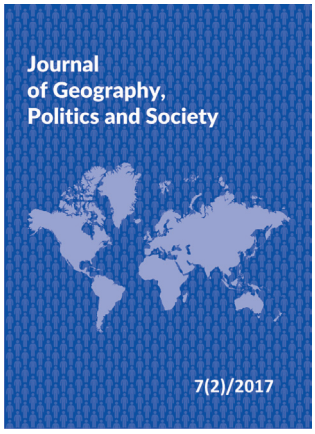


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# TRANSPORT AND LOGISTIC POTENTIAL OF THE WESTERN UKRAINIAN BORDERLAND

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**Abstract**
Arrangement of logistic companies over oblasts of the Western Ukrainian borderland is studied and characterised. Main logistic centers within the oblasts are singled out. Availability of subjects of transportation and distributional logistics is studied. Railway and automobile networks are comprehensively assessed. Capacity and peculiarities of railway and automobile freight traffic flows are studied. Customs posts and crossing points at Western Ukrainian State border are described. Methods of numerical evaluation of transport and logistic potential index for borderland oblasts are suggested and index values for the Western Ukrainian borderland oblasts are calculated. Numerical evaluation of transport and logistic index is conducted.

**Key words**
transport, logistics, Western Ukrainian borderland, freight traffic flow, index, potential.

## 1. Introduction

Logistics has a distinct geographical component, which manifests itself through the concept of flows, junctions and networks within a supply chain (Rodrigue (ed.), 2013). Analysis of logistic activities in a region and assessment of these activities' potential is a subject of study of human geography. In recent years, there was a number of research papers that explore the logistic aspect of economic activity in a region, the logistic potential of a region in particular. Some authors understand the logistic potential in a region as "the possibility of a regional system to ensure optimal parameters of economic flows in space and time, which are formed as the result of application of logistic management methods" (Коблянська et al., 2015, p. 26). Also, these authors propose a quantitative assessment of the logistic potential of a region, which is proportional to the mean-square value of the input parameters, but this approach is not justified.

Logistic inputs are natural, financial and informational resources; logistic outputs are competitive advantage, time and space utility, effective delivery to consumers, etc. (Сток, Ламберт, 2005). Potential as a functional and resource characteristic signifies the ability of a resource to ensure the performance of certain functions. The measure of such potential

has multiplicative nature and includes the capacity of a resource as well as its functional output (Грицевич, 1999). The basis of logistic potential is transport infrastructure (Ібрагімхалілова, 2011). Consequently, transport and logistic potential is a multiplicative characteristic of the transport and logistic infrastructure of a region, carried out with regard to business entities activity. It is therefore advisable to evaluate numerical measure of such potential as the sum of products of resource (factor) attributes and functional (resulting) attributes, wherein significant coefficients of these products are correspondent coefficients of correlation for account of real impact of resource attributes on functional ones.

## 2. Subjects of logistic activity

The largest number of logistic companies in the Western Ukrainian borderland is focused on major international transport routes, particularly in Lviv and in the cities of Rivne and Lutsk. In the Volyn Oblast, except Lutsk, the following logistic centers are singled out: the cities of Kovel, Novovolynsk, Liuboml, Ustylug and others. In the Zakarpattia Oblast the next logistic centers can be identified: Uzhhorod (the largest logistic center), Mukacheve, Khust, Irshava, Svaliava, Berehove and others. The largest logistic centers in Ivano-Frankivsk Oblast are the cities of Ivano-Frankivsk, Kalush, Dolyna and others. In the Lviv Oblast, except Lviv, there are such logistic centers as the cities of Drohobych, Chervonograd, Horodok, Zhovkva, Stryi and others. In the Rivne Oblast logistic centers are the cities of Rivne, Zdolbuniv, Dubno, Kostopil and others. In the Chernivtsi Oblast logistic centers as the cities of Chernivtsi, Storozhynets, Khotyn and others are singled out (Грицевич, Сеньків, 2015).

The largest number of companies engaged in automobile freight transportation is in the Lviv, Rivne, Zakarpattia and Volyn Oblasts. The Lviv and Volyn Oblasts are distinguished by the number of companies providing services of the freight transportation. The largest number of companies providing forwarding services is in the Lviv, Rivne and Zakarpattia Oblasts. The largest number of companies providing storage services are in the Lviv, Volyn and Zakarpattia Oblasts. The Lviv and Rivne Oblasts are distinguished by the number of companies engaged in multimodal transportation, in freight railway transportation – the Lviv, Rivne and Volyn Oblasts. The Lviv Oblast leads in the number of companies providing express mail and courier services (Lardi-trans).

Within the Western Ukrainian borderland, the Lviv, Volyn and Ivano-Frankivsk Oblasts are best equipped with the wholesale trade enterprises, the Chernivtsi Oblast is least equipped. The maximum amount of wholesale trade turnover is typical for the Lviv and Volyn Oblasts, the minimum value of the amount of wholesale trade turnover is characteristic of the Chernivtsi and Rivne Oblasts. Per one company, the maximum value of wholesale trade turnover is characteristic of the Zakarpattia Oblast, the minimum value – of the Rivne Oblast. In the structure of the wholesale trade turnover of the Chernivtsi Oblast, food products dominate; in all other oblasts the share of non-food products exceeds the share of food products. In general, in the structure of wholesale trade turnover of the oblasts, non-food products dominate. The Lviv and Ivano-Frankivsk Oblasts have the largest warehouse space at the wholesale trade enterprises, warehouse space is significant in the Volyn Oblast, the smallest space is in the Rivne, Zakarpattia and Chernivtsi Oblasts (Оптова і біржова торгівля України…, 2014).

## 3. Railway transportation

The length of railway tracks of general use within the Western Ukrainian borderland oblasts is 3940 km. The greatest length of railways has the Lviv Oblast, the smallest – the Chernivtsi and Ivano-Frankivsk Oblasts. The maximum density of the railway network is characteristic of the Lviv and Chernivtsi Oblasts, the minimum – of the Rivne and Volyn Oblasts (Транспорт і зв'язок України..., 2015). The railway track width in Ukraine is 1520 mm, while in Western Europe – 1435 mm. In the states neighbouring Ukraine (Poland, Slovakia, Hungary and Romania) there are sections with a width of 1520 mm. In Ukraine, sections of railway tracks of European width are also used, particularly in the sections of Chop – Batiovo – Mukacheve, Batiovo – Korolevo – Diakove, from the border with Poland to Kovel, from the border with Poland to Mostyska, from the border with Poland to Hyriv. At the stations Mostyska I/Mostyska II there are modern terminals of railway carriage reloading from one track to another, but now they are loaded on 30%. In order to accelerate the pace of integration of railway transport of Ukraine into the global transport system, the "Eurokoliya do Lvova" ("European railway to Lviv") project was developed, according to which the new railway track is to pass from Polish to Romanian border through Lviv and Chernivtsi (Євроколія може об'єднати Європу…).

On the territory of the Western Ukrainian borderland there are double-, single- and narrow-track railways. Almost all sections of double-track railway

lines (except section of Kovel – Yagodyn – State border with Poland) and several sections of single-track railway lines are electrified. In "Program of electrification of railways of Ukraine for 2015–2020 years", the need for electrification of Kovel – Izov – State border with Poland, which is a part of the international transport corridor, is stressed; it is planned to increase by 30% the capacity of the given section (Де буде струм?). It should be noted, that transportation with the usage of electricity is twice cheaper than heat haulage. The electrification improves the speed of the railway traffic and the capacity of the railways. Therefore, the lack of electrified railways in the Ivano-Frankivsk and Chernivtsi Oblasts is a constraining factor for implementation of transport and logistic activities in these oblasts.

A challenging obstacle for passage of railways within the Western Ukrainian borderland is the Carpathians. The most complicated section is between Lavochne and Volovets stations, where trains go up to the highest point along the way. In order to lay a railway track through this area on the border of the Lviv and Zakarpattia Oblasts, the single-track Beskydsky tunnel was built. Not only for the Western Ukrainian borderland, but also for the whole Ukraine, the Beskydsky tunnel is of strategic importance because a half of transit goods towards Western and Central Europe is carried through it. Now it is the only single-track section of the 5th Pan-European transport corridor, which runs through Italy, Slovenia, Hungary, Slovakia and Ukraine. The Beskydsky tunnel has long ago exhausted its service life, therefore trains pass through it at low speed. A new double-track tunnel has been already laid parallel to the old single-track one at a distance of 30 meters from it. The new Beskydsky tunnel will increase the capacity of areas from 47 to 100 trains per day (Будівництво нового Бескидського тунелю).

The biggest railway junction station of the Western Ukrainian borderland is Lviv. The large railway junction stations are Rivne, Uzhhorod, Ivano-Frankivsk, Chernivtsi, Stryi, Kovel, Chop, Krasne. Zakarpattia and Rivne Oblasts have the greatest total freight railway traffic, the Ivano-Frankivsk and Lviv Oblasts also have significant freight railway traffic. The Chernivtsi Oblast has the smallest amount of freight railway traffic.

In the Zakarpattia Oblast, the amount of goods arrival by railway significantly prevails over the amount of goods shipment. It can be explained by the fact that Zakarpattia serves as the western gate of Ukraine to Europe on the path of Eurasian transit transportation. In the Rivne Oblast, goods shipment by railway significantly prevails over goods arrival. It is connected with the operation of a cement plant in Zdolbuniv, the products of which are exported, and also with the grain export, as evidenced by the presence of elevators (mostly in the southern part of the oblast). Prevalence of the amount of goods arrival by railway over the amount of shipments in the Ivano-Frankivsk Oblast is associated with the operation of the Burshtyn thermal power station in the oblast, which is a major consumer of coal. However, this prevalence is not as significant as in some other oblasts due to the operation of a cement plant in Yamnytsia and cultivation of grains in the oblast, which are exported. In the Lviv Oblast, the relatively slight predominance of the amount of goods arrivals by railway over the amount of shipments is also observed, which is caused by the operation of the Dobrotvir thermal power station, that uses coal produced within the Lviv – Volyn Coal Basin (particularly, on the territory of Sokal Raion). Goods shipments by railway in the Lviv Oblast are also associated with the operation of a cement plant in Mykolaiv and grains cultivation. The predominance of goods arrivals amount over shipments by the railways in the Volyn and Chernivtsi Oblasts can be explained by transitivity of the geographical location of these oblasts.

## 4. Automobile transportation

The density of roads of general use, their technical condition significantly affect the speed of transportation, the quality of transported products, the ability to service international transportation.

The network of hard-surfaced automobile roads of general use within the Western Ukrainian borderland is 29400 km. The largest length of hard-surfaced automobile roads of general use is in the Lviv Oblast, the smallest – in the Chernivtsi and Zakarpattia Oblasts.

The maximum value of the density of hard-surfaced automobile roads is characteristic of the Lviv, Chernivtsi Oblasts, the minimum – of the Rivne and Zakarpattia Oblasts. Automobile roads of the I and II categories, technical parameters of which are the most relevant to the modern European and world requirements, constitute just 2860 km within the Western Ukrainian borderland. The Lviv Oblast has the greatest length of such roads. The smallest index of availability of roads of the I and II categories is in the Chernivtsi Oblast. Automobile roads of the IV category prevail almost in all oblasts of the Western Ukrainian borderland, in Zakarpattia and Chernivtsi Oblasts prevail automobile roads of the V category (Транспорт і зв'язок України …, 2015).

Due to its geographical position on the way of the main transit flows between Europe, on the territory

of the Western Ukrainian borderland there are two international automobile corridors – Krytsky №3 (at the section Krakovets – Lviv – Rivne and further towards Kyiv) and Krytsky №5 (Kosyny – Chop – Stryi – Lviv). The main problem of the latter is overcoming of the Carpathian Mountains, and crossing of railway tracks and automobile roads on the same level (Грицевич, Сеньчук, 2010).

Automobile transport is the most mobile means of passengers and freight transportation. In terms of the amount of passengers and freight transportation of different modes, automobile transport takes the first place in Ukraine and within the Western Ukrainian borderland as well. In the structure of freight transportation by vehicle companies agricultural, forest, food products, etc. prevail. Automobile transport has superiority in the freight transportation on average per day, but the average distance of the transportation of one tonne of goods by means of automobile transport is the lowest among all modes of transport.

Within the Western Ukrainian borderland, the leader in terms of freight transportation is the Lviv Oblast, and in terms of cargo turnover by automobile transport, the Lviv and Zakarpattia Oblasts are leading. The Chernivtsi and Zakarpattia Oblasts have the minimum amount of freight transportation, the smallest cargo turnover by automobile transport is in the Chernivtsi Oblast. Significant cargo turnover by automobile transport in the Zakarpattia Oblast is conditioned by the maximum average distance of transportation of one tonne of goods by automobile transport.

In recent years, in the world and in Ukraine in particular, automobile container transportation is becoming more common, which is considered one of the fastest ways of transportation, after airshipment.

## 5. Border crossing points

Volyn, Ivano-Frankivsk, Lviv, Rivne, Chernivtsi customs function in the Western Ukrainian borderland. Lviv, Zakarpattia and Volyn customs have the biggest number of customs posts. In general, customs and logistics activities of the Western Ukrainian borderland are carried out in 59 customs posts.

A leading Ukrainian 3PL-provider "УВК Україна" ("UVK Ukraine") offers to customers comprehensive logistics solutions, including customs brokerage services and consulting in the field of customs brokerage legislation. In all administrative centers of the Western Ukrainian borderland there are offices of logistics provider "UVK Ukraine". It should be mentioned that often customs brokerage services are provided by specialised companies. In general, the biggest number of companies providing customs brokerage services (excluding individual entrepreneurs) is concentrated in the Lviv, Volyn and Rivne Oblasts.

There are 64 crossing points and seven control points within the Western Ukrainian borderland. Categorisation (Перелік пунктів пропуску): crossing points: 56 international, one interstate, seven local; control points: seven international. Classification according to the transportation mode: crossing points: 29 automobile, seven automobile and pedestrian, one automobile, pedestrian and for bike riders, one pedestrian and for bike riders, 19 railway, seven air; control points: seven railway. Classification according to the format of transportation: crossing points: 18 passenger, three freight, 43 passenger and freight; control points: one passenger, five freight, one passenger and freight. Classification according to the mode of functioning: crossing points: 48 permanent, 16 temporary; control points: seven permanent. Classification according to the working hours: 57 twenty-four-hour, seven with particular time of working; control points: seven twenty-four-hour. In general, workload of the West Ukrainian borderland crossing points is low. High workload is only at the Ustylug – Zosinh, Rava-Ruska – Hrebenne, Krakovets – Korchova, Sheheni – Medyka crossing points, medium – at the Diakove – Halmeu crossing point.

The absence or small number of crossing points on a significant segment of the border is not always evidence of weak external economic relations between the neighboring territories. And on the contrary, a significant number of crossing points on a relatively significant segment of the border is not always evidence of intensive external economic relations. For example, the Zakarpattia Oblast has no border crossing points with Poland, but the amount of export–import operations between them is very significant. The Chernivtsi Oblast, instead, has a large density of crossing points with Moldova (one checkpoint per 15 km), which suggests irrationality in the opening of some points, as the amount of export–import operations between them is slight. It is obvious that the current density of crossing points between Poland and the Lviv Oblast (one checkpoint per 26 km) is too small, given the intensive external economic relations between these territories. An efficient alternative to creating new and closing existing crossing points can be implementing of logistic approach in all activities of customs authorities, including crossing points. This approach involves, above all, the creation of temporary customs and logistics centers, improving customs legislation, the

use of new information and technical means of customs bodies activities, etc.

## 6. Numerical evaluation of logistic potential

Let us consider the theoretical and methodological foundations of evaluation of potential index. Suppose on M of territorial elements values $K^A$ of factor and $K^B$ of resulting parameters are known. Information about the value of factor parameters is set by the matrix $\{u_i^\alpha\}$, $i = 1,\ldots, M$; $\alpha = 1,\ldots, K^A$. Information about the value of resulting parameters is set by the matrix $\{u_i^\beta\}$, $i = 1,\ldots, M$; $\beta = 1,\ldots, K^B$.

First of all, let us carry out the standartisation of factor parameters:

$$\xi_i^{\alpha} = \frac{u_i^{\alpha} - u_{min}^{\alpha}}{u_{max}^{\alpha} - u_{min}^{\alpha}}, \text{ де } u_{min}^{\alpha} = \min_{1\le i\le M} u_i^{\alpha},$$

$$u_{max}^{\alpha} = \max_{1\le i\le M} u_i^{\alpha},$$

and, similarly, the standartisation of resulting parameters:

$$\eta_i^{\beta} = \frac{v_i^{\beta} - v_{min}^{\beta}}{v_{max}^{\beta} - v_{min}^{\beta}}, \text{ де } v_{min}^{\beta} = \min_{1\le i\le M} u_i^{\beta},$$

$$v_{max}^{\beta} = \max_{1\le i\le M} u_i^{\beta}.$$

Calculate the rectangular matrix of correlations $\{r_{\alpha\beta}\}$ of size $K^A \times K^B$, where $r_{\alpha\beta}$ – the correlation coefficient between $\alpha$-м column of matrix of factor parameters and $\beta$-м column of matrix of resulting parameters, $\alpha = 1,\ldots, K^A$, $\beta = 1,\ldots, K^B$. The index of potential of territorial element is calculated by the formula (Грицевич, 1999):

$$\zeta_i = \sum_{\alpha=1}^{K^A}\sum_{\beta=1}^{K^B} r_{\alpha\beta}\xi_i^{\alpha}\eta_i^{\beta}, \quad i = 1,\ldots, M.$$

For computational convenience, on the Fig. 1 the values $100 \cdot I_i$ are presented. For indexes calculation, four factor and four resulting parameters are taken, which are available on the basis of statistic materials. The territorial elements are oblasts of Western Ukrainian borderland.

Factor parameters:

- number of logistic companies;
- number of wholesale trade enterprises;

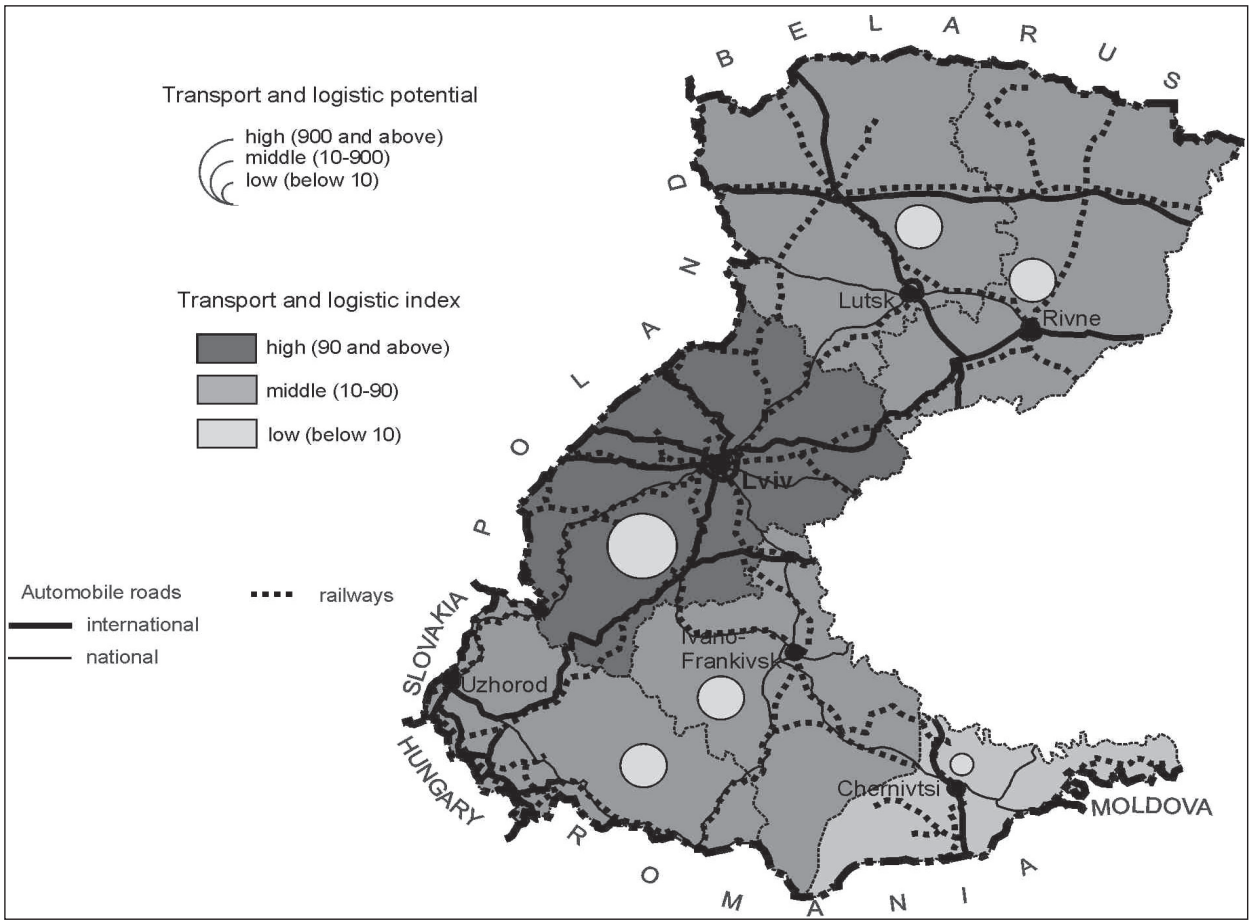


Fig. 1. Transport and logistic potential of the Western Ukrainian borderland

Source: Own calculation and mapping.

- the length of railway tracks;
- the length of automobile roads.

Resulting parameters:

- amount of wholesale turnover;
- amount of retail turnover;
- amount of freight shipments and arrivals by means of railway transport;
- amount of freight transportation by means of automobile transport.

## 7. Summary

Transport and logistic potential is a multiplicative characteristic of the transport and logistic infrastructure of a region, carried out with regard to business entities activity The Western Ukrainian borderland has the advantageous geographical position, and developed network of subjects of logistics activities, especially in Lviv. The territory of the Western Ukrainian borderland is well equipped with the railway and automobile transport networks, which have a greater density in the lowland sub-regions and less density in the mountain areas. Transport networks are connected with the networks of neighboring countries through multiple border crossing points. In general, the high value of the transport and logistic index has the Lviv Oblast, the middle – the Volyn, Rivne, Ivano-Frankivsk and Zakarpattia Oblasts, the low – Chernivtsi Oblast. The highest transport and logistic potential has the Lviv Oblast, the lowest – the Chernivtsi Oblast.

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