимостью строительства, а также с расходами на эксплуатацию, техническое обслуживание и развитие соответствующей инфраструктурной сети.

Для этого исследования были взяты официальные данные Евростата об инвестициях и затратах на эксплуатацию и техническое обслуживание транспортной инфраструктуры, а именно:

- количество тонно-километров, пройденных за год;

- объем инвестиций в дорожную инфраструктуру в год;

- объем средств на содержание дорожной инфраструктуры в год.

Показатели взяты для стран ЕС, по которым имелась статистика за 2016 и 2019 годы. Согласно исследованию, эффект от инвестиций в транспортную инфраструктуру сильно проявляется как в том же году, так и влияет на последующие годы по объему годовой транспортной работы. То есть увеличение инвестиций в дорожную инфраструктуру однозначно положительно сказывается на объеме выполняемой транспортной работы. С другой стороны, объем инвестиций в инфраструктуру ЕС приносит гораздо больший положительный эффект, чем средства на содержание дорог.

Таким образом, опыт развитых стран показывает положительную связь между инвестициями в содержание и строительство транспортной инфраструктуры и экономическими показателями государства. Часть исследования была посвящена изучению влияния инвестиций в дорожную инфраструктуру Украины на примере глобального украинского инфраструктурного проекта «Большая стройка». Прогнозируется, что в 2024 году благодаря дорожным работам в рамках Большой стройки ВВП Украины будет на 4,4% выше ВВП 2020 года. Но, как показывают исследования, хорошая транспортная инфраструктура является необходимым, но не достаточным условием роста. Проект «Большая стройка» в Украине в настоящее время не оказывает положительного влияния на объем выполняемых внутренних транспортных работ.

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Причины могут крыться как в более долгосрочном эффекте от улучшения инфраструктуры, так и в фактах коррупции и хищения средств, выделенных на проект.

Ключевые слова: автомобильный транспорт, дорожная инфраструктура, инфраструктурные расходы и затраты, транспортные показатели, инфраструктурные инвестиции, корреляция, проект «Большая стройка».

Introduction. Transport infrastructure is a necessary element of logistics all over the world. In general, the quality of infrastructure determines the quality of the provision of services for the transportation of goods and passengers, and in particular - the speed of transportation, comfort while driving, the safety of cargo and vehicles, etc. However, the high quality of the transport infrastructure implies significant and long-term investments. For developing countries, such financial investments in transport infrastructure are often unattainable. Countries with developed economies can afford to maintain a high level of highways, railways, etc., in particular, due to public-private partnerships and the introduction of the toll roads practice.

Road transport is a key contributor to economic development and integration. Its flexibility and capabilities make it indispensable to development strategies and integration processes. For example, in the European Union road transport is a main enabler of integration both through well connected infrastructure and by extensive integration of services [1].

The purpose of this work is to analyze the existing European approach to assessing transport infrastructure expenditures and costs, their impact on transport performance at the country level, as well as trends in Ukrainian policy regarding the support and development of road infrastructure.

Literature analysis. At the moment, there are many studies concerning the relationship between the level of road infrastructure and the country's economy.

Numerous authors of the work [2] present methods and models for assessing the impact of transport projects on economic development.

Research [3] provides a modern overview of transport infrastructure costs and expenses. This report is produced with in the project 'Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities'.

Here are some definitions of the term "infrastructure". Dmytriieva O.I. formed a vision of transport infrastructure as a complex of objects, within which transport, terminal, warehousing, commercial and virtual-information service of consumers of transport services is provided, and also scientific-production support and management of transport process is carried out [4].

In [3] transport infrastructure is understood as "a physical and organizational network that allows to move between different places".

CE Delft [5] presents cost data for 2013 for the entire road network for all EU 28 countries. In addition, in work [6] the costs of highway infrastructure for trucks and vans are estimated.

Studies like [7, 8], devoted to marginal road infrastructure costs.

According to the work [9], the transport infrastructure provides transportation of goods and passengers, including communications of various modes of transport - railways, highways, inland waterways, sea and air routes, pipelines for pumping oil and gas, transport and logistics enterprises working in the field of movement of people and goods.

In Guiding Principles for Practitioners and Policy Makers [1], in particular, the role of road transport in economic development is stated. In particular, it is argued that adequate infrastructure provides physical links between regions and countries, with road transport services playing a key role in unlocking economic potential.

Presentation of the main results. Road transport has an important social dimension through the opportunities it offers for entrepreneurship and job creation. The sector has traditionally played a key role in upward mobility as it allowed, for example, professional drivers to become entrepreneurs and create their own business, developing it as a small or medium size company. In general, road transport can create a significant number of jobs. A recent study in East Africa found that there were 1.2 jobs for each truck on the road. In addition to the direct employment, the sector generates a significant number of indirect jobs and employment. The indirect employment includes various transport related activities such as infrastructure building and maintenance in particular in areas dedicated to road transport services (fuel stations, secured parking, cold chain storage, warehouses and repair/maintenance activities), rescue and emergency services, forwarding and brokerage, vehicle manufacturers and specialized insurance businesses. ILO data suggest that employment in road transport can reach five percent of total employment [1].

The infrastructure sector is not only the cost of services provided to counterparties of all groups, but also a guarantee of efficiency, mobility and uninterrupted economic activity, the stability of relations with counterparties all over the world [10].

Thus, according to Eurostat, the transport sector brings about 5% to the EU economy, another 2% is added by transport engineering. Problems arising in the course of transportation, in turn, are estimated at 1% of GDP, car accidents with human casualties cause damage to the economies of developed countries in the amount of at least 2% of the gross product [10].

According to a McKinsey research report, to support sustainable economic growth in the world in line with forecasts for 2030, it is necessary to cover the need for additional investment of $ 3.3 trillion annually, equivalent to 3.8% of world GDP [11].

McKinsey also argues that $ 1 of additional infrastructure investment can increase GDP in the long term by 20 cents only through the indirect effect of increasing labor productivity, excluding effect from the construction itself.

Columbia University in the United States, in research of 95 countries [12], claims that doubling road density on average results in an increase in economic growth of 1% annually. An increase in the "aggregate infrastructure provision" of the economy by 10% leads to an increase in output in the economy by 1%. According to their own estimates, the coefficient of elasticity of output in the economy as a whole to the level of development of transport infrastructure is 7%.

World Bank claims [13], that an increase in assets in the infrastructure sectors of the economy by 2 times leads to an increase in GDP by an average of 15 pp, but this applies only to "developed" countries. And the elasticity of output to the level of infrastructure development ranges from 7% to 10%, which is surprisingly correlated with the data of Columbia University.

Fig. 1 gives an overview of the existing policy instruments in the transport sector and the related outputs and potential outcomes of using one or several of the instruments..

The European Union has conducted a global study of transport infrastructure costs in EU countries [15].

In particular, this study aims to provide overall, average and marginal infrastructure costs for road transport, rail transport, inland waterway transport (IWT), maritime transport and aviation in the EU28 member states and some other western countries (Norway, Switzerland, US states of California and Missouri, Canadian provinces of Alberta and British Columbia, and Japan) [15]. The study identifies the so-called marginal costs of various modes of transport in euros per kilometer traveled, ton-kilometer, passenger-kilometer, etc. Appropriate marginal costs can be found according to the rolling stock used. For example, for motor transport there is a

classification into passenger and freight transport, each of which further has its own categories: passenger - passenger car, bus, coach, motorcycle; freight - HGV (heavy freight transport - more than 3.5 tons) and LCV (light commercial freight transport - up to 3.5 tons).

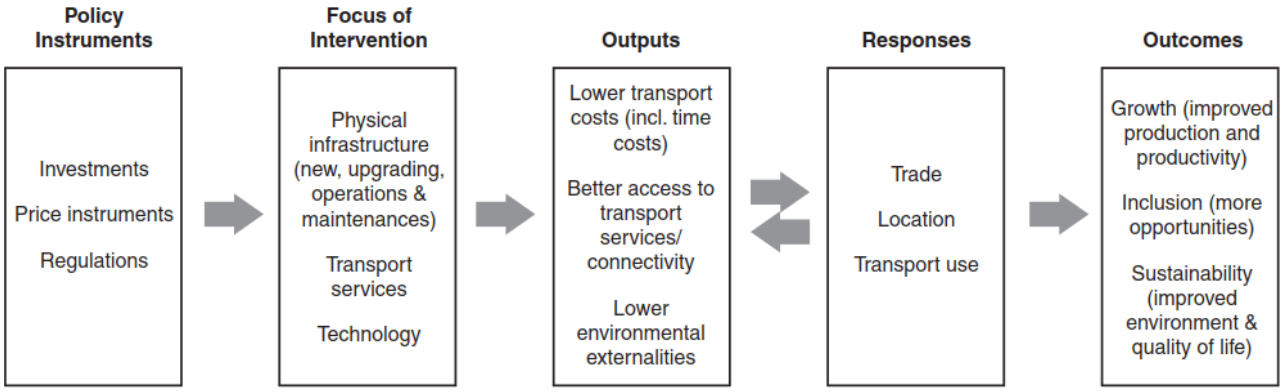

Figure 1 - Impacts of Transport Policies: The Mechanisms
Source: based on [14]

Transport infrastructure costs include the investment in new infrastructure, the cost of upgrading the existing infrastructure, the cost of maintaining the infrastructure, and the operating costs to enable the use of the transport infrastructure.

For road, rail and inland waterway transport, total infrastructure costs in the 28 EU countries were EUR 267 billion in 2016 (Fig. 2)..

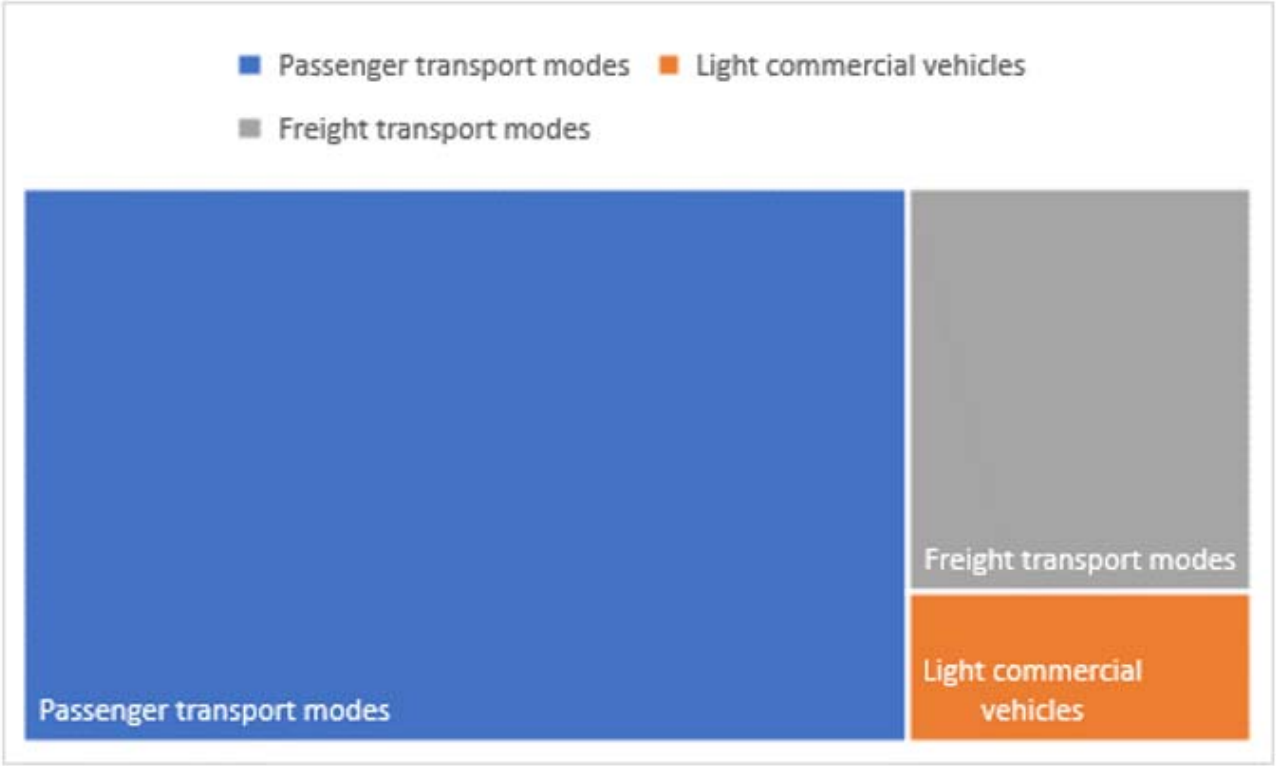

Figure 2 - Total infrastructure costs in EU, Billion € (2016)
Source: based on [15].

Marginal infrastructure costs refer to the additional costs to the transport infrastructure manager caused by an additional vehicle kilometer (or call or LTO) on the network. In this study, the variable part of the average infrastructure costs (usage-dependent renewal and maintenance costs) are used as a substitute for the marginal infrastructure costs.

In [15] it is noted that the construction, maintenance and management of transport infrastructure entails significant costs. In contrast to the benefits, the external and infrastructure costs of transport without political intervention are usually not borne by transport users and are therefore not taken into account in their transport decisions. By internalizing external and infrastructure costs (i.e. incorporating these costs into decision making), the efficiency of the transport system can be improved.

In practice, there are also large differences in approaches to the internalization of infrastructure (and external) costs. For example, Directive 2011/76 / EU [16] prescribes that road infrastructure charges for heavy vehicles in Europe should be based on a cost recovery principle, i.e. the weighted average infrastructure charges should be linked to construction costs, as well as the costs of operation, maintenance and development of the corresponding infrastructure network. On the other hand, Directive 2012/34 / EU [17] requires that EU rail use charges be based on direct network-wide costs, that is, costs that are directly related to use of rail infrastructure.

Productivity data for road transport are taken from Eurostat according to the principle of nationality, that is, transport activities are distributed according to the countries in which the vehicle is registered. In an alternative territorial approach, transport activities are allocated to the countries in which these activities are actually carried out. For example, kilometers driven by Polish cars in Germany are counted in Poland if the principle of nationality applies, and in Germany if the territorial principle applies. The territorial principle would be more consistent with the size of infrastructure costs. However, since a detailed EU-wide dataset on road transport efficiency based on the territorial principle is not available, the official Eurostat data set based on the citizenship principle was used for this study.

This study [15] presents both investment and O&M costs of transport infrastructure [18]. More specific:

- improvement costs are all costs of new infrastructure or expansion of existing infrastructure in terms of functionality and / or lifetime;

- upgrade costs are all costs associated with upgrading (parts of) the infrastructure. The updated infrastructure (parts) will have a service life of at least 1–2 years. Upgrade and upgrade costs can be incurred at any time and are not directly related to the condition of the assets.

Operating and maintenance costs include two elements:

- maintenance costs are costs associated with "normal" maintenance, ie maintenance that cannot be avoided. These actions do not change the performance of the infrastructure object, but simply keep it in good working order or restore it to its previous state in the event of a breakdown. These are all relatively minor repairs with an economic life of less than 1-2 years;

- operating expenses are those that are spent on the efficient use of infrastructure (e.g. lighting, traffic control).

The main direct users of road infrastructure, affecting related costs, are cars and motorcycles, buses and trucks. According to the authors, although pedestrians and bicycles are also road users, their impact on the cost of road infrastructure is negligible, which predetermined the exclusion of these categories of users from comparative estimates.

To analyze the real impact of investments in infrastructure (investment and support) on the state of the transport sector, statistics were taken for the EU countries, namely:

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- the number of ton-kilometers traveled per year;
- the volume of investments in road infrastructure per year;
- the amount of funds for the maintenance of road infrastructure per year.

The factor of the number of ton-kilometers traveled (transport work) was taken as one of the main indicators of transport performance, showing the volume of traffic and the level of development of logistics in the country. In addition, the number of ton-kilometers performed is one of the general economic indicators of the country's development, which, in turn, affects trade relations both within the country and abroad.

Considering that the effect of investments in infrastructure may not appear immediately, data on the above three indicators were taken for 2 years - 2016 and 2019 (Fig. 3, Fig. 4) [19].

a) b) c)

Figure 3 - Data on transport infrastructure (2016): a) Freight road transport, Million ton-kilometers; b) Road Infrastructure investment, Euro; c) Road Infrastructure maintenance, Euro

a) b) c)

Fig. 4. Data on transport infrastructure (2019): a) Freight road transport, Million ton-kilometers; b) Road Infrastructure investment, Euro; c) Road Infrastructure maintenance, Euro

It is known that the relationship between two parameters can be successfully estimated using the correlation coefficient:

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

where:

r_{xy} – the correlation coefficient of the linear relationship between the variables x and y;
x_i – the values of the x-variable in a sample;
$\bar{x}$ – the mean of the values of the x-variable;
y_i – the values of the y-variable in a sample;
$\bar{y}$ – the mean of the values of the y-variable.

To assess the closeness of the relationship between investments in road infrastructure and the performed ton-kilometers, the logic set out in Table 1 was adopted.

Table 1 - Assessment of the degree of relationship by the value of the correlation coefficient

Scale of correlation coefficient	Conclusion
$0< r \leq 0.19$	Very Low Correlation (no correlation)
$0.2 \leq r \leq 0.39$	Low Correlation
$0.4 \leq r \leq 0.59$	Moderate Correlation
$0.6 \leq r \leq 0.79$	High Correlation
$0.8 \leq r \leq 1.0$	Very High (almost linear) correlation

It should be noted that the indicators were taken only for those countries for which statistics were available for 2016 and 2019. Unfortunately, for some countries it was not possible to obtain values for 2019, so the level of correlation was estimated without them.

The relationship between investments in road infrastructure and the volume of transport work performed in tkm was analyzed (Table 2).

Table 2 - Volume of transport work and infrastructure investment (2016, 2019)

Country of the EU	Transport work, million ton-kilometers		Infrastructure investment, Euro	
	2016	2019	2016	2019
Austria	26138	26502	444000000	562000000
Bulgaria	35402	20613	163104612	528172615
Croatia	11337	12477	197358816	354803052
Czech Republic	50315	39059	849231714	1383064925
Estonia	6717	4795	148600000	220000000
Finland	26853	28847	1178000000	1522000000
France	151213	181400	9216000000	9816000000
Germany	315769	311869	12870000000	16650000000
Greece	24560	28197	2187037728	710327243
Hungary	40006	36951	802745136	2288587059
Ireland	11564	12403	622000000	837000000
Latvia	14227	14965	190000000	223000000
Lithuania	30974	53117	357000000	352000000
Poland	303560	395311	3075442295	2415357766
Slovenia	2135	2306	100000000	204000000
Spain	216993	249555	3880000000	3445000000
Sweden	42686	42601	2086339294	2503424108

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The obtained correlation coefficients between the performed ton-kilometers and the volume of investments in infrastructure are set out in Table. 3.

Table 3 - Coefficients of correlation between the performed transport work and the volume of investments in road infrastructure

(Year of investment) - (Year of transport work)	Correlation coefficient	Conclusion
2016-2016	0,78	High Correlation (but next to Very High Correlation)
2019-2019	0,65	High Correlation (but next to Moderate Correlation)
2016-2019	0,73	High Correlation

It can be concluded that the effect of investments in transport infrastructure is strongly manifested both in the same year and affects subsequent years in terms of the volume of annual transport work. That is, an increase in investment in road infrastructure clearly has a positive effect on the volume of transport work performed.

We analyzed the relationship between the costs of maintaining the road infrastructure and the volume of transport work performed in the tkm. Unfortunately, data on investments in road infrastructure maintenance for both years is contained in statistics for few of EU countries. Correlation analysis was carried out only for these countries (Table 4).

Table 4 - The volume of transport work and investment in Infrastructure Maintenance (2016, 2019)

Country	Infrastructure Maintenance, Euro		Transport work, Million ton-kilometers	
	2016	2019	2016	2019
France	2430850000	2324750000	151213	181400
Hungary	292602581	375727022	40006	36951
Ireland	83000000	75000000	11564	12403
Latvia	175000000	179000000	14227	14965
Lithuania	152000000	147000000	30974	53117
Poland	418690989	480977312	303560	395311
Slovenia	138000000	206000000	2135	2306
Sweden	1129994824	999839421	42686	42601

The obtained correlation coefficients between the executed ton-kilometers and the volume of investments for the maintenance of road infrastructure are presented in Table. 5..

Table 5 – Coefficients of correlation between the performed transport work and the volume of investments in infrastructure

(Year of investment) - (Year of transport work)	**Correlation coefficient**	**Conclusion**
2016-2016	0,35	Low Correlation
2019-2019	0,30	Low Correlation
2016-2019	0,33	Low Correlation

It can be concluded that the effect of investments in maintaining the transport infrastructure has little effect on the volume of transport work. That is, an increase in investments in the maintenance of road infrastructure does not have a pronounced positive effect on the volume of transport work performed.

As for Ukrainian research, according to [20], in 2016, transport, warehousing, postal and courier activities accounted for about 6.6 % of gross domestic product and 6.1 % of the total employed population. The most dependent on the transport industry are agriculture, metallurgical production, coal industry, mining, chemical and food industry, construction, retail trade, communications and postal services, defense.

At the time of approval of the National Transport Strategy of Ukraine for the period up to 2030 [20] the transport industry as a whole met only the basic needs of the population and the economy in transportation by volume, but not by quality. It was noted that the state of the transport sector does not fully meet the requirements of the effective implementation of Ukraine's European integration course and the integration of the national transport network into the Trans-European Transport Network.

Currently, the President of Ukraine has introduced an unprecedented program for the construction of road infrastructure - "Big Construction".

The Big Construction project is a large-scale development of high-quality infrastructure in Ukraine. Two years of implementation of the Big Construction program have significantly changed the road market in Ukraine. The construction and repair of the longest state roads and man-made structures in the history of Independence has been a powerful impetus for the growth of existing and the emergence of new companies. During the pandemic, public investment in a high-multiplier infrastructure sector mitigated the fall in GDP in 2020. According to experts of the Kyiv School of Economics, long-term effects as a result of the project "Big Construction" will increase GDP in the next 5 years by 2.2% [21].

One of the tasks of the project in 2021 is the construction or reconstruction of 6.6 thousand km of roads, based on the principles of energy efficiency and high quality, inclusiveness and focus on every Ukrainian as a customer [22].

Results of the transport infrastructure project for 2020:

- 258 bridges and overpasses on local and state roads were built, reconstructed and overhauled;

- 4056 km of state roads were built and repaired;

- 2527 km of local roads were built and repaired;

These values are twice the volume of the most productive 2018 (Fig. 5).

The plan for 2021 is 6500 km of roads: 4500 km of state roads and 2000 km of local ones.

Funds from the state budget, the State Fund for Regional Development and local budgets will be used to implement the project.

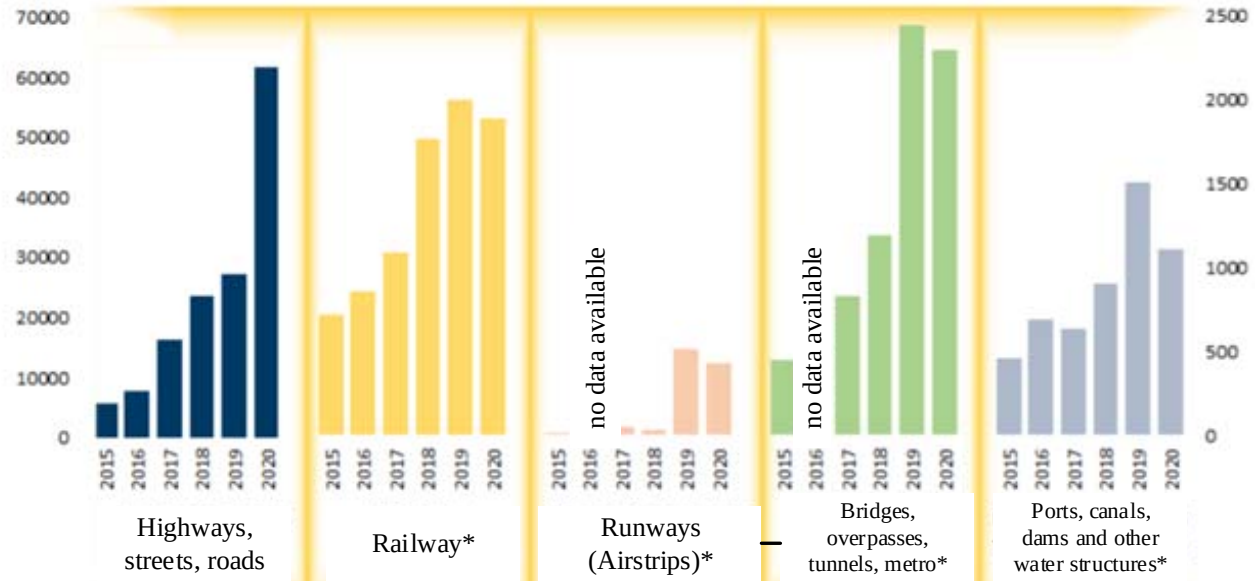

Figure 5 – Construction of infrastructure structures during 2015-2020, UAH billion [23]

Regarding the end time of the project, President Volodymyr Zelensky stated that the Big Construction program will end when "bad roads end" [24]. Moreover, the goal of Big Construction should be not only the maximum mileage of the renovated roads, but also the maximum durability of the repaired routes.

It is planned that in 2022 Ukravtodor will receive UAH 79 billion directly from the state budget for the repair and construction of new state roads, and another UAH 45 billion will be lent by banks and international financial organizations under state guarantees, so UAH 124 billion should be accumulated together. For comparison: in 2021 in the state budget for Big Construction was laid about 110 billion UAH, i.e. 10% less [25].

It is projected that in 2024, thanks to road works under the Big Construction, Ukraine's GDP will be 4.4% higher than GDP in 2020 [26].

Consider the global experience of investing in the country's road infrastructure and the relationship of such investments and national economic indicators.

It is known that foreign countries pay considerable attention to investment in roads and show significant socio-economic effects from new and improving the quality of existing roads.

The most similar to the Big Construction is the project of road development in Poland in 2007-2012 (the period of active reconstruction of infrastructure under the EU program "Infrastructure and Environment"). The direct immediate economic effect of road construction in 2007–2013 was reflected in the annual average contribution to GDP growth of 0.3%. We can draw parallels with the Latvian construction in Saulkrasti. The improvement in traffic safety was estimated at 23% of the total socio-economic effect of the project - 89 million euros per year. Additional effects were noise reduction and air pollution in the city. In Turkey, in 2003-2019, highway development projects were implemented. The three involved highway projects were to give a total GDP growth of 1.6%.

Belarus has an interesting experience, in particular, regarding the M5 motorway and the fare system. In 2006-2015, the state program Roads of Belarus continued in Belarus. Belarus has a positive experience in tolling and sees it as an important source of funding for infrastructure construction. This allows to partially solve the problem of

overweight trucks, because it depends on the weight of the fare [26].

Thus, the experience of developed countries shows a positive relationship between investments in the maintenance and construction of transport infrastructure and economic indicators of the state.

At the same time, there is reason to believe that investing significant funds in infrastructure projects for a certain type of transport may result in a decrease in work performed on other types. In particular, in the realities of Ukraine, there is a bias of financial injections towards road and air transport (Fig. 6).

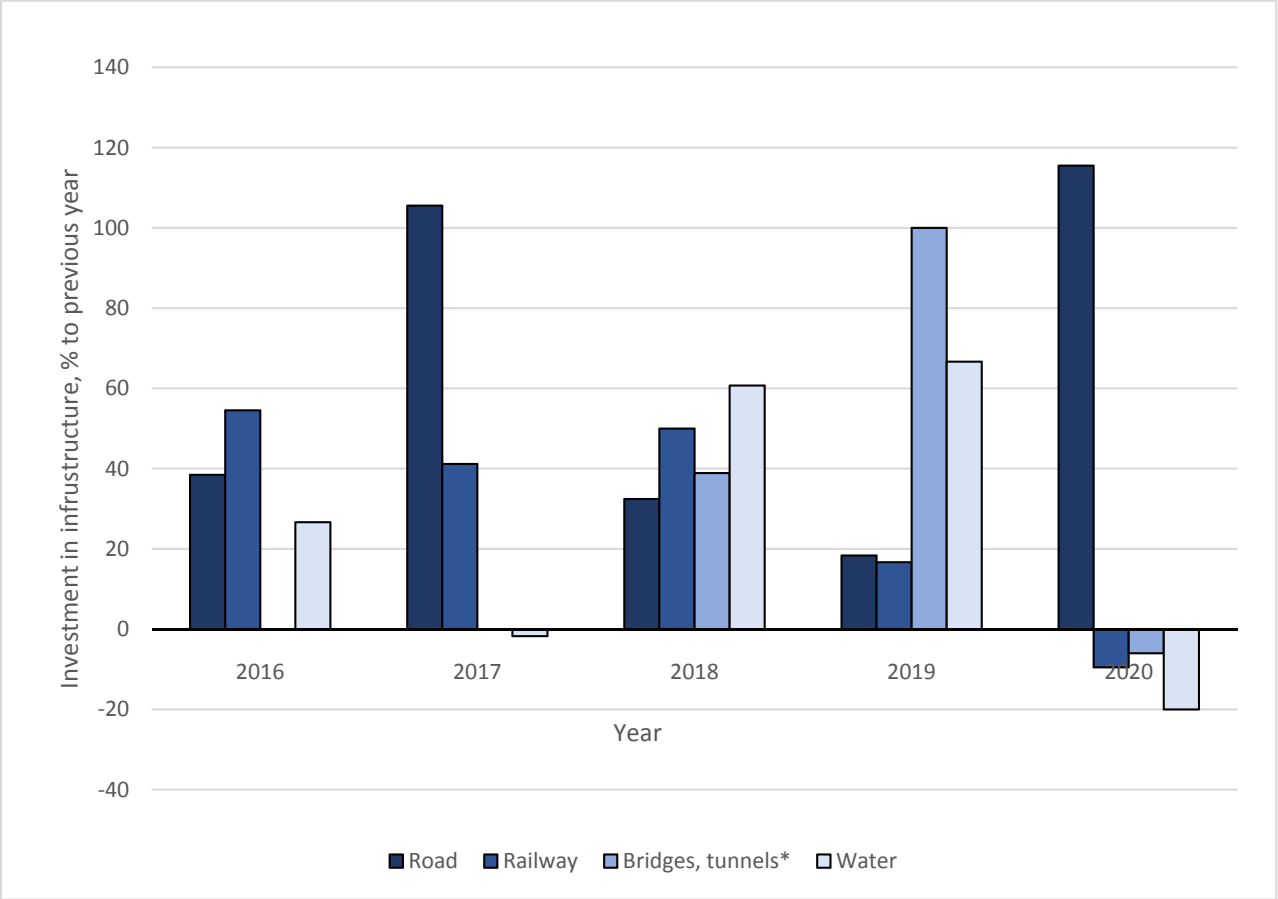

Figure 6 – Growth in investment in transport infrastructure in relation to the previous year for various modes of transport (* - no available data for 2016-2017)

Such a distribution of infrastructure funds should lead to an outflow of goods and passengers from, for example, rail transport. This consideration is confirmed by the metric ton-kilometers performed (Fig. 7).

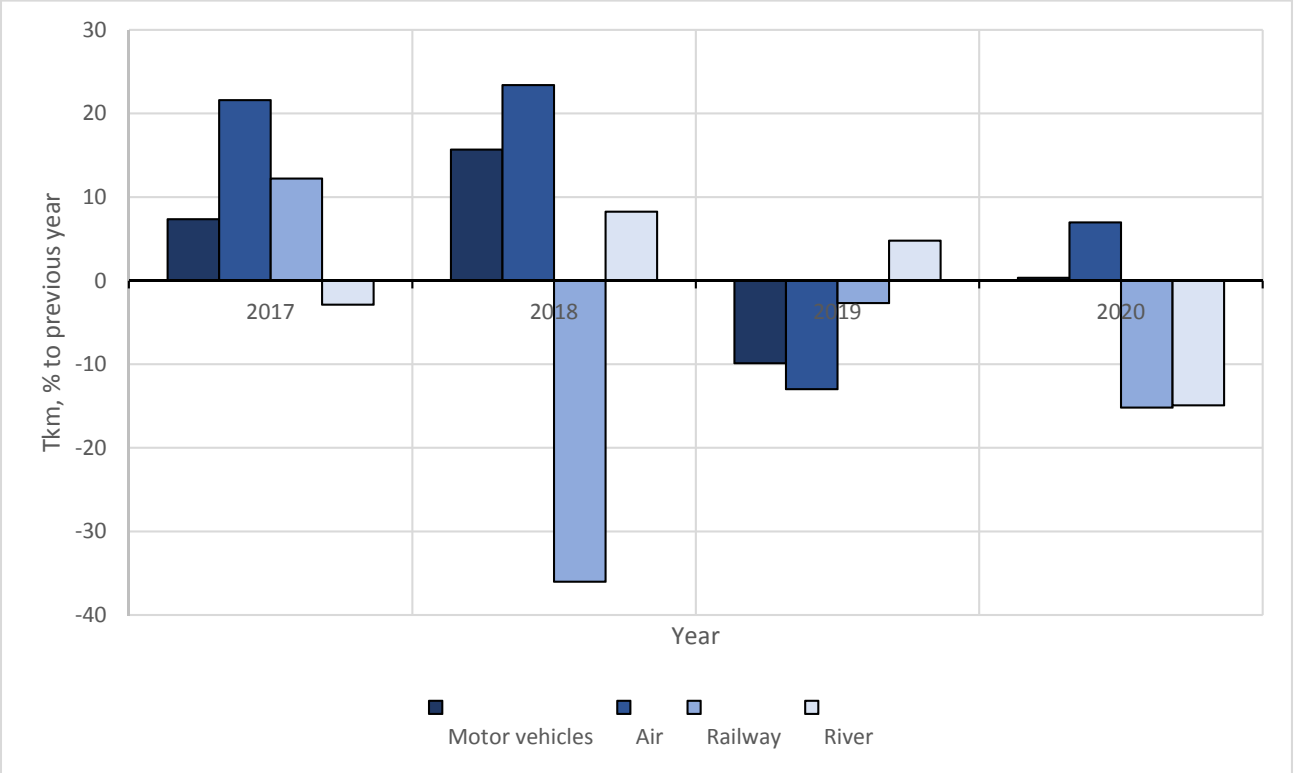

Figure 7 – Growth in ton-kilometers performed in relation to the previous year for various modes of transport (based on [23])

Fig. 8 shows performed estimation of the general state of the transport sector (in terms of ton-kilometers and investments) in% of the previous year.

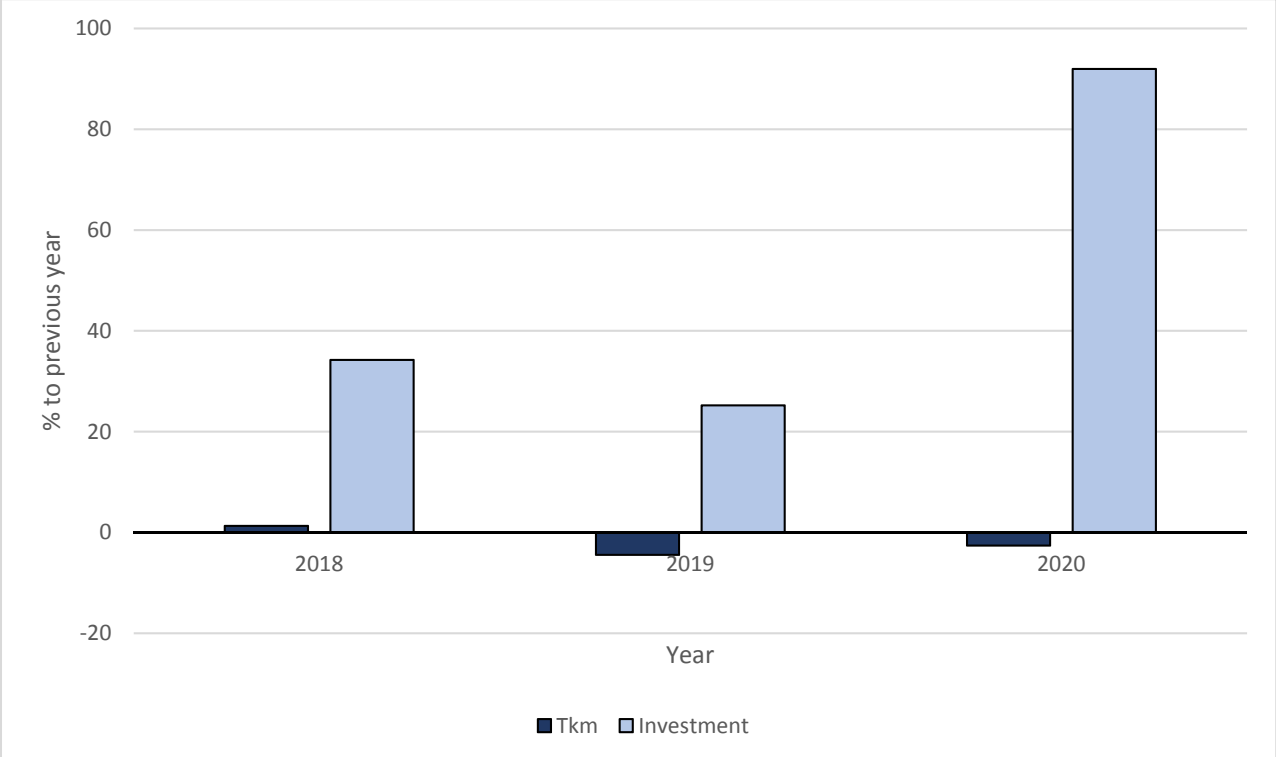

Figure 8 – Ton-kilometers and investments for all types of transport (in% of the previous year)

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It can be clearly seen that for Ukraine at the moment there is no positive dynamics of the influence of investments in transport infrastructure on the amount of transport work performed. The correlation coefficient of these two indicators is (-0.88), which is equivalent to a strong inverse correlation. That is, an increase in investments in transport infrastructure has the opposite effect on the indicator of transport work, reducing the number of ton-kilometers performed. The reasons for this state of affairs may be different (including their combination):

1. Perhaps, the positive effect of investments in transport infrastructure for Ukraine will not appear immediately, and an increase in the performed transport work will occur in a few years.

2. It is possible that the volume of investments in transport infrastructure does not directly affect the volume of transport work performed and a positive effect only in national indicators (for example, GDP) should be expected.

3. It is possible that investments in transport infrastructure will be noticeable only in the context of transit flows, which will increase the attractiveness of Ukraine for international transportation.

4. Perhaps, that there is no positive effect from significant investments due to the facts of corruption and theft of investment funds.

C**onclusions.** Thus, according to the study, a general conclusion can be drawn about the impact of investments in the EU transport infrastructure on the volume of transport work performed:

- an increase in investments in road infrastructure brings a positive effect on the transport industry of the European Union, namely, on the amount of transport work performed (in tkm);

- the volume of investments in the EU infrastructure brings a much greater positive effect than funds for road maintenance;

- based on the available statistics, it is not possible to determine whether there is a difference in the short- or long-term impact of investments in EU road infrastructure on the volume of transport work. This relationship requires further study.

In addition, good transport infrastructure is a necessary, but not a sufficient condition for growth. For example, the experience of recent years in Ukraine does not show any positive effect from a large-scale infrastructure project Big Construction on the volume of internal transport work performed. The huge funds allocated for the project have not yet increased the volume of ton-kilometers. The reasons may lie both in the impossibility of obtaining a quick effect from improving the infrastructure, and in the facts of corruption and theft of funds allocated for the project. The higher level of infrastructure services could be used to increase the volume of transit flows, combining investments with the launch of toll road experience for the most attractive directions in terms of transit flows.

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