

# “Evaluation of seaports’ investment attractiveness”

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# EVALUATION OF SEAPORTS' INVESTMENT ATTRACTIVENESS

## Abstract

Ukraine's European integration requires the involvement of seaports in the international TEN-T network, so it is extremely important to create favorable investment conditions to develop port infrastructure. This study aims to make a comprehensive assessment of the seaports' investment attractiveness to use it for increasing the efficiency of attracting investment in the development of Ukrainian seaports, which are part of the European transport network. The study was conducted using the Saati method and the method of calculating the integrated indicator of seaports' investment attractiveness. The integrated indicator includes assessing indicators of business activity in the region and consolidated indicators of financial and property status, logistical attractiveness, and prospects for port development. According to the results of calculations, the seaports of Ukraine were divided into three groups. The ports of Yuzhne, Odesa, Illichivsk, and Mykolaiv have a high level of investment attractiveness. The ratio of investment attractiveness ranges from 3 to 2.6. The ports of Izmail, Mariupol, Oktyabrsk, and Kherson have an average level (ratio from 2.2 to 1), and other ports have a low investment attractiveness (coefficient from 0.9 to 0.7).

## Keywords

investments, investment conditions, seaport of Ukraine,  
port infrastructure, integrated indicator

## JEL Classification

L91, R42

## INTRODUCTION

In the conditions of deepening Ukraine's European integration, seaports' development as starting points of transport corridors is especially important. Implementation of the Association Agreement between Ukraine and the EU provides for integrating Ukrainian seaports into the international TEN-T network with the subsequent creation of a single sea window, transit routes, and a secure sea network. Thus, Ukrainian seaports require significant additional investment. This is due to the rapid development of logistics, improvement of port infrastructure technologies, construction of new infrastructure facilities, and raising environmental standards. The European Commission estimates that from 2016 to 2030, the total investment required to form the core TEN-T network will be around EUR 750 billion. Therefore, there is a need to properly assess the investment attractiveness of seaports as objects of investment. Assessing the investment attractiveness of seaports is important for both private investors and public authorities, as it provides them with additional information on the level of development of seaports and its prospects.

Thus, this study aims to make a comprehensive assessment of Ukrainian seaports' investment attractiveness as part of the European transport network to increase investment decisions' efficiency and promote investors' attraction.

# 1. LITERATURE REVIEW

The research has shown that there are several approaches to define a seaport in scientific publications. This is because a seaport is a complex socio-economic system, which place and role in the national and international economy are constantly evolving and improving. Traditionally, a port (French port, from Latin portus – harbor, pier) is a shore section with the adjacent water area, naturally or artificially protected from waves and equipped with devices for safe berthing, loading and unloading works, passengers boarding and drop-off, and fleet maintenance (Shemshuchenko, 2007). Besides, seaports have recently undergone drastic changes in the changing international environment, especially in their organization and structure. In this regard, there are four approaches to analyze seaports: economic, geographical, legal, and institutional (Hlali & Hammami, 2017).

A seaport is a line of contact between the sea and land areas in a geographical sense. Vigarié (2004) stated that a port is primarily a contact zone between two organized spaces for freight and passengers' carriage.

In an economic sense, a port is a system consisting of a set of tangible and intangible elements designed to service ships and cargo and perform transport, industrial, and commercial functions. Tangible and intangible elements are the port infrastructure, deck structure, berth equipment, navigation, information systems, tools, etc.

A legal definition is often used to analyze seaport efficiency. Ukraine's legislation defines a seaport as a certain territory and water area equipped for servicing ships and passengers, carrying cargo, transport, fieldwork, and other related economic activities. It is also important to define the seaport concept and its classification.

In an institutional sense, ports are defined as service companies, in the center of the logistics chain, which organizes world trade and provides traffic flow and "coastal areas specifically provided by the competent administrative body for maritime trade" (Makashina, 2010).

Lee and Lam (2013) emphasize that to respond to changes in the global economy, particularly those caused by technology, ports should offer more and more services that involve constant updating of specific equipment.

Particularly active discussions in the scientific community are around the relationship between investment in transport, including maritime port infrastructure and economic growth in the country. Transport infrastructure is seen as one of the means by which governments can stimulate economic growth (Munnell, 1992; Banister & Berechman, 2001). Many studies usually show a relationship between transport investment and economic growth. Jouili and Allouche (2016), using an econometric model based on the Cobb-Douglas production function, prove the significant impact of investment in the seaport infrastructure on the country's economic growth. However, not all studies of this relationship are unequivocally convincing. A systematic review of the empirical study of the transport infrastructure's impact on productivity and economic growth, conducted by Deng (2013), identified three categories of reasons for such ambiguity: (a) different research contexts, including study period, geographic scale, and economic development capacity; (b) different phenomena measured, e.g., different economic sectors, different types of transport infrastructure, and different levels of the transport infrastructure quality; and (c) different ways of measuring the phenomenon: methods used to describe the dependent and functional variables, and methods for estimating the econometric model.

Developing the methods for assessing the effectiveness of port projects and developing and selecting the strategies for investing in seaports were studied to research investment in the port infrastructure. Investment in port development is mainly related to strategies for increasing productivity and economic potential, which leads to increased efficiency of the port infrastructure. Several researchers have developed approaches to make investment decisions regarding investments in the port infrastructure, taking into account the uncertainty. Their methodology for estimating the alternatives is based on calculating an expected existing net value based on operating income before payment of interest, taxes, depreciation

and amortization (EBITDA) (Lagoudis, Rice, & Salminen, 2014). Methods for estimating the investments in the port projects based on the method of discounted cash flows and methods for developing several investment scenarios for applying a flexible investment strategy are presented in detail in the contributions of Evans (1984), Bendall (2007), and Stent (2007).

The development of practical advice on investment in a seaport through several assessment methods: assessing financial and economic costs, analyzing costs and benefits, analyzing the cross-impact of factors of port investment development, and their dynamic modeling is presented in the contributions of Hawkins (1991). According to the results, the method or combination of methods that should be used by seaport managers to achieve their higher competitiveness depends on the problem's nature.

Garcia-Alonso and Martin-Bofarull (2007), in their research of Spanish seaports by the DEA (Data Envelopment Analysis) method, analyzed how the port investment costs increased its efficiency and how this increased the port traffic in the country. This study has empirically confirmed how port investment impacts the growth of other types of transport activities' volume and efficiency; thus, it impacts the country's general economic activity.

The research aimed at identifying the factors that make such investments attractive is very important for researching the port investment. Quite often, the infrastructure investments are risky as they require high financial and time costs, and they operate in highly competitive markets, which leads to a certain «restraint» of private investors in making investment decisions. One way to reduce the risk for private investors is to develop public-private partnerships and cluster port networks based on them, which are often quite attractive. The issues of their development and implementation have been studied in several scientists' contributions, both national and foreign (Oblak & Bistričić, 2013; Karpenko, Palyvoda, & Bondarenko, 2018; Palyvoda & Karpenko, 2017; Kolesnik, 2016).

Aerts, Grage, Doooms, and Haezendonck (2014) presented the critical success factors for implementing the public-private partnerships in port investment, based on the multi-factor analysis.

The results showed eight critical success factors, including the specificity and accuracy of the concession agreement, the ability to share the risk, the technical feasibility of the project, the commitments made by the partners, the attractiveness of financial conditions, a clear definition of responsibilities, a strong private consortium and a realistic cost and benefits estimate.

Based on the existing theoretical contributions of national and foreign scientists to assess the investment component in the seaport development, the authors propose a new approach to assess the investment attractiveness of seaports based on an integral indicator that includes indicators of the region's business activity; consolidated indicators of financial and property status; logistical attractiveness and prospects of port development.

## 2. METHODS

In research, the seaport's investment attractiveness is proposed to be determined by the method of calculating the integral indicator. This indicator is calculated as a result of weighing a certain combination of components (indicators) and comprehensively characterizes the seaport's investment attractiveness. Its main components were selected: a) financial and property status of the port; b) the logistical attractiveness of the port; c) prospects for port development; d) investment attractiveness of the region where the port operates. The structural and logical scheme of calculating the integrated indicator of investment attractiveness of the seaport is presented in Figure 1.

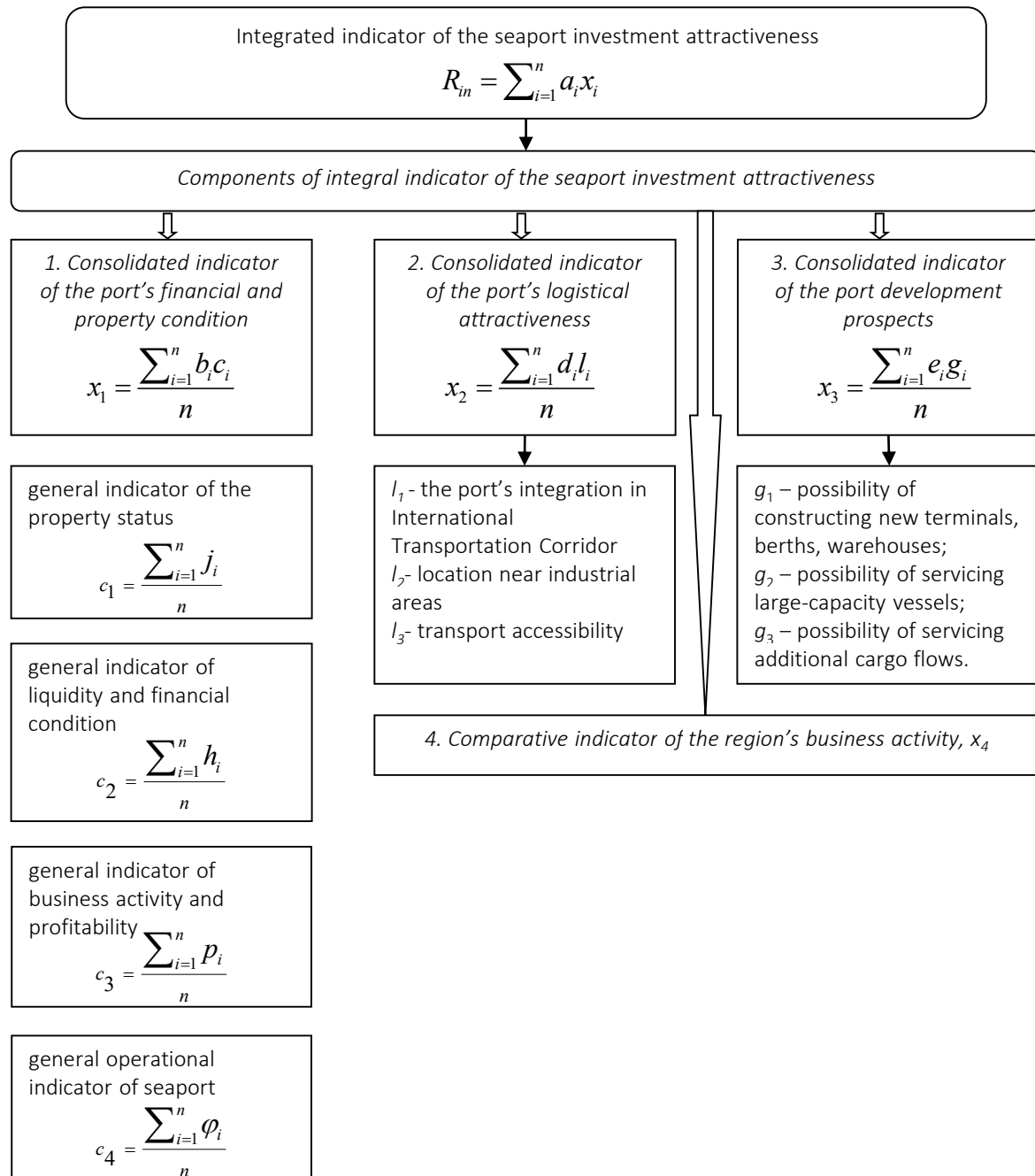
Each of the components affects the attractiveness of investment in the port in different ways. The results of expert research determined the importance of the indicator component of the attractiveness of investments in ports by pairwise comparisons based on the method of statistical data processing proposed by Saati (1993). The choice of this method to determine the weight of the indicators is because a qualitative comparison of the two objects is considered easier and more reliable than the representation of the advantage in points or rating scales. The pairwise comparisons method has the following advantages: clear mathematical substantiation of the performed operations; ease

of compiling initial matrices; the ability to transform expert information in another way (reference estimates, rankings, etc.).

The quantitative expert-analytical method used involved a survey of a group of 12 experts. The application of this interviewing experts method gave more accurate results, as it took into account the consistency of experts' opinions. The

experts were selected competent specialists who have the knowledge and extensive experience in the seaports of Ukraine and scientists dealing with the problems of investment management in maritime transport. Based on the experts' statements, a matrix of pairwise comparisons (formula 1) was formed, the rows and columns of which meet the  $n$  criteria, i.e., the matrix is symmetric:

Source: Developed by the authors.



**Figure 1.** Structural and logical scheme for determining the integral indicator of the seaport investment attractiveness

$$A = \begin{bmatrix} 1 & a_{i2} & a_{1n} \\ \frac{1}{a_{12}} & 1 & a_{2n} \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & 1 \end{bmatrix}. \quad (1)$$

The priority vectors of the experts' judgments were calculated using a matrix of pairwise comparisons, the consistency of each matrix was determined, and only then were they used for further calculations.

Therefore, the processing of expert questionnaires took place in the following sequence:

1. A matrix of pairwise comparisons is constructed to determine each of the components of the port's investment attractiveness indicator.
2. The normalized vector of advantages is defined.
3. Assessment of the consistency of the expert's judgments (each matrix is checked for consistency).
4. The coefficient of agreement of experts' opinions is determined.
5. The weight of each of the components of the investment attractiveness of the seaport is determined.

Based on an expert survey, it was found that the seaport's investment attractiveness should be calculated using the formula:

$$R_m = 0.191x_1 + 0.379x_2 + 0.294x_3 + 0.136x_4, \quad (2)$$

where  $x_1$  is a consolidated indicator of the port's financial and property condition;  $x_2$  – consolidated indicator of the port's logistical attractiveness;  $x_3$  – consolidated indicator of the prospects for port development;  $x_4$  – comparative indicator of the region's business activity.

Each of the above components was evaluated using a consolidated indicator. When determining

the individual parameters, a system of aggregate indicators was formed. They reflect property, liquidity and financial condition, business activity and profitability, production indicators, logistical attractiveness, prospects for development, and the region's investment attractiveness. Each of the components of the aggregate indicator has an equal impact on the corresponding consolidated indicator. First, the aggregate indicators' component values were calculated, and then they were converted into points. The scale for converting values into points is uniform. The interval between the upper and lower limits was determined, taking into account regulatory and adjusted industry values. Each group of indicators had its scale of conversion into points. The maximum number of points was assigned to the indicator, the value of which corresponded to the regulatory and/or the best company in the industry.

An extremely important and determining aspect in determining a seaport's investment attractiveness is the choice, development, and justification of a system of indicators. Given the peculiarities of seaports, a two-tier system of indicators was chosen. The first level contained an assessment of indicators based on regulatory values; the second level contained indicators established by expert assessment.

To ensure the calculation reliability and accuracy, the authors proposed to determine the seaport investment attractiveness in the sequence: a) analysis of financial statements, trends, and problems of the seaport development; b) determining the components of the integrated indicator of the seaport investment attractiveness; c) determining the weight of indicators' individual groups; e) calculation of indicators' components; f) determining the integrated indicator of the seaport investment attractiveness.

### 3. RESULTS

The investment attractiveness of a seaport is a set of factors that determine the level of profitability of the port, efficiency of its assets, solvency, financial stability, logistical attractiveness, and ability to self-development, which encourages potential investors to take risks and secure investments.



External and internal factors influence the investment attractiveness of seaports. External factors include the degree of state regulation, the development of the region's maritime economic complex, material and technical attractiveness, and investment attractiveness. Internal factors include production potential, financial condition, management, port investment program, degree of innovative development, etc.

The study began with the calculation of internal factors, including financial and property status. According to the survey results and the processing of expert opinions, the following analytical formula was obtained:

$$x_1 = \frac{0.371c_1 + 0.219c_2 + 0.215c_3 + 0.195c_4}{n}, \quad (3)$$

where  $c_1$  is an indicator of property status;  $c_2$  – indicator of the seaport's liquidity and financial condition;  $c_3$  – indicator of the seaport's business activity and profitability;  $c_4$  – the seaport's production indicators.

To determine the components of the consolidated indicator of the seaport's financial and property condition, the renewal ratio, the depreciation ratio, and the return on investment ratio were used. Depending on the calculated indicator's value, each indicator was assigned points from 0 to 10. The scale of converting the values into points is shown in Table 1.

The following formula was used to calculate the port's property status:

$$c_1 = \frac{\sum_{i=1}^n j_i}{n}, \quad (4)$$

where  $c_1$  is the port's property status;  $j_i$  – value,  $i$  – indicator of property status in points;  $n$  – the number of indicators.

Among the indicators of liquidity and financial condition, those indicators were selected that most accurately determine the financial condition and are significant for seaports. Namely: coverage ratio; solvency ratio; autonomy ratio; maneuverability ratio; investment ratio. Consolidated indicator of the port's liquidity and financial condition,  $c_2$  was calculated by the formula:

$$c_2 = \frac{\sum_{i=1}^n h_i}{n}, \quad (5)$$

where  $c_2$  is a consolidated indicator of the port's liquidity and financial condition;  $h_i$  – value of the  $i$  – indicator of the port's liquidity and financial condition in points;  $n$  – the number of indicators. The obtained values of the indicators were converted into points given in Table 2.

The next group is the seaport's business activity and profitability indicators, which characterize the port's efficiency. Seaports have different levels of profitability. On average, the profitability of the

**Table 1.** Scale of converting the component's values of the general indicator of the property status into points

Source: Developed by the authors. Indicator components of the port's property status,  $c_1$ .

Points $j_i$	Renewal ratio $k_{re}$	Depreciation ratio $k_d$	Return on investment $r_i$
0	0-0.09	1-0.95	0-0.08
1	0.1-0.19	0.96-.08	0.09-0.1
2	0.2-0.29	0.81-0.7	0.11-0.2
3	0.3-0.39	0.69-0.6	0.21-0.3
4	0.4-0.49	0.59-.05	0.31-0.4
5	0.5-0.59	0.49-0.4	0.41-0.5
6	0.6-0.69	0.39-0.3	0.51-0.6
7	0.7-0.79	0.29-.02	0.61-0.7
8	0.8-0.89	0.19-0.1	0.71-0.8
9	0.9-0.94	0.09-0.02	0.81-0.9
10	0.95-1	0.01-0.0	0.9-1

**Table 2.** Scale of converting the indicator components of the port's liquidity and solvency into points

Source: Developed by the authors.

Indicators	Indicator components of liquidity and financial condition $c_2$										
	Points $h_i$										
	0	1	2	3	4	5	6	7	8	9	10
$r_{cover}$ Coverage ratio	0-0.09	0.1-0.19	0.2-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-0.99	$\geq 1$
$r_{solv}$ Solvency ratio	0-0.01	0.02-0.03	0.04-0.05	0.06-0.07	0.08-0.09	0.10-0.11	0.12-0.13	0.14-0.15	0.16-0.17	0.18-0.19	$\geq 0.2$
$r_{aut}$ Autonomy ratio	0-0.08	0.09-0.1	0.16-0.24	0.25-0.32	0.33-0.4	0.41-0.48	0.49-0.56	0.57-0.64	0.65-0.72	0.73-0.79	$\geq 0.8$
$r_{man}$ Maneuverability ratio	0-0.04	0.05-0.1	0.11-0.15	0.16-0.2	0.21-0.25	0.26-0.3	0.31-0.35	0.36-0.4	0.41-0.45	0.46-0.49	$\geq 0.5$
$r_{inv}$ Investment ratio	0-0.09	0.1-0.19	0.2-0.29	0.3-0.39	0.4-0.49	0.5-0.59	0.6-0.69	0.7-0.79	0.8-0.89	0.9-0.99	$\geq 1$

leading ports' production is 40-45%. Therefore, a port with this level of profitability receives 10 points. After calculating this group of indicators, they were converted into scores according to the scale shown in Table 3.

The consolidated indicator of the seaport business activity and profitability was calculated on the basis of the formula:

$$c_3 = \frac{\sum_{i=1}^n p_i}{n}, \quad (6)$$

where  $c_3$  is a consolidated indicator of the seaport business activity and profitability;  $p_i$  – the value of the  $i$  – indicator of the seaport business activity and profitability in points;  $n$  is the number of indicators.

The group of the seaport's production indicators includes such indicators as the utilization ratio of

the port's production capacity, the volume of cargo handling, the growth rate of cargo handling. The volume of cargo handling is the main quantitative indicator of the port's operation, which includes those cargoes that are handled at the port berths or customer berths by the port's means and capacity, according to its work order and the operational staff guidance. The port organizes these works and it's responsible for the timely ship loading and unloading. The volume of cargo handling is influenced by both external and internal factors. The capacity utilization ratio shows how much additional cargo can be attracted without increasing production capacity. But if production capacity is not fully used, one of the reasons may be insufficient cargo flow through the port. In the present study, the components of the port production indicator include  $c_4$  – the utilization ratio of the port production capacity; volume of cargo handling; growth rates of cargo handling. The obtained values of these indicators were also converted into points on the scale in Table 4.

**Table 3.** Scale of converting the indicators of the port's business activity and profitability into points

Source: Developed by the authors.

Indicators	Indicator components of the port's business activity and profitability										
	Points										
	0	1	2	3	4	5	6	7	8	9	10
$R_a$ Return on assets, %	0-3	4-6	7-9	9-12	13-15	16-18	19-21	22-24	25-27	28-30	$>30$
$R_{eq}$ Return on equity, %	0-3	4-6	7-9	9-12	13-15	16-18	19-21	22-24	25-27	28-30	$>30$
$R_{prof}$ Profitability of production, %	0-4.5	4.6-9	10-13.5	13.6-18	18.1-22.5	22.6-27	27.1-31.5	31.6-36	36.1-40.5	40.6-45	$>45$
$R_{fa}$ Return on fixed assets, %	0-3	4-6	7-9	9-12	13-15	16-18	19-21	22-24	25-27	28-30	$>30$



**Table 4.** The scale of converting the components of the port's production indicator in points

Source: Developed by the authors.

Components of the port's production indicator, $c_4$											
Indicators	Points $\varphi_i$										
	0	1	2	3	4	5	6	7	8	9	10
$c_3$ Utilization ratio of port production capacity	1.0-0.95	0.94-0.90	0.89-0.85	0.84-0.80	0.79-0.75	0.74-0.60	0.59-0.55	0.54-0.50	0.49-0.45	0.44-0.40	0.39-0.30
$Q$ , thousand tons Volume of cargo handling, thousand tons	<1,000	1,000-5,000	6,000-10,000	11,000-15,000	16,000-20,000	21,000-25,000	26,000-30,000	31,000-35,000	36,000-40,000	41,000-45,000	≥50,000
$Gr_a$ The growth rate of cargo handling	0	0.01-0.15	0.16-0.30	0.31-0.45	0.46-0.60	0.61-0.75	0.76-0.9	0.91-0.45	0.46-1.05	1.06-1.2	>1.5

The consolidated production indicator of the seaport was calculated based on the formula:

$$c_4 = \frac{\sum_{i=1}^n \varphi_i}{n}, \quad (7)$$

where  $c_4$  is a consolidated production indicator of the seaport;  $\varphi_i$  – the value of the  $i$  production indicator of the seaport in points;  $n$  is the number of indicators.

The obtained values  $c_1$ ,  $c_2$ ,  $c_3$ ,  $c_4$  were used to calculate the port's total financial and property condition based on Formula 3.

The seaport's logistical attractiveness is a generalized characteristic of a set of geographical, economic, organizational prerequisites that determine the possibility of effective use of the port attractiveness for its further development. The only parameters in determining the ratio of logistical attractiveness are the port's affiliation to international transport corridors, location near industrial areas, transport accessibility.

Experts determined the importance of the logistical attractiveness indicator's components; therefore,  $x_2$  it was determined as follows:

$$x_2 = \frac{0.2165l_1 + 0.3428l_2 + 0.4407l_3}{n}, \quad (8)$$

where  $l_1$  is the port belonging to the ITC;  $l_2$  – location near industrial areas;  $l_3$  – transport accessibility.

When determining the port's logistical attractiveness, not all indicators can be presented in

kind, so conditional indicators were used (in points) with experts' assessments. This slightly increases the duration of assessment and the cost of its implementation but it takes into account important parameters of the port's logistical attractiveness.

At the present stage of the society development, it is not enough just to load cargo quickly and efficiently in ports. It is necessary to ensure the timely delivery of these goods to the final destination, and this is possible with the close interaction of road, rail, pipeline and water transport, and in the long run – air transport as well. Thus, transport accessibility is one of the important components of investment attractiveness.

To assess the seaport's logistical attractiveness, it is necessary to identify seaports that are at the intersection with the main railways and highways in the corridors No. 5, 7, 9, connected with industrial centers. The role of the seaport investment attractiveness increases if they are considered in the framework of participation in international transport corridors (ITC).

The seaports have a connection with Pan-European transport corridor No. 9, which runs through Helsinki – St. Petersburg – Vitebsk – Kyiv (Moscow) – Odesa (Chisinau) – Plovdiv – Bucharest – Alexandroupolis (with 4 branches), Pan-European transport corridor No. 7, member countries of which are Austria, Hungary, Yugoslavia, Bulgaria, Romania, Moldova, Ukraine.

Transport corridors created by the EU and the Black Sea Economic Cooperation (BSEC) countries pass through the territory of Ukraine. All

these corridors have a direct or radial connection with the seaports of Ukraine:

1. Cretan ITC No. 7 (Danube-Main-Rhine) – ports: Izmail, Reni, Ust-Dunaisk (Pan-European transport corridor);
2. Cretan ITC No. 9 (Helsinki-Alexandroupolis) – ports: Odesa, Yuzhne (Pan-European transport corridor);
3. Euro-Asian Transport Corridor (Illichivsk-Baku) together with ITC Gdansk-Odesa ports: Illichivsk, Odesa, and Yuzhne;
4. ITC BSEC ports: Reni, Izmail, Odesa, Mykolaiv, Kherson, Berdiansk, Mariupol (Asaul, 2014).

However, one entry of ports into the ITC is not enough to increase the logistical attractiveness. It is necessary to have a developed road and railway infrastructure. In the next Global Competitiveness Report of the World Economic Forum for 2019, Ukraine ranks 59th in terms of transport infrastructure quality, 114th – in terms of road quality, 78th – in terms of ports quality, and 34th – in terms of railways quality (Schwab, 2019). Such analytical data indicate the urgent need for investment in transport infrastructure, including port infrastructure.

The ranking of ports was carried out according to the scoring system and connection with the international transport corridors, and taking into account the international transport corridors to which the ports of a certain region are connected. For example, Mykolaiv seaport – to:

- ITC No. 9 Helsinki – St. Petersburg – Kyiv (Moscow) – Odesa (Chisinau) – Bucharest – Alexandroupolis;
- ITC No. 7 “The Danube Waterway”;
- ITC TRACECA “Europe – Caucasus – Asia”;
- one of the routes NELTI “New Eurasian Land Transport Initiative”, “Northern China – Kazakhstan – Western Europe” (Asaul, 2014).

The number of logistical attractiveness points was determined by the number of connecting trans-

port corridors, the development of transport infrastructure, and the location near industrial areas. As Ukraine’s production complexes are located in long-established areas and new industrial construction is limited, their development is possible through improvement, modernization, and reconstruction. One of the most important factors in ensuring a stable flow of goods is the production of competitive products for export. Thus, the number of points was determined to consider how close the port was located to factories, metallurgical plants, and agricultural enterprises. For example, the Mykolaiv and Odesa seaports have the potential for developing grain logistics, as it is well located for transporting grain from the northern and eastern parts of Ukraine. Therefore, grain exports through the port are growing. The port’s logistical attractiveness is why there is a demand among private port operators to rent berths.

For the expert calculation of the seaport’s logistical attractiveness, the maximum number of points was set at 10 in the present study (Table 5).

**Table 5.** Indicators of logistical attractiveness of Ukrainian seaports

Source: Developed by the authors.

Port	Indicators of the seaport’s logistical attractiveness, points		
	$I_1$ belonging to ITC	$I_2$ location near industrial areas	$I_3$ transport accessibility
Berdiansk	2	5	4
Bilhorod-Dnistrovskiy	2	3	3
Izmail	3	4	4
Illichivsk	4	8	8
Mariupol	2	9	8
Mykolaiv	4	8	8
Odesa	5	7	8
Oktiabrsk	4	7	7
Reni	4	5	3
Skadovsk	2	4	5
Ust-Dunaisk	2	3	4
Kherson	2	5	7
Yuzhne	5	8	9

The only parameters in determining the prospects for the seaport development was the possibility of building new terminals, berths, warehouses, the ability to service large vessels.

Using the importance of the indicator components of the logistical attractiveness, which experts determined, the calculation  $x_3$  was performed based on the formula:

$$x_3 = \frac{0.3971g_1 + 0.4165g_2 + 0.01864g_3}{n}, \quad (9)$$

where  $x_3$  is the port's logistical attractiveness;  $g_1$  – possibility of constructing new terminals, berths, warehouses;  $g_2$  – possibility of servicing large-tonnage vessels;  $g_3$  – possibility of servicing additional cargo flows.

Seaport development is an ongoing process that causes purposeful and spontaneous transitions from one life cycle to another through processes of change towards innovation and progress. Of course, all measures for its development should be aimed at removing objective obstacles along the way, obtaining the expected results of work and profit, investment, risk minimization. Taking into account the peculiarities of the port's geographical location and the proposal for a promising cargo base, two main ways of possible development of seaports in Ukraine were identified. The first is the berth reconstruction with increasing their depths (up to 15-16 m) and increasing their production capacity for receiving and handling modern vessels; the second one is creating new transshipment complexes outside the water areas. A combination of both options is also possible.

The seaport development ratio is an integrated indicator that takes into account the possibility of increasing the production capacity of berths, berth depths, improving mechanization and automation of loading and unloading, development of the port network of railways, roads, conveyors and pipelines, transport hubs, providing the most rational interaction of transport in transport hubs, direct cargo operations.. The possibility of building new terminals, berths, warehouses is an important indicator of the seaport development. The heavier traffic flows become, the more important seaports become that increases their transshipment and shipping functions, as well as highly specialized terminals.

All Ukrainian seaports have a defined territory and most of them are located within the built-up

area. The ability to build port facilities is limited by factors such as:

- impossibility to develop the port territory due to limited urban area;
- the possibility of harming the environment by building new terminals, berths, warehouses and increasing the load on the ecological system of the region;
- the need to reconcile the port's interests with the tourism and recreation industry;
- impossibility to technologically combine terminals for processing different types of cargo in one territory;
- low capacity of the infrastructure adjacent to the port and the port transport infrastructure.

Some ports do not have significant prospects for development as they are limited by the depth parameters of the Kerch-Yenikale Canal, the Danube limited by the location of bridges, the depths of the Danube-Black Sea Canal and other factors.

In the authors' opinion, the port of Yuzhne has the greatest prospects for development, taking into account these factors. By 2030, the port can build another 18 berths and increase the total capacity by 40 million tons – up to about 130 million tons. This is facilitated by the port's depth and the availability of area (including rear area) for the organization of warehousing. Other ports in the region have no prospects for further development. Thus, the ports of Odesa and Illichivsk do not have rear areas for the expansion of warehousing, limited by cities, which makes it impossible to intensively transship such goods as coal, fertilizers, and iron ore. Based on the results of expert assessments, analysis of the port's capacity, the possibility of expanding the port territory, the state of rail and road transport, the port's development prospects' indicators have been determined. These indicators are presented in Table 6.

In ports with missing areas for constructing new berths, it is necessary to improve transshipment technology by specializing berths, namely constructing specialized complexes and modernizing the existing specialized complexes for transship-

**Table 6.** Indicators of the development prospects of Ukrainian seaports

Source: Developed by the authors.

Port	Indicators of the port development prospects, in points		
	$g_1$ the possibility of building new terminals, berths, and warehouses	$g_2$ possibility of servicing large-capacity vessels	$g_3$ possibility of servicing additional cargo flows
Berdiansk	3	6	5
Bilhorod-Dnistrovskiy	4	2	4
Izmail	3	6	6
Illichivsk	3	8	5
Mariupol	4	6	6
Mykolaiv	5	7	7
Odesa	4	8	6
Oktiabrsk	4	7	7
Reni	1	5	4
Skadovsk	1	2	6
Ust-Dunaisk	1	3	4
Kherson	5	6	6
Yuzhne	2	10	7

ment of grain, ore, and coal, containers. The port of Illichivsk does not have a clear program for reconstructing its facilities and restoring and specializing its facilities, which would be reconciled with all related transport modes, which certainly negatively affects its investment attractiveness. The restraining factor is that, in general, the ports of the North-West Coast of the Black Sea are connected by a single railway system, which today is too congested, and it limits their further development. The Mykolaiv region ports can increase their capacity by 30 million tons, but they are limited by the depths of the Bug-Dnieper-Lyman Canal and its considerable length for dredging so it is impossible to make these ports deep-water. The implementation of such projects is quite questionable in terms of efficiency and involvement of cargo flows, which are attracted by great depths.

The region's investment attractiveness ratio characterizes the socio-economic condition of the re-

gion at a given time, trends in its development, reflected in investment activity, the satisfaction level of financial, production, organizational and other requirements or investor's interests in a particular region (see Table 7).

This indicator is used to determine a comparative indicator of the regional business activity where the seaport is located. This indicator should be determined in the following periods according to the methodology proposed by the Institute for Economic Research and Policy Consulting (Tymoshchuk & Melnyk, 2013).

Based on the  $x_1, x_2, x_3, x_4$  calculated values above, the integrated indicator of *Rin* investment attractiveness of the seaport was calculated based on the analytical formula 3. According to the results of calculating the integrated indicator of investment attractiveness according to the developed scale, Ukrainian seaports are divided into

**Table 7.** Determining the comparative indicator of business activity in the region

Source: Developed by the authors.

Ports	Region	Investment attractiveness index of the region	Comparative indicator of the region business activity, $x_4$
Odesa, Illichivsk, Yuzhne, Bilhorod-Dnistrovskiy, Reni, Izmail, Ust-Dunaisk	Odesa	1.459	9
Mykolaiv, Oktiabrsk	Mykolaiv	1.339	8
Kherson, Skadovsk	Kherson	1.264	3
Mariupol	Donetsk	1.281	4
Berdiansk	Zaporizhzhia	1.355	6

**Table 8.** Ratio scale of the seaport investment attractiveness

Source: Developed by the authors.

The value of the integrated indicator of the port investment attractiveness, $R_{in}$	The ratio value of the port investment attractiveness, $K_{in}$	The level of the port investment attractiveness	Ports
1-10	3	High level	Yuzhne
8.6-9	2.9		Odesa
8.1-8.5	2.8		Illichivsk
7.1-8	2.6		Mykolaiv
6.1-7	2.2	Medium level	Izmail
5.1-6	1.8		Mariupol
4.1-5	1.4		Oktiabrsk
3.8-4	1.0		Kherson
3-3.7	0.9		Reni
1.1-2.9	0.8	Low level	Ust-Dunaisk, Berdiansk
1	0.7		Skadovsk, Bilhorod-Dnistrovskiy

three groups: high, medium, and low level of investment attractiveness (Table 8).

The ratio of the port investment attractiveness can be used to determine the number of concession fees. It can also be used to determine the seaport ranking. This indicator should be used in determining the value of commercial seaports to privatize them.

## 4. DISCUSSION

According to the calculations results, it is established that the ports of Yuzhne, Odesa, Illichivsk, Mykolaiv have a high level of investment attractiveness. Their investment attractiveness ratio ranges from 3 to 2.6. The ports of Izmail, Mariupol, Oktiabrsk, and Kherson have a medium level (ratio ranging from 2.2 to 1), and the other ports have low investment attractiveness (ratio from 0.9 to 0.7). The developed methodological approach forms the basis for management decisions on assessing key functional areas of seaports. Besides,

it provides an assessment of the objective level of investment attractiveness of the port. Private and public investors can use the assessment results in choosing the optimal strategic decision for investment in the development of seaport infrastructure. Also, it can be used by the Ministry of Infrastructure of Ukraine in the implementation of public-private partnership projects in seaports, in particular, in determining concession fees based on a differentiated approach.

The advantage of this assessment of the investment attractiveness of seaports is to take into account a combination of various factors that determine not only the level of profitability of the port, efficiency of its property, solvency, financial stability, but also logistical attractiveness and ability to self-development. It is worth noting that assessing the development potential of ports helps investors to make investment decisions, especially with increased risk. The disadvantage of assessing the investment attractiveness of seaports is its subjective nature, as it depends on the level of competence of the experts involved.

## CONCLUSION

The study allowed us to draw the following conclusions. First, Ukrainian seaports have different investment attractiveness for investors in terms of their internal development level, the set of external components that affect investment attractiveness and taking into account growth prospects. This assessment's practical use creates a basis for attracting investment in seaports in proportion to the level of their investment attractiveness and contributes to the effectiveness of investment decisions.

Secondly, the presented assessment of investment attractiveness indicates the need for seaport management to develop differentiated approaches to the mechanisms and measures needed to modernize and enhance each individual seaport's investment attractiveness.

Thirdly, at the same time, as each seaport has its investment gaps, several common problems need to be addressed to all Ukrainian seaports to accelerate integration into the Trans-European Transport Network. Among the priority points for increasing the investment attractiveness of Ukrainian seaports are the following:

- development of knowledge exchange and access to the best European practices of port development;
- participation in the work of the association's committees, promotion of Ukrainian terminals in the international arena;
- expanding opportunities for the introduction of European port standards;
- transformation of domestic seaports into active participants in the formation of European port policy;
- participation in international investment projects;
- development of public-private partnerships and concessions in seaports;
- improvement of domestic legislation, in particular, the adoption of the Law of Ukraine "On Multimodal Transportation".

The novelty of the presented integrated assessment of seaports' investment attractiveness is that it consolidates four components:

- 1) indicators of business activity in the region;
- 2) indicators of financial and property status (which take into account production, enterprise assets and financial conditions, its liquidity, business activity, and profitability);
- 3) indicators of assessment of material and technical attractiveness (taking into account the port's affiliation to the international transport corridor, location near industrial zones, transport accessibility);
- 4) indicators for assessing the prospects of port development (considering the possibility of building new terminals, berths, warehouses, the possibility of servicing large vessels and additional cargo flows).

Further research can be conducted to develop a differentiated approach to the calculation of concession fees in the seaports of Ukraine based on this assessment of investment attractiveness.

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## REFERENCES

1. Aerts, G., Grage, T., Dooms, M., & Haezendonck, E. (2014). Public-Private Partnerships for the Provision of Port Infrastructure: An Explorative Multi-Actor Perspective on Critical Success Factors. *The Asian Journal of Shipping and Logistics*, 30(3), 274-298. <https://doi.org/10.1016/j.ajsl.2014.12.002>
2. Asaul, A. (2004). Sistematizatsiya faktorov, kharakterizuyushchikh investitsionnyu privlekatelnost regionov [Systematization of factors characterizing the investment attractiveness of regions]. *Regional Economy*, 2, 53-62. (In Russian)
3. Banister, D., & Berechman, Y. (2001). Transport investment and the promotion of economic growth. *Journal of Transport Geography*, 9(3), 209-218. [https://doi.org/10.1016/S0966-6923\(01\)00013-8](https://doi.org/10.1016/S0966-6923(01)00013-8)
4. Bendall, H. B., & Stent, A. F. (2007). Maritime investment strategies with a portfolio of real options. *Maritime Policy and Management*, 34(5), 441-452. Retrieved from [https://www.researchgate.net/publication/233212297\\_Maritime\\_investment\\_strategies\\_with\\_a\\_portfolio\\_of\\_real\\_options](https://www.researchgate.net/publication/233212297_Maritime_investment_strategies_with_a_portfolio_of_real_options)
5. Deng, T. (2013). Impacts of Transport Infrastructure on Productivity and Economic Growth. *Recent Advances and Research Challenges Transport Reviews*, 33(6), 686-699. <http://dx.doi.org/10.1080/01441647.2013.851745>
6. Evans, J. J. (1984). Some practical aspects of investment appraisal in shipping. *Maritime Policy and Management*, 11(3), 197-222. <https://doi.org/10.1080/03088838400000017>
7. Garcia-Alonso, L., & Martin-Bofarull, M. (2007). Impact of port investment on efficiency and capacity to attract traffic in Spain: Bilbao versus Valencia. *Maritime Economics and Logistics*, 9(3), 254-267. Retrieved from <https://link.springer.com/article/10.1057/palgrave.mel.9100183>
8. Hawkins, J. E. (1991). Port investment appraisals for the 1990s. *Maritime Policy and Management*, 18(3), 225-232.
9. Hlali, A., & Hammami, S. (2017). Seaport Concept and Services Characteristics: Theoretical Test. *The Open Transportation Journal*, 11, 120-129. Retrieved from <https://www.semanticscholar.org/paper/Seaport-Concept-and-Services-Characteristics%3A-Test-Hlali-Hammami/88b57f23af533edfc5582cabcb64d446217cd317>
10. Jouili, T. A., & Allouche, M. A. (2016). Impacts of Seaport Investment on Economic Growth. *Promet – Traffic & Transportation*, 28(4), 365-370. Retrieved from [https://www.researchgate.net/publication/312047529\\_Impacts\\_of\\_Seaport\\_Investment\\_on\\_the\\_Economic\\_Growth](https://www.researchgate.net/publication/312047529_Impacts_of_Seaport_Investment_on_the_Economic_Growth)
11. Karpenko, O., Palyvoda, O., & Bondarenko, O. (2018). Simulation modelling of strategic development of transport and logistics clusters in Ukraine. *Baltic Journal of Economic Studies*, 4(2), 93-98. Retrieved from [https://www.researchgate.net/publication/326710845\\_SIMULATION\\_MODELLING\\_OF\\_STRATEGIC\\_DEVELOPMENT\\_OF\\_TRANSPORT\\_AND\\_LOGISTICS\\_CLUSTERS\\_IN\\_UKRAINE](https://www.researchgate.net/publication/326710845_SIMULATION_MODELLING_OF_STRATEGIC_DEVELOPMENT_OF_TRANSPORT_AND_LOGISTICS_CLUSTERS_IN_UKRAINE)
12. Kharlamova, G. (2014). Investment attractiveness of Ukrainian regions: rating assessment and marketing promotion *Journal of International Studies*, 7(1), 9-26. <https://doi.org/10.14254/2071-8330.2014/7-1/1>
13. Kolesnik, I. M. (2016). Osoblyvosti rozvytku morskikh portiv Ukrainy na zasadakh derzhavno-pryvatnoho partnerstva [Features of development of seaports of Ukraine based on public-private partnership]. *Economics and Organization of Management*, 4(24), 201-208. (In Ukrainian)
14. Lagoudis, I. N., Rice, J. B., & Salminen, J. B. (2014). Port Investment Strategies under Uncertainty: The Case of a Southeast Asian Multipurpose Port. *The Asian Journal of Shipping and Logistics*, 30(3), 299-319. Retrieved from [https://www.researchgate.net/publication/270650939\\_Port\\_Investment\\_Strategies\\_under\\_Uncertainty\\_The\\_Case\\_of\\_a\\_South-east\\_Asian\\_Multipurpose\\_Port1](https://www.researchgate.net/publication/270650939_Port_Investment_Strategies_under_Uncertainty_The_Case_of_a_South-east_Asian_Multipurpose_Port1)
15. Law of Ukraine "On seaports of Ukraine". Retrieved from <http://zakon1.rada.gov.ua/laws/show/4709-17>
16. Lee, P. T., & Lam, J. S. (2013). Fifth generation ports? Competitive-ness analysis on major Asian ports. In *Proceedings of the International Workshop on Port Economics*. Singapore.
17. Makashyna, E. V. (2010). Sravnitelnyy analiz sovremennogo sostoyaniya morskikh portov v raznykh stranakh [Comparative analysis of the current state of seaports in different countries]. *Management in Russia and Abroad*, 2. (In Russian). Retrieved from <http://www.mevriz.ru/articles/2010/2/6087.html>
18. Munnell, A. H. (1992). Policy Watch: Infrastructure Investment and Economic Growth. *The Journal of Economic Perspectives*, 6(4), 189-198. Retrieved from <https://www.aeaweb.org/articles?id=10.1257/jep.6.4.189>
19. Oblak, R. A., & Bistričić, A. (2013). Jugović: Public-private partnership – management model of Croatian seaports. *Management*, 18(1), 79-102. Retrieved from [https://www.researchgate.net/publication/284170352\\_Public-private\\_partnership\\_-\\_Management\\_model\\_of\\_Croatian\\_seaports](https://www.researchgate.net/publication/284170352_Public-private_partnership_-_Management_model_of_Croatian_seaports)
20. Palyvoda, O. M., & Karpenko, O. O. (2017). Mechanism of providing economic development of transport and logistics enterprises on the basis of clustering. *Scientific Bulletin of Polissya*, 4(14), 33-39. Retrieved from <http://195.69.76.76/handle/123456789/15759>
21. Rodrigue, J-P., Notteboom, E., & Pallis, A. A. (2011). The

- Financialisation of the Terminal and Port Industry: Revisiting Risk and Embeddedness. *Maritime Policy and Management*, 38(2), 191-213. <https://doi.org/10.1080/03088839.2011.556675>
22. Saati, T. (1993). *Prinyatie resheniy [Decision making]* (278 p.). Moscow: Radio and communication. (In Russian)
23. Schwab, K. (2019). *The Global Competitiveness Report*. World Economic Forum. Retrieved from [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitiveness-Report2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitiveness-Report2019.pdf)
24. Shemshuchenko, Yu. S. (Ed.) (2007). *Velykyi entsyklopedychnyi yurydychnyi slovnyk [Large encyclopedic legal dictionary for order (992 p.)]*. Kyiv: Legal opinion. (In Ukrainian)
25. Tymoshchuk, O. M., & Melnyk, O. M. (2013). Formuvannia mekhanizmu realizatsii lohistychnoi stratehii richkovykh portiv [Formation of the mechanism for the implementation of the logistic strategy of fish ports]. *Actual problems of the economy*, 3, 146-155. (In Ukrainian)
26. Van Ham, H., & Koppenjan, J. Building. (2001). Public Private Partnerships: Assessing and Managing Risks in Port Development. *Public Management Review*, 3(4), 593-616.
27. Vigarié, A. (2004). La manutention des conteneurs dans le delta du Rhin, des enjeux européens? *Transport*, 425, 149-157.
28. Vlasova, V. P. (2013). Suchasni naukovi pidkhody shchodo definitsii "morskyi port" [Modern scientific approaches to the definition of a seaport]. *Water transport – Vodnyi transport*, 3(18), 115-119. (In Ukrainian)