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INVESTMENT ATTRACTIVENESS OF THE PORT INDUSTRY IN CRISIS CONDITIONS

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Abstract

Historically, the maritime industry in Ukraine, which previously was subordinated to the Ministry of Transport of Ukraine and whose successor is the Ministry of Infrastructure of Ukraine, was complex of different organizations (shipping companies, ports, ship-repairing and shipbuilding factories and other related and auxiliary enterprises). They had their own organizational structures, goals and tasks and in some way interacted with each other. Such organization was aimed, first of all, at achieving target production indicators formed by the state authorities. In fact, such structure of maritime industry can be regarded as vertically integrated. When the issue of increasing the economic efficiency of the main component of the maritime industry (of the ports) was raised, the main efforts were aimed at minimizing the costs of their functioning. This led to the creation of horizontally integrated (in whole or in part) companies in the maritime industry. The driving factor for their implementation should be the transformation of organizational and economic mechanisms of regulation of the port's activity from the point of view of a clearly defined anti-crisis character.

Therefore, the goal of the study was to develop and justify the feasibility of using a model that will determine the effectiveness of the strategy of investment into the development of the organizational and economic mechanism of regulation of the port activity. The calculations of determining the best variant of an investment project under different external conditions are presented. In calculations based on certain criteria (appropriate levels of capitalization and effective dividend policies), we took into account the factors related to the expectations of the crisis in Ukraine, Ukraine's unpreparedness to enter the new technological phase, the loss of scientific and technical personnel, inflationary phenomena and instability of the national and world currencies.

In addition, within the framework of the developed model, the authors propose an algorithm that makes it possible to select the characteristics and determine the parameters of optimization of the organizational and economic mechanism of regulation of the port activity under the conditions of long-term continuation of the crisis situation.

Keywords	port activity, investment attractiveness, dividend policy of ports, financial and economic crisis, Ukraine
JEL Classification	G31, R42

INTRODUCTION

Taking into account the factor of permanent uncertainty (economic, political, social, etc.), in the short-term perspective, the optimization of the organizational and economic mechanism of regulation of the port activity, provision of the desired efficiency of implementation of the chosen market strategy as the main component of the organizational and economic mechanism, as well as increasing the overall level of competitiveness of domestic ports, require the attraction of additional private capital, the expediency and effectiveness of which should be quantitatively assessed through the implementation of appropriate economic instruments for the evaluation and selection of projects for the development of ports.

In the conditions of various restrictions on optimization of regulation of the capital-based industries (including ports), in which the production experiment is economically unjustified, it is necessary to develop adequate models and select valid criteria, which will make it possible to recommend correct and effective management decisions that take into account the marginal possibilities of technologies, resources, economic and other conditions for improving the efficiency of functioning and regulation of such ports.

1. LITERATURE REVIEW

The beginning of the scientific discussion of the problem of assessment of the optimal investment projects was the works of Damodaran (2012), Grynin (2010), Bodie (2013), Hirschleifer (1958), Solow (1963), Gale (1973), Dorfman (1981). In these works, attempts were made to find a universal indicator calculated on the basis of the flow of the project's payments and to establish the principles and mechanisms of assessment.

With the help of the obtained data, it is possible to choose the most appropriate investment project. The complexity is in the fact that future profits cannot be determined precisely, and, therefore, should be described as an object of non-numerical nature.

Consequently, the task of maximization of profits should be defined as maximization of uncertain profits in uncertain time intervals. Theoretical analysis of this situation was carried out by Nobel laureate in economics Leontief, who made a conclusion that it is impossible to compare economic values from different periods (Leontief, 1966).

In our view, it is possible to use an approach in the form of a task, for example, the search of inflation index in interval form.

Even more blurred and generalized are macroeconomic indicators of the "gross domestic product" type (GDP), especially when compared according to years and countries. According to the well-known economist Morgenstern, such macroeconomic indicators can only be determined with an accuracy of 5-10% (Morgenstern, 1950). In other words, a thorough economic and mathematical analysis of a situation is needed, which requires the building of appropriate econometric models, development and/or application of the necessary software.

A conceptually different approach was proposed in the works of Cantor and Lipman (1995). The authors set a formal mathematical task of optimizing investment activity. However, in their model, the NPV and IRR indicators were not explicitly used as criteria for optimization, but were merely characteristics of investors' actions, who maximize their capital to the known moment of time under the conditions of imperfect market (when investment activity is carried out by means of self-financing, that is, an enterprise does not have the capacity or intention to borrow).

Paper by Kgaugelo Sammy Boya (2016) presents the results of the analysis of market strategies that are the most suitable for the introduction of high-speed bus lines between metropolises. The strategies of the "blue" and "red" oceans are considered in order to achieve a certain level of profitability, the expediency for users and flexibility for managers, innovation, the compliance with legislative restrictions and environmental requirements, the role of the state in regulating these processes, etc. The covered list of issues (10 key elements of these strategies) is quite capacious, informative and useful, but this study contains no assumptions about the existence of uncertainty conditions and their consideration in building these strategies, the degree of investment attractiveness and the mechanisms for its evaluation.

The authors Ilchenko and Oneshko (2017) conducted the analysis of Ukraine's trade potential in terms of ensuring the volumes of export of agricultural products by transport capacities. According to Ilchenko and Oneshko (2017), the quality of the port infrastructure, the compliance of its technical and technological conditions with the requirements of cargo owners and carriers, require significant investments and instruments for selecting the most appropriate projects for the development of port facilities. Moreover, the inability to carry out projects (or select proj-

ects) in the absence of consideration of risk factors and the factors of uncertainty (Boiko, 2016; Oneshko & Ilchenko, 2017) eliminates the possibility of considering such a selection successful and justifiable in the long term.

That is why the article proposes a model the aim of realization of which is the analysis of the influence of uncertainty on the occurrence of crisis phenomena (critical moment) on investment decisions in the imperfect market and the development of mechanisms for developing a strategy (and tactics) for assessing the growth rate of investor's capital, which will give him an opportunity to avoid losses.

The proposed model makes it possible to develop a certain technology for conducting a scenario analysis of micro and macroeconomic circumstances, to analyze the medium- and long-term effects of tax innovations of the state and to assess their influence on investment decisions.

However, in the process of their functioning, enterprises of the port industry are also subject to the natural processes of technological obsolescence, changes in the resource base, changes in the characteristics and functioning modes. Moreover, there are constant changes in the environment for selling outgoing products, in economic interactions between the ports and external environment. These factors and parameters determine ports as systems with their elements and relationships determining their place in this system.

We believe that the global goal of the production system of ports should be maximization of the life cycle with an implementation of certain restrictions and certain operating conditions. The goal of the system of their regulation is to search for such impact on the elements, structure and parameters of the system (port) that would ensure its maximum life cycle. In general, the managerial influence should be directed at changing the structure of the managed system and the parameters of this system as a whole or of its individual elements. It is clear that these managerial influences must adapt the composition, structure and links of ports to compensate or reduce the degree of negative environmental impact and encourage internal changes.

In practice, despite the constant nomenclature of traditional services, the adaptation can take place in two directions:

- the parametric one, in the course of which there are changes in the parameters of technologies, techno-economic characteristics of the process of service provision, technological regimes, the parameters of energy and material resources;

- the structural one, in the course of which there are changes in the structure of services through the implementation of new or exclusion of the existing technological processes, changes in the structure of transport operations with an introduction of new technological routes, structures of planning and management.

These directions are interconnected – the change of the structure of services is caused by the change in the parameters of technological and transport operations, technological process charts and instructions. The quality of the structural and parametric adaptation of the process of service delivery is determined by the nature and significance of the criteria that assess their internal organizational and economic efficiency, consumer quality and efficiency of market implementation.

1.1. The main results of the study

It is known that according to the Law of Ukraine ("On the sea ports of Ukraine: as of May 17, 2012"), ports were legally allowed to be transformed into Public Joint Stock Companies. This form is most commonly used in international practices of port activity. Despite the practical absence of such an organization on the territory of Ukraine, we consider it expedient to draw attention to the propriety (economic, financial, environmental, innovative, investment, etc.) of this form for domestic ports. Therefore, we propose a model that can be used by organizations of the port industry integrated into such a company. To form a model of efficient functioning of ports and to increase their investment attractiveness, it is necessary to analyze their operative, investment and financial activity. It is obvious that the goal of all ports is to increase their profits. Under the model's condi-

tions, we consider a port to be a joint-stock company and the payments of dividends to shareholders are paid at the critical moment of time T and will be observed for some fixed time T_c. Therefore, the goal of ports is:

$$\sum_{t=1}^{T} \frac{DIV(t)}{(1+V_a)^t} + \sum_{t=T+1}^{T+T_c} \frac{DIV(T)}{(1+V_a)^t} \rightarrow \max. \qquad (1)$$

It leads to the averaging-out of indicators at a critical time for all units and investment projects in the development of port activities.

The above description makes it possible to draw a plan of optimal investment projects for the port and to optimize its operational activities.

However, this description is quite difficult to analyze because of the large number of variables and relationships that have a technical nature (for example, the correlation that appeared as a result of countering the nonlinearity of the original description).

It is necessary to understand which principles the company should be used in the formation of its investment plan, which parameters and conditions of operation will have a significant effect on it.

The most rational means of producing and realizing managerial influences aimed at the structural and parametrical adaptation of ports to the prevailing conditions is an economic and mathematical modeling of these processes and prediction of the expected results. The biggest difficulty in the formal description of the abovementioned processes is a combination of relatively simple private models and relationships in the general model, which is adequate to the real processes.

We apply the following approach to systematize investment projects in such a way that the following inequalities are fulfilled:

$$\frac{n_1}{C_1} \geq \frac{n_2}{C_2} \geq \ ... \ \geq \frac{n_{k_1}}{C_{k_1}} \geq 1 \geq \frac{n_{k_1+1}}{C_{k_1+1}} \geq \frac{n_{k_2}}{C_{k_2}} >$$

$$> 1 - l(1-a) \geq \frac{n_{k_2}}{C_{k_2+1}} \geq \ ... \ \geq \frac{n_{k_3+1}}{C_{k_3+1}} \geq \ ... \ > \frac{n_k}{C_k}. \qquad (2)$$

Such a breakdown classifies investment projects into the following four groups:

- $i \in [1, \ k]$ – a group of unconditionally effective projects that are beneficial to the port's shareholders; they should be primarily financed even from the net profit of the port – at the expense of dividends;

- $i \in [(k_1 +1) \ ... \ k_3]$ – a group of relatively effective projects that are interesting to port shareholders only if they are able to finance them at least in part by using the borrowed funds. The implementation of these projects depends on the shortage (or redundancy) of the funds in the port and its financial leverage l. Therefore, this group is divided into two subgroups:

- $i \in [(k_1 +1) \ ... \ k_2]$ – a sub-group of projects for which the port can attract enough borrowed funds on the collateral of its fixed assets during the implementation of projects. The implementation of the projects of this subgroup is a priority for the company so that part of the net profit of the port can be spent on additional (in addition to the attracted target loan) financing if there is a deficit of free funds;

- $i \in [(k_2 +1) \ ... \ k_3]$ – a subgroup of projects the financing of which takes place only if the port does not have a deficit of free funds;

- $i \in [(k_3 \ ... \ k]$ – a group of unprofitable projects. If the company has free funds after the financing of all profitable projects and the payment of dividends, they should be used to reduce the debt burden rather than to finance these projects.

Thus, four situations can be distinguished:

Situation 1: $\hat{R} + \hat{E} > (1-l)\sum_{i=1}^{k_3} C_i.$

In this situation, ports have excessive free funds, which make them able to finance (from the borrowed funds mainly) all profitable projects and, if after this there are remaining money resources, to pay back part of the old debt.

$DIV = NI;$

$\hat{\theta}_i = C_i; \ \forall_i \in [1 \ ... \ k_3];$

$\hat{\theta}_i = 0; \ \forall_i \in [(k_3 + 1) \ ... \ k];$ $\qquad (3)$

$\Delta D = \sum_{i=1}^{k_3} C_i - \hat{R}.$

Situation 2:

$(1-l) \cdot \sum_{i=1}^{k+1} C_i > \hat{R} + \hat{E} \geq (1-l) \cdot \sum_{i=1}^{k^r} C_i; \ k_3 > k \geq k_2.$

In this situation, ports lack the funds to finance all relatively effective projects. Therefore, they initially launch all potentially cost-effective projects, after which they pay dividends, and only then they launch relatively cost-effective projects for the realization of which the borrowed loans are sufficient.

$DIV = NI;$

$\hat{\theta}_i = C_i; \ \forall_i \in [1 \ ... \ k];$

$\hat{\theta}_{k+1} = \dfrac{R+E}{1-l} - \sum_{i=1}^{k^k} C_i;$ $\quad (4)$

$\hat{\theta}_i = 0; \ \forall_i \in [(k+2) \ ... \ k];$

$\Delta D = \dfrac{\hat{E} + l \cdot \hat{R}}{1-l}.$

Situation 3:

$(1-l) \cdot \sum_{i=1}^{k_2} C_i > \hat{R} + \hat{E} \geq (1-l) \cdot \sum_{i=1}^{k_2} C_i - N.$

In this situation, ports have to abandon the implementation of relatively effective projects and even partially reduce the level of dividends in order to allocate part of net profits to the additional financing of highly effective projects.

$DIV = \hat{R} + \hat{E} + NI - (1-l) \cdot \sum_{i=1}^{k_2} l_i;$

$\hat{\theta}_i = C_i; \ \forall_i \in [1 \ ... \ k_2];$

$\theta_i = 0; \ \forall_i \in [(k_2 + 1) \ ... \ k];$

$\Delta D = E + l \sum_{i=1}^{k_2} C_i.$ $\qquad (5)$

Situation 4:

$(1-l) \cdot \sum_{i=1}^{k+1} C_i > \hat{R} + \hat{E} \geq$

$\geq (1-l) \cdot \sum_{i=1}^{k} C_i \cdot (1-l); \ \sum C_i - 1.$

In this situation, ports suffer from a lack of available funds so that they are used for prioritized goals – for absolutely effective projects. But even with the maximum use of credit limits and all net profits, ports are able to realize only a part of absolutely effective projects.

$DIV = 0;$

$\hat{\theta}_i = C_i; \ \forall_i \in [1 \ ... \ k];$

$\hat{\theta}_{k+1} = \dfrac{\hat{R} + \hat{E} + NI}{1-l} - \sum_{i=1}^{k^k} l_i;$

$\hat{\theta}_i = 0; \ \forall_i \in [(k^D + 2) \ ... \ k];$

$\Delta D = \dfrac{\hat{E} + l + (\hat{R} + NI)}{1-l}.$ $\qquad (6)$

Each expression has an economic meaning:

NI – net profit of the port; $\hat{R}$ – difference between the amount on the current account of the port and its capital costs not related to the investment project. It is analyzed at the present moment of time, that is, it is an unencumbered balance of the current account; $\hat{E}$ – free credit limit of the port; a – the cost of the port's debt; n_i – assessment of the future income from investment projects.

It should be noted that the sign of the parameter is

not known in advance, the negative meanings $\hat{R}$ are interpreted as the means necessary for implementation of the ports' development projects, the decision to launch which was taken earlier.

Taking into account the problems inherent in the modern Ukrainian economy regarding the possibilities of its financing (imperfect market) to solve the problems of port development and attraction of investors, including foreign ones, it is expedient to use the approach of searching the solution by applying a dynamic model with phase variables under the conditions of unsteady market and the possible occurrence of the critical moment of time (that is, the requirement to maximize capital at some point in time).

For Ukraine, one of the restrictive conditions is the possibility of occurrence (or strengthening) of a crisis phenomenon, the moment of manifestation of which is unknown in advance.

This phenomenon has a significant impact on the investment attractiveness of ports. Because port activity requires constant investments due to its considerable capital intensity (first of all, infrastructure), it is highly dependent on the overall investment climate in the country. However, there are situations when the market of investments is not stationary, the investment horizon is uncertain and investment projects may become inaccessible at any given time.

Under these circumstances, the search for investors and the attraction of the necessary amount of investment resources for the development of ports or the choice of the most appropriate form of investment of the equity capital into their development becomes complicated.

Another problem may become the selection of an investment project among the possible ones taking into account the existence of all restrictions on its effective implementation. That is, the procedures for optimization of investment activity as a significant stage in the process of regulation of port activity involve the development of a methodological basis for the evaluation of potential investment projects and the selection of the most attractive of them for the development of ports.

However, the implementation of big investment projects cannot be carried out directly in ports due to the lack of the necessary and sufficient capital as a result of the current taxation pressure. We propose to consider the model of investment projects implementation with different volumes of freight traffic and different rates of dividends (in order to bring the calculations closer to the modern conditions, under dividends we understand the portion of the net profit that domestic ports have to give to the state, which is 75%, but we have also considered the variants of 50 and 30% as was the case before).

Investment projects considered as the projects for the introduction of new reloading technologies in ports are the most relevant.
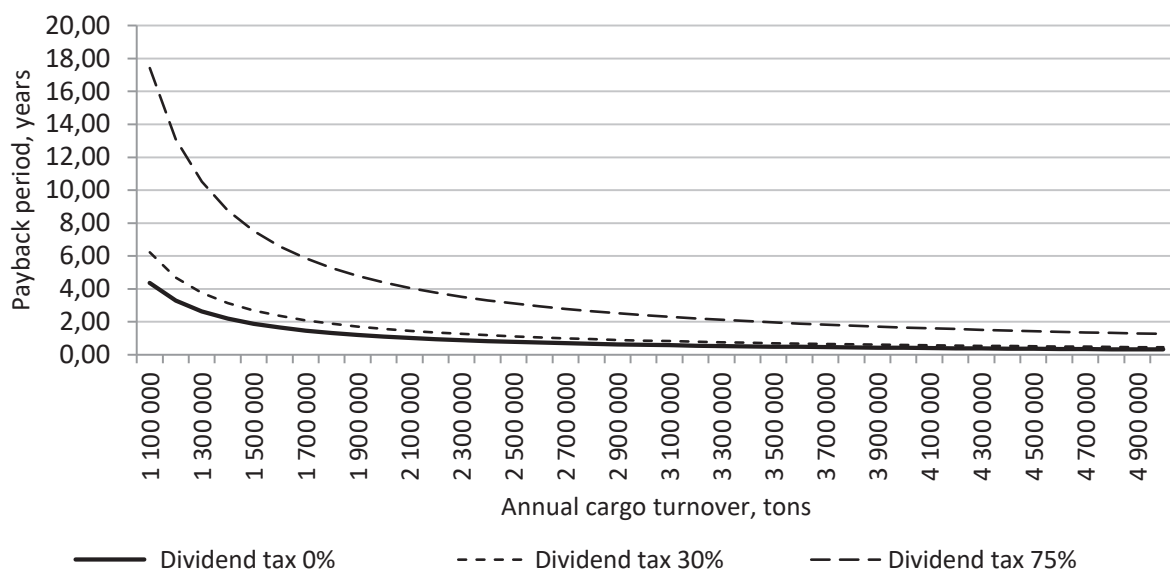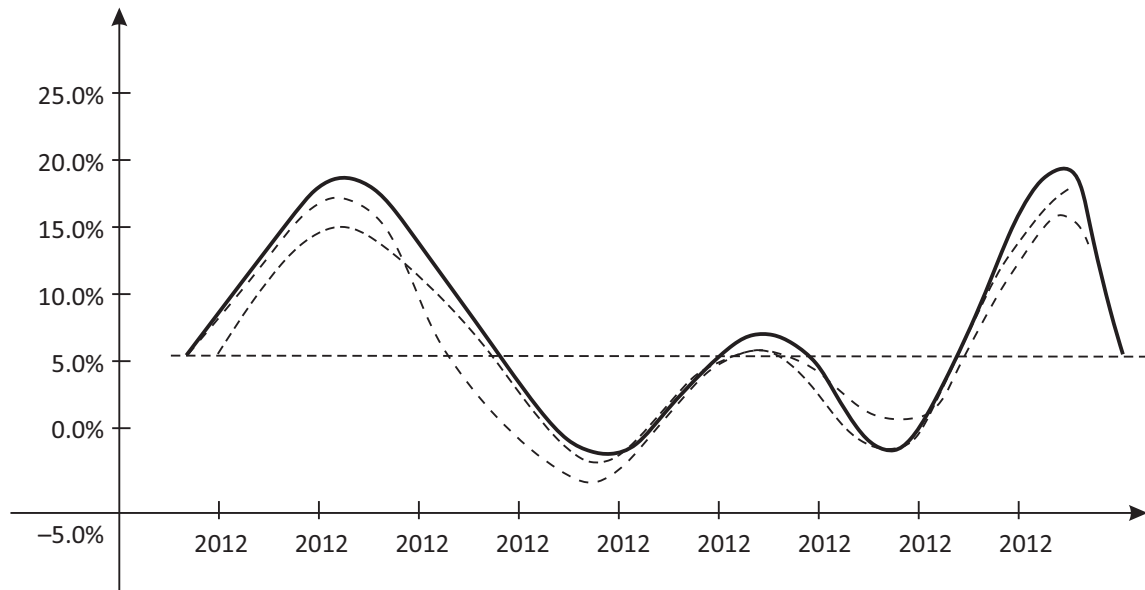

Figure 1. The value of the payback period on investment projects depending on the annual cargo turnover and the rate of taxation on dividends

Table 1. The results of calculations of the indicators of economic effect from investment projects at the rate of dividend tax $d = 75\%$ and the values of cargo turnover from 1600000 to 2000000 tons

Indicators	Conventional signs, calculation formulae	Values				
Cargo turnover per year, tons	Q	1600000	1700000	1800000	1900000	2000000
Annual revenues, mln. UAH	$D = P \cdot Q$	166,6	177,0	187,4	197,8	208,2
Costs of electricity, mln. UAH	$Z_1 = z_1 \cdot t_1 \cdot Q$	0,36	0,39	0,41	0,43	0,46
Total operating costs per year, mln. UAH	$Z = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 + Z_7$	83,1	83,1	83,1	83,1	83,2
Profit for the year, mln. UAH	$D - Z$	83,5	93,9	104,3	114,7	125,1
Annual profit after income tax, mln. UAH	$(D-Z) \cdot \left(1 - \dfrac{J}{100}\right)$	68,5	77,0	85,5	94,0	102,6
Annual profit after the payment of taxes on dividends, mln. UAH	$(D-Z) \cdot \left(1 - \dfrac{J}{100}\right) \cdot \left(1 - \dfrac{d}{100}\right)$	17,1	19,2	21,4	23,5	25,6
Payback period, years	$S = \dfrac{I}{(D-Z) \cdot \left(1 - \dfrac{J}{100}\right) \cdot \left(1 - \dfrac{d}{100}\right)}$	6,59	5,86	5,27	4,80	4,40
Planning horizon, years	T	Net present value, mln. UAH $$NPV = (D-Z) \cdot \left(1 - \frac{J}{100}\right) \cdot \left(1 - \frac{d}{100}\right) \cdot K - I$$				
1		−97,2	−95,3	−93,3	−91,4	−89,5
2		−83,1	−79,4	−75,7	−72,0	−68,3
3		−70,2	−64,9	−59,6	−54,3	−49,0
4		−58,5	−51,8	−45,0	−38,3	−31,5
5		−47,9	−39,8	−31,7	−23,7	−15,6
6		−38,2	−28,9	−19,7	−10,4	−1,1
7		−29,4	−19,1	−8,7	1,7	12,0
8		−21,4	−10,1	1,3	12,6	24,0
9		−14,2	−1,9	10,4	22,6	34,9
10		−7,6	5,5	18,6	31,7	44,8
11		−1,6	12,3	26,1	39,9	53,8
12		3,9	18,4	32,9	47,4	61,9
13		8,8	24,0	39,1	54,2	69,3
14		13,3	29,0	44,7	60,4	76,1
15		17,4	33,6	49,8	66,0	82,2
16		21,2	37,8	54,5	71,2	87,8
17		24,6	41,6	58,7	75,8	92,9
18		27,6	45,1	62,6	80,0	97,5
19		30,4	48,2	66,1	83,9	101,7
20		33,0	51,1	69,2	87,4	105,5

Figure 2. Capital expenditures of ports during the crisis period

A software package that makes it possible to assess the impact of investments on capitalization is developed in the Matlab environment.

To get the final version of the model we have to describe the financial activity of ports. As calculations show, the main factors for the port sector are the availability of cargo flows and tariffs on cargo handling.

Below is a graphical representation and the values of the calculated payback periods of investment projects of the ports under certain conditions (Figure 1).

This leads to the possible situations when ports, focusing on the forecasts that were made at the initial trend of prices, start investing into new technologies, which become unprofitable due to the new adjustments of prices.

There may also be a crisis in the ports themselves due to the existence of rigid bureaucratic procedures and the inability to react in a timely manner to the volatility of the market. An interesting issue is the assessment of how investment activity is affected by the expectations of such a crisis Δ (Figure 2).

A crisis is possible only after the critical moment of time T, that is, on the "tail" described in the model.

Considering the proposals, the goal of ports has a formalized form:

$$\sum_{t=1}^{T}\frac{DIV(T)}{(1+r_a)^t}+\sum_{t=T+1}^{T_c}\frac{DIV(t)(1-\Delta)^{t-T}}{(1+r_a)^t}\rightarrow\max.\,(7)$$

With increasing Δ the investment strategy is becoming more "short-sighted" (Figure 3). The management of ports seeks to invest in a short-term period when a crisis situation is not expected.

If we define capitalization as the present value of dividends paid without considering the probability of a crisis, one can see that such short-sighted behavior negatively affects the value of all ports.

Applying the appropriate estimates of investment projects and focusing on the current market conditions an economic agent draws up a certain investment program.

However, over time, the external conditions of the agent's activity may change significantly and he may face a situation where additional funds are needed to service an already accepted investment program.

Such temporary horizons indicate that in assessing projects, it is necessary to take into account both the price situation and the changes in demand and terms of the project's implementation.

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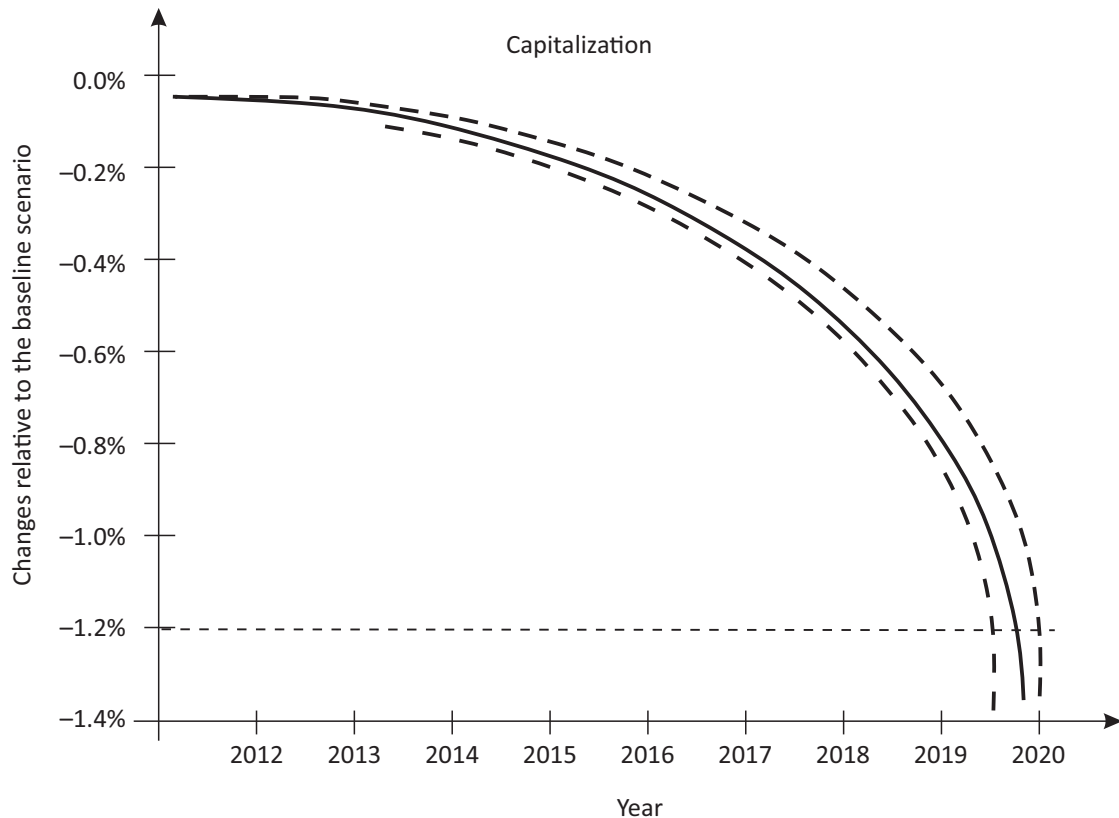
Figure 3. The impact of capitalization on the value of ports

Given the current state of the Ukrainian economy it is extremely difficult to make such assessment.

Firstly, most economic agents are focused on the short-term planning horizon for their activities. The time periods of the main project's payback cannot be analyzed in detail because of the lack of information about the behavior of counterparties.

A way out can be the modeling of the agents' behavior for different scenarios of the events' development.

Secondly, Ukraine does not have much experience in solving such problems.

Thirdly, in Ukraine, there is no structured domestic market, that is, there is no specific specialization of ports. All ports are ready to fight for small freight flows, even those ports, which do not have the necessary technologies for carrying out the required types of port activity.

Fourthly, it is problematic to obtain a qualitative long-term forecast of macroeconomic parameters. The natural requirements for forecasts are consistency and efficiency. Therefore, it appears necessary to study the connection between macroeconomic characteristics and investments.

CONCLUSION

The paper proposes a model of the horizontally integrated port industry in the form of Public Joint Stock Company, which is especially relevant for the implementation of projects with significant capital investments during the initial stages and a long period of their implementation.

Within the framework of the developed model an algorithm is proposed that makes it possible to select the characteristics and to set the values of parameters indicating the continuation of the crisis situation.

The results of calculations according to the abovementioned criteria (capitalization and dividend policy), which also took into account the expectations of the crisis in Ukraine, the country's unpreparedness to enter the new technological phase, the loss of scientific and technical personnel, inflationary phenomena and instability of the national and world currencies make it possible to obtain the best variant of investment project for the development of port activities under different external conditions. In addition, within the framework of the developed model we have proposed an algorithm which makes it possible to select the characteristics and to determine the parameters of optimization of the mechanism of regulation of port activities in the conditions of a long-term continuation of the crisis situation.

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