

# International Transport Corridors Functioning Efficiency in the Digital Economy Conditions

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The problem of international transport corridors efficiency estimation in the digital economy conditions is considered. The set of efficiency key indicators, which allows to compare efficiency of corridors use in different countries, is substantiated. A comparative analysis of the international transport corridors usage efficiency in Ukraine and Poland was conducted.

**Keywords:** international transport corridor, efficiency, digital transport corridors.

## 1. INTRODUCTION

The topicality of the research on the international transport corridors (ITC) functioning efficient problems is due to the dynamic changes in the economies of different countries, such as, China, Turkey, Iran, India, which are currently generating a significant supply of goods to the European market. In the European Union itself, the balance between the various modes of transport, which requires the flashing of "bottlenecks" in transport infrastructure, is changing, and it traces the transport policy clear orientation to the customer service and reducing harmful emissions to the atmosphere. On the other hand, the digital technology era shifts the emphasis on the international transport corridors development from purely technical issues to deepening intergovernmental integration and the trade economic partnership development, which promotes the development of global supply chains of goods and services. The use of modern information and communication technologies makes supply chains more transparent, increases the speed of commodity movement in real time and creates new opportunities for increasing the efficiency of using existing transport infrastructure [1].

The changes taking place in the global economy determine the relevance of research on the

redistribution of global freight flows and the development of international transport corridors. On the one hand, the expansion of the trans-European network of TEN-T to the European Union neighbouring countries is growing [2]. On the other hand, new transport corridors are being created in the EU countries, which will contribute to the development of the logistics industry in Europe [3]. Future transport corridors are tailored to alternative fuels and multimodal transport, and should contribute to improving the quality of logistics services for global supply chains.

The consolidation of domestic and foreign researchers' scientific works, in particular [4-7], made it possible to clarify the modern interpretation of the term «ITC». We consider that it is incorrect to define a transport corridor just as a path, a road, a highway or part of the territory, since the roads on which it is laid are used not only for its needs. It should be noted that from the point of international law view, the ITC is an international agreement ratified by all participating countries. We propose to define ITC through the logistics prism. That is, as a set of multifunctional objects of **transport** (roads, vehicles, terminals, etc.), **logistics** (multimodal logistic centres, customs and border posts, packaging, etc.) and **digital** (information system) infrastructure, as well as **services that provide consolidated goods movement in global chains / networks**. It should

be noted that recently the term «digital transport corridor» is actively used. In our opinion, any ITC should be digital, because it represents a unified information system for collecting, storing and transmitting data in a «single window» format without territorial restrictions, with user access to system services in 24×7×365 mode.

The presented understanding of the ITC essence allows to determine the efficiency and effectiveness of the ITC functioning. In the scientific literature, there are different approaches to determine the effectiveness and its calculation methods. We believe that the efficiency of the ITC functioning should be ensured by common technical requirements, advanced customer service technologies and the creation of unified information space to provide the reliability, safety and competitiveness of the delivery cost, on the base of «door-to-door» and «just-in-time» logistics principles. Taking into account the presented essence of ITC we feel that generalized and integrated indicators of the ITC functioning efficiency are such indicators as the transit potential use rate, the forwarding (logistic) services market development rate, and forwarding towards transportation volumes correlation rate. These indicators significantly affect the Logistics Performance Index, which is defined by the World Bank experts every two years.

## 2. COMPARATIVE ANALIZES. UKRAINE AND POLAND LPIS AND THEIR COMPONENTS IN THE CONTEXT OF THE EFFECTIVE USE OF INTERNATIONAL TRANSPORT CORRIDORS.

The relevance of Ukraine's comparison with Poland is due to the fact that both countries have many common features in transport policy, and are connected with each other with numerous routes which are used by all modes of transport. Efficient trade and transport logistics are key to developing competitiveness among countries all around the world. Location of Ukraine at the intersection of main transport routes from Europe to Asia and from the Scandinavian countries to the Mediterranean region creates unique opportunities for development transit services which could be strengthened due to collaboration with neighbouring Poland.

Ukraine and Poland also have very similar development dynamics in the terms of logistics. Let us look into the details of the main data which

are counted while calculating LPI according to the World Bank methodology (<https://lpi.worldbank.org/>). Six key dimensions are valued while ranking:

- clearance process efficiency (not only speed, but also simplicity and formalities predictability);
- infrastructure and trade quality (the state and quantity of ports, roads, hubs, information technology);
- easiness while planning competitively priced shipments;
- quality level of logistics services and competence of transport operators, customs brokers etc.
- possibility to track and trace cargo;
- timeliness of in reaching destination within the scheduled or expected delivery time.

The Logistics Performance Index is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance.

While analysing LPI rates and its components for Ukraine and Poland since 2014 (Fig. 1), we could come to the conclusion that they have the same dynamics and trends for future development. Each line on the graph has almost the same trajectory, so it means that both countries have resembling conditions for doing business in the logistics sector. As a result, we have close enough opportunities, as well as potential to be an equal partner in international transport corridors and to use them with the same level of effectiveness.

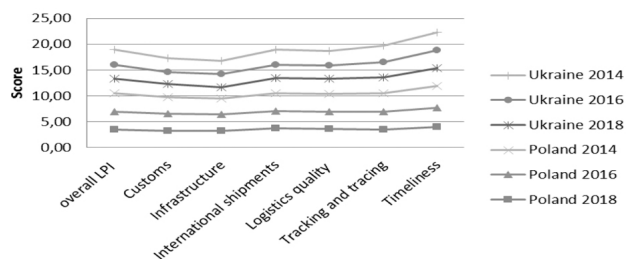


Fig. 1. Ukrainian and Polish score cards for Logistics Performance Index.

Source: Own compilation.

Furthermore, analysing and comparing logistics performance index components for Ukraine with Polish dimensions during the last decade we have found that the country score card radar for Ukraine

in 2014 is practically equal to the country score card radar for Poland in 2007 (Fig. 2).



Fig. 2. Ukraine 2014 vs Poland 2007, LPI components. Source: <https://lpi.worldbank.org/>

The time interval between Ukrainian and Polish dimensions is equal to 7 years, so it is expected for Ukraine to reach Polish results within the same time frame. But it must be mentioned that LPI components values of Ukraine in 2018, for the first time in the last decade, are based inside not only Polish results, but also inside results of the whole region (Europe and Central Asia), that means that Ukrainian pace of development in this sphere started to improve slower than in other countries of the region (Fig. 3).

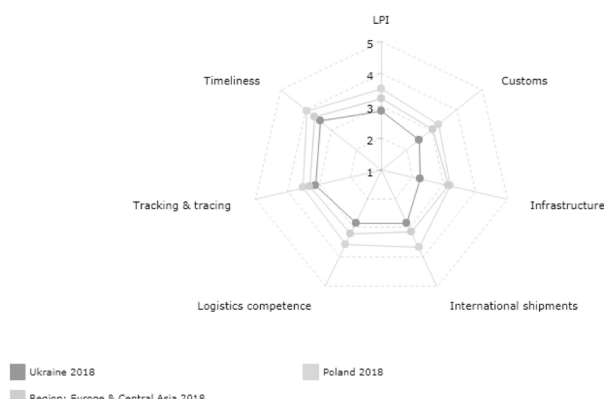


Fig. 3. Country Score Card: Ukraine, Poland and Region: Europe and Central Asia, 2018. Source: <https://lpi.worldbank.org/>

Nevertheless, Ukraine continues to increase trade with the countries of the European Union, that is why the demand for effective and innovative logistics environment is increasing and vital necessity for implementing strategy for improving infrastructure and investment climate in logistics sphere are determined at the governmental level (EU-Ukraine Association Agreement, National Transport Strategy of Ukraine 2030, project

document Sustainable Logistics Strategy 2030 and Action Plan for Ukraine and so on). Hence, Ukraine has potential and strategy to improve its logistics potential and there are some markers which could prove it. According to statistical information from the statistical office of the European Union [11] Ukraine is importing to 28 countries of European Union (blue line on fig. 4, because what is export from the EU is import to Ukraine) more than exporting from them, but nevertheless the trend is going up. That is why it is so important to use common transport network.

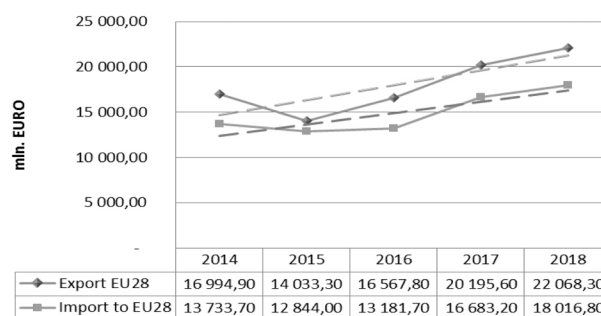


Fig. 4. Trade volumes between Ukraine and EU28. Source: Own compilation.

We are analysing trade flows of the European Union, which means that export volumes for the EU are the import volumes for Ukraine (to the EU). Mutual analysis of export and import volumes illustrates that Ukraine’s foreign trade balance has shown the widening gap between export and import with the negative impact on the economy, as it leads to the decreasing GDP of the country. Also it correlates with general trend in foreign trade balance of Ukraine with all the countries, which is growing and reaches the level of minus 8.6% of GDP in 2018 according to the National Bank of Ukraine data (comparing minus 6.3% in 2017 and minus 6.2% in 2016). This can be explained by a military conflict on its territory which led to the loss of transit volumes and caused the need for reorientation of the geographical structure of goods movement. Thus, nowadays Poland as a part of the EU is one of the biggest partners for Ukraine in foreign trade. According to official statistical data in Ukraine [12] Poland was the second trade partner for Ukraine by scale in means of export, and the fifth in means of import in 2018. As it could be seen from Fig. 5 trade volumes between Ukraine and Poland are increasing every next year after 2015.

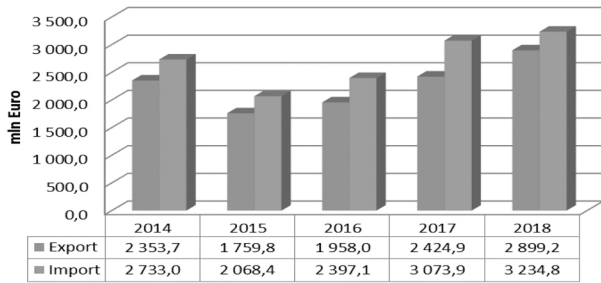


Fig. 5. Dynamics of trade volumes between Ukraine and Poland.

Source: Own compilation.

The analysed data have shown that Ukraine and Poland are increasing mutual trade turnover what determines the urgency, necessity and expediency of joint efforts to maximize both countries' transit potential by maximizing the effectiveness usage of international transport corridors capacities.

Now the share of Ukrainian exports to the European Union is approaching 50%. The growth rate of exports of Ukrainian goods to the EU in 2018 amounted to 15%, Ukrainian business exports to the European Union countries goods was worth \$20.15 billion, and the EU market share was 42.6%, while in 2017 the share of exports to the EU was 40.5%.

In 2017, the volume of bilateral trade in goods between Ukraine and Poland amounted to \$6.2 billion and increased by 26.2% compared with 2016.

According to the latest State Fiscal Service of Ukraine statistical data, Poland has become the largest importer of Ukrainian goods. In the first quarter of 2019 Ukrainian companies exported to the world countries goods worth \$12.3 billion, which is 7% more than in the same period in 2018. Also, as compared to last year, the share of exports of goods to the countries of the European Union increased by 5% - in January-March 2019, goods worth \$ 5.7 billion were exported.

Poland has become the leader among the countries importing Ukrainian goods. During this period, Ukraine exported to Poland goods worth \$818 million, to the Russian Federation - \$759 million. In third place Egypt - \$652 million, on the fourth China - \$640 million. Closes five importing countries of Turkey - \$638 million.

The largest Ukrainian companies exported:

- products of the metallurgical complex (\$2.8 billion);
- products of vegetable origin (\$2.4 billion);
- machinery, equipment, mechanisms, electrical equipment, electric machines (\$1.1 billion).

Exports of goods to CIS countries this year, compared with the first quarter of 2018, decreased by 6% (Fig. 6).



Fig. 6. Main importers of Ukrainian goods in the beginning 2019.

Source: <http://ukranew.com/>

The National Transport Strategy of Ukraine "Drive Ukraine 2030: A Step to a Great Infrastructure Revolution" identifies the priority development of international transport corridors, the development of the network of highways and the improvement of the quality of logistics infrastructure [8]. Implementation of this strategy involves the implementation of a variety of investment infrastructure projects, including cross-border.

That is why Ukraine and Poland have strong mutual background for implementing common projects which would be directed on future development of infrastructure objects and transport systems in general to become active participants and effective users of international transport corridors. GO Highway (GO is abbreviation from Gdansk and Odesa) is a good example of such collaboration. GO Highway will provide a direct link between the Baltic and the Black seas, it lengths is 1,746 km, 1,088 from which is going through Ukraine. This route is projected to reduce transit time between Gdansk/Gdynia and Odesa seaports from 23 hours to 15 hours.

According to the data of Ministry of Infrastructure of Ukraine [14] project GO Highway will impact TEN-T Corridors, national transport strategy, sustainable logistics, freight transport and logistics potential, interconnectivity of all transport modes, promoting environmentally friendly and energy-efficient freight transport, reconstruction of existing roads and eliminating traffic and cargo bottlenecks.

As of today, the goods moving from the ports of the Odessa region to the ports of Poland in the Baltic Sea follow the route Odessa, UA – Kiev, UA (route E95) - Lublin, PL (route E373) - Warsaw, PL (track E372) - Gdansk, PL (route E77) with a total length of about 1,700 km (Fig. 7).



Fig. 7. Route from Odessa to Gdansk through Kyiv, Lublin and Warsaw.  
Source: Own compilation

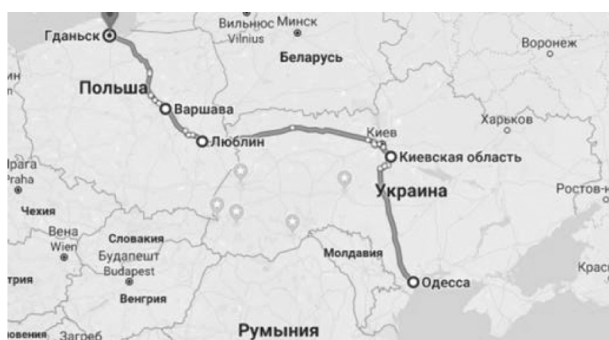


Fig. 8. Route from Odessa to Gdansk through Lviv, Katowice and Lodz  
Source: Own compilation

The alternative route which is developed within the project GO Highway is going to be located south of the previous one (fig. 8) and walk away capitals (Kyiv and Warsaw), which is a very good argument in means of eliminating traffic and avowing cargo bottlenecks.

Within the implementation of Go Highway, new projects have been launched, one of which is the renovated Lviv-Ternopil- Vinnysia-Odesa-

Mykolayiv route, which will become part of the Odessa-Gdansk transport corridor. In August 2017, Ukravtodor announced the parameters of the northern bypass motorway of Lviv, which will be built within the project GO Highway.

In particular, it is planned that the northern bypass of Lviv will connect the international route M-06 Kyiv-Chop and the road H-17 Lviv-Lutsk with international routes M-09 Lviv-Rava-Ruska, M-10 Lviv-Krakovets, M-11 Lviv - Shehyni, which provide a connection between Ukraine and Poland. The road will have four lanes - two in each direction. On the road, construction of three overpasses from reinforced concrete constructions length of 191 m, 551 m and 332 m is foreseen.

The Polish part of the GO Highway route consists of two parts: A4 motorway from the border with Ukraine to Katowice has been fully put into operation; A1 Katowice-Gdansk motorway is being constructed (as of 2018, the Piotrków Trybunalski-Czestochowa-Katowice plot is under construction).

To continue work in the budget of Ukraine for 2019, UAH 4 billion is foreseen (approximately \$142 million).

3. RESULTS AND DISCUSSION

GO Highway transport corridor will have a significant impact on the development of integration links between Ukraine and Poland, as both countries generate significant flows of cargo and participate in the servicing of global supply chains. To predict the possible volumes of road freight transport, we use the methods of regression-correlation analysis and forecast data on the GDP dynamics of both countries by 2030 (Table 1).

The method of calculating the forecasts for freight volumes between Poland and Ukraine ( $Y_{1t}$  on the one hand, and Ukraine and Poland ( $Y_{2t}$ ) on the other hand, provides for the identification of correlations with such indicators (independent export-import flows ( $X_{21t}, X_{22t}, X_{31t}, X_{32t}$ , the

Table 1. Projections of GDP volumes of Ukraine and Poland by 2030.

Indicator/Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GDP current billion US\$, UA	148.3	153.9	160.1	166.6	170.5	174.4	178.2	182	185.9	189.9	194	198.2
GDP current billion US\$, PL	659.1	677.6	695.7	713.6	735.7	758.9	783.3	808.7	835.1	862.2	889.7	917.3

Source: <https://lpi.worldbank.org/>

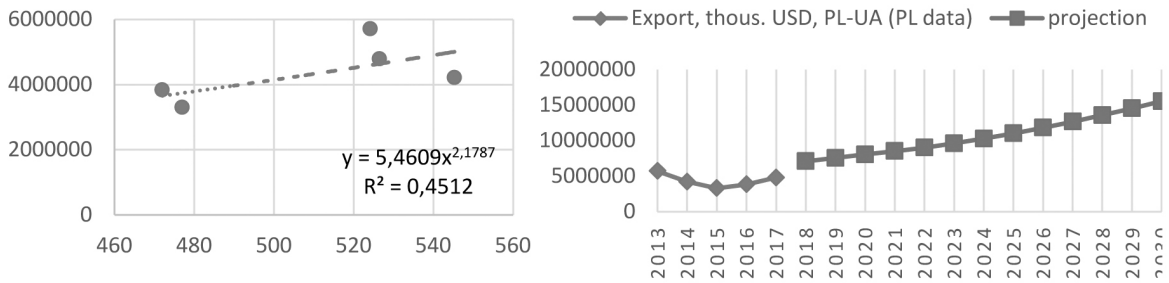


Fig. 9. Forecast of export volumes of goods from Poland to Ukraine.  
Source: Own compilation.

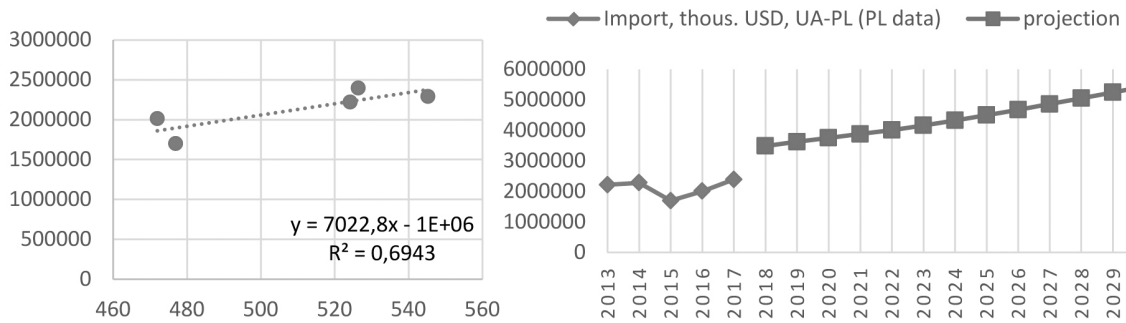


Fig. 10. Forecast of import volumes of goods from Ukraine to Poland.  
Source: Own compilation.

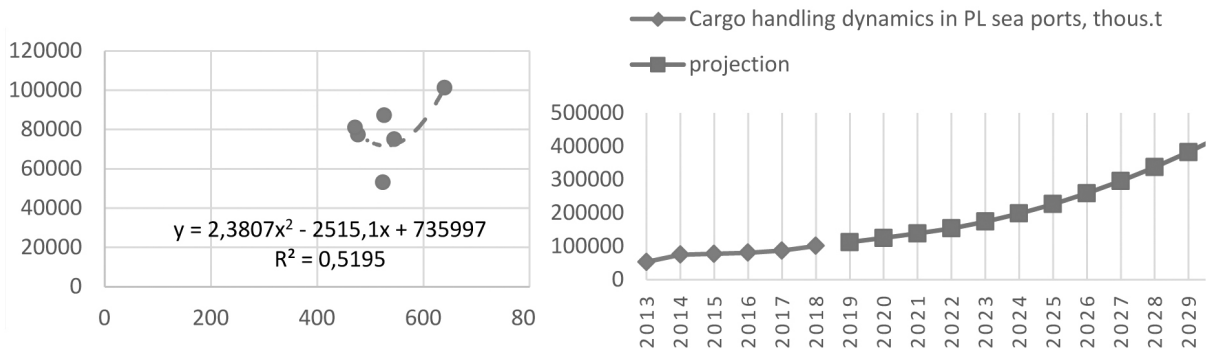


Fig. 11. Forecast volumes of cargo handling at seaports in Poland.  
Source: Own compilation.

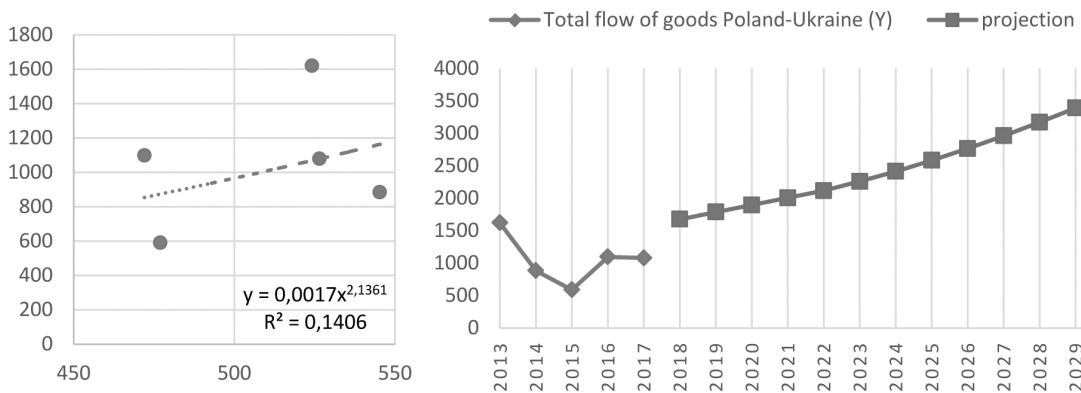


Fig. 12. Forecast volumes of total flow of goods Poland-Ukraine.  
Source: Own compilation.

volume of cargo handling in the Polish and variables) – GDP ( $X_{11t}, X_{21t}$ , the volume of Ukrainian seaports ( $X_{41t}, X_{42t}$ ). The collected statistical data in the form of time series were analysed from the stationary point of view by finding dispersion, autocorrelation and autocovision of the sample. The degree of tightness of interconnections between the resulting indicators and independent factors on the basis of pair correlation is determined. The obtained results of calculations are presented in Fig. 9-12.

According to the provided analysis and calculated figures, the volume of export-import operations between Ukraine and Poland tends to increase. Similarly, the volume of cargo handling in seaports is increasing. At the same time, the volume of import of goods from Ukraine to Poland (the correlation coefficient is 0.833) is most closely connected to the growth of Poland's GDP, which is explained by the structure of goods. The average impact on GDP has the volume of export of goods from Poland to Ukraine (the correlation coefficient is 0.629). Other parameters, that is the volume of cargo handling in the ports of Poland, and the total freight traffic from Poland to Ukraine) have little effect on Poland's GDP, respectively, the correlation coefficients are -0.242 and 0.329.

The revealed trends allow us to predict the volume of goods that can be transported from Poland to Ukraine with the use of road transport corridor in the range of 1.7 to 3.6 million tons per year (Fig. 13).

We have conducted an analysis of macroeconomic indicators of Ukraine, based on the GDP forecast by 2030. The largest link with domestic GDP is the import of goods from Poland to Ukraine, the correlation coefficient is 0.889. The average impact is on the volume of export of goods from Ukraine to Poland, the correlation coefficient of 0.569 and the volume of cargo handling in Ukrainian seaports, the correlation coefficient of 0.621. The predicted values of these indicators are presented in Fig. 13-15

However, the contradiction between statistical data of Ukraine and Poland should be noted. So the volume of export of goods from Poland to Ukraine varies by 37- 40% of the volume of goods imported into Ukraine from the territory of Poland, which indicates the presence of a shadow component.

Since the data of Ukrainian statistics are quite controversial and do not have a clearly defined trend, there is a methodological problem with

forecasting volumes of road freight transport from Ukraine to Poland. Therefore, we have used expert assessments and believe that there is a prospect of increasing volumes of road transport from Ukraine to Poland in the presence of high-quality highways and the functioning of the transport corridor between the ports of Ukraine and Poland several times.

The calculations show that Ukraine and Poland are actively involved into international trade and are interested in increased speed of goods movement and reduction of delivery expenses. One of the effective tools for improving the efficiency of cross-border cooperation of neighbouring countries is the use of digital services and electronic document circulation in the implementation of control procedures at customs and border crossings. The introduction of an information exchange transport corridor can shorten the length of the check-in procedures by up to 15 minutes per car and significantly reduce the waiting times and downtime. Simplifying cross-border control procedures requires the development of intelligent transport systems, including electronic logistics and digital transport corridors. That is why the strategic development direction of the domestic logistics industry is connected with the creation of the "e-government", "electronic customs", the active use of "single window" technologies in transport terminals and at points of goods passing through the state border in order to achieve 90% of documents processing in the mode real time and without direct communication with government officials. The digital concept of the new GO Highway transport corridor involves creating a "smart road" that will provide communication between vehicles and the infrastructure. The first stage of this concept implementation involves the launch of a system for reading traffic, weighing in motion, fixing speed on regular sections of roads. The next step is to start in the test mode on areas where smart cars will be checked, 5G networks to connect the car.

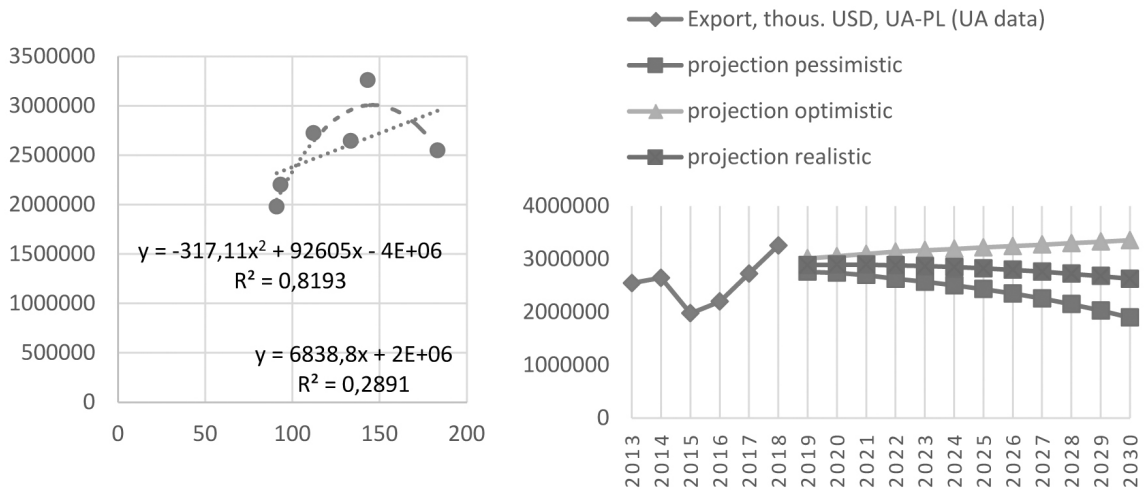


Fig. 13. Forecast volumes of flow of goods for automobile transport corridor.  
Source: Own compilation

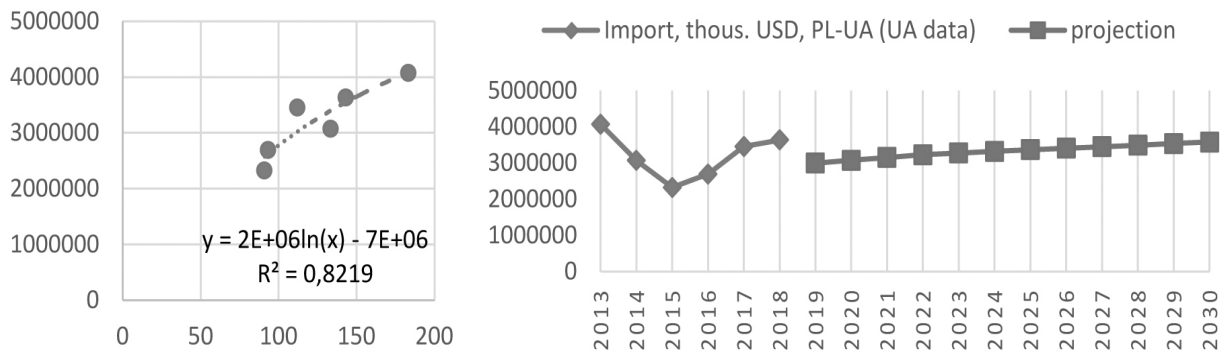


Fig. 14. Forecast of import volumes of goods from Poland to Ukraine.  
Source: Own compilation.

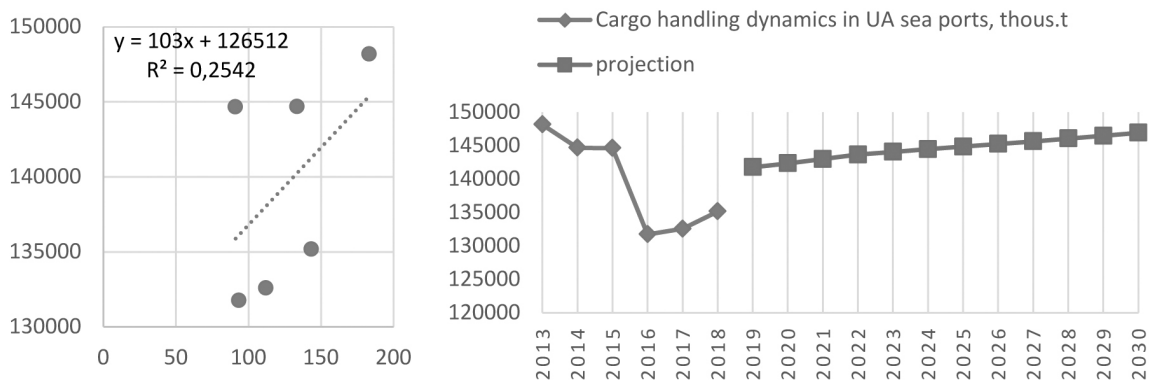


Fig. 15. Forecast of cargo handling at seaports in Ukraine.  
Source: Own compilation.

4. CONCLUSION

Consequently, the research carried out has confirmed the correctness of the hypothesis that Ukraine has a great ability to participate in global networks of goods production and international trade. The integration of Ukraine's transport system into the pan-European transport network TEN-T

opens new opportunities for the effective use of existing international transport corridors and the development of new ones due to the significant transformations of global trade routes. Modern digital technologies can significantly accelerate the movement of commodity flows, reduce the waiting time for control procedures, and reduce overall



overhead, which in aggregate significantly improves the efficient use of the existing international transport corridors infrastructure and the quality of logistics customer service.

The presented understanding of the essence of ITC allows us to determine the efficiency and effectiveness of ITCs functioning, which must be ensured by uniform technical requirements, advanced customer service technologies, and the creation of a single information space to ensure the reliability, safety and competitiveness of the goods delivery cost according to logistic principles "door to door" and "just in the time". These indicators significantly affect the Logistics Performance Index, which is defined by the World Bank experts every two years.

The conducted analysis of the efficient use of the logistic potential of Ukraine and Poland shows the significant reserves for increasing the effectiveness of cross-border cooperation between these countries. The common border presence and an advantageous geographical location contribute to attracting both countries to service global commodity flows and create opportunities for increasing volumes of road transport between countries. In particular, the project of the transnational transport corridor "GO Highway" can connect the Ukrainian Black Sea ports of Mykolayiv and Odesa region with the Polish city of Gdansk in the Baltic Sea. The project implementation will accelerate and cheapen the transportation of goods from the Baltic to the Black Sea, which will facilitate the restoration of the transit potential of Ukraine in close cooperation with Polish partners.

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