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Diagnostics of Efficiency of an Enterprise's Export-import Activity

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ABSTRACT

Solving the problems of the efficiency of export-import activity remains relevant for all enterprises of different countries because, due to this, they enter the world economy and develop on a global scale. The article proposes the technology of diagnostics of objects in the economy, which contributes to the objectivity of the diagnosis of the enterprise's effectiveness of export-import activities and which consists of a sequence of information, analytical, and management blocks. Based on a critical analysis of well-known scientists on the efficiency and effectiveness of export-import activities, five criteria for this efficiency have been proposed at the enterprise level. The formation of a rational management decision on the effectiveness of export-import activities involves a diagnostic procedure that uses integrated indicators of Harrington's quality, with the transformation functions of the criteria proposed to modify to take into account the numerical characteristics of their distribution laws. For an objective diagnosis of efficiency, it is necessary to have standards of criteria that reflect the regular operation of the enterprise. The article proposes to form standards of criteria, taking into account the forecast and optimal values. Due to deviations of real values of criteria from reference establishes the diagnosis of efficiency level. To determine the predicted values of the criteria, it is sufficient to calculate the equations of the growth curves, and to choose the optimal values of the requirements, it is recommended to determine the dependence of the general level of efficiency on these criteria. Calculations on real enterprise data have shown that these dependencies are nonlinear functions. For a specific enterprise in the nonlinear optimization problem, there is a limited region of values change of efficiency criteria of export-import activity. The optimal values of efficiency criteria are of great importance both in diagnostics and in management in general.

INTRODUCTION

One of the leading indicators of the economic development of the country is the advantage of exports of goods over imports, and the intensity of this development depends on the ratio of exports and imports for some time. Therefore, solving the problems of managing the efficiency of export-import activities remain relevant for any country in the world. This problem is especially acute for developing countries (Chen et al., 2019, Lv et al., 2019). For example, according to the official statistics of Ukraine (Official site of the Ministry of Economic Development and Trade of Ukraine), in the first quarter of 2020, exports of goods amounted to 12251,0 million US dollars or 99,8% compared to the first quarter of 2019, imports – 13310,2 million dollars, or 96,6%. The negative balance amounted to 1059,2 million dollars; for comparison – in the first quarter of 2019, the negative balance amounted to 1503,8 million dollars. The export-import coverage ratio was 0,92 (0,89 in the first quarter of 2019), which indicates an unsatisfactory state of foreign trade relations. In the context of global deterioration in demand dynamics due to the spread of coronavirus incidence, in particular in the main partner countries of Ukraine (EU, China), the expected fall in world commodity markets, as well as temporary cessation of activities in many industries in Ukraine both external and domestic demand, in 2020 a significant deterioration in the dynamics of the country's economy is expected compared to previously forecast. In this regard, the problem of managing the effectiveness of export-import activities of industrial enterprises, especially its elements such as diagnostics, which allows to recognize, identify, evaluate and analyze the deviations from the normal state, predict trends and recommend organizational and managerial measures to prevent problems.

1. LITERATURE REVIEW

There are many concepts of efficiency in the economy and for the correct formulation of the content of the effectiveness of export-import activities and its measurement should be considered at different levels, both at the macro level and at the micro level. In the political-economic context, the concept of A. Smith is known, according to which efficiency is characterized by the degree of satisfaction of needs, which is directly proportional to the physical volume of the product produced by society. He equates economic efficiency with gross domestic product (GDP) and national wealth. An increase in the latter is the movement to the economic optimum (Smith, 2008). At the same time, D. Ricardo (2001) believes that the pure product is a measure of economic efficiency and national wealth, while the optimum efficiency is achieved in equilibrium, it is here that the pure product becomes the largest. The marginalist concept of efficiency is a consequence of the theory of general equilibrium, which includes the efficiency of exchange, which is a consequence of the theory of balance of supply and demand in the consumer goods market and the efficiency of production and distribution of resources to maximize output. But all the classics of political economy recognize that in this concept, measuring efficiency is difficult because of the measurement of individual utility and the impossibility of summing them up. It is believed that this problem was solved by W. Pareto, who formulated the optimum efficiency of exchange as a state of equilibrium, when none of the individuals can improve their condition without deteriorating the condition of others (Wicksteed, 1906). Political economists believe that the theory of general equilibrium solves the problem of efficiency in production. The novelty and difference of the neoclassical school is that efficiency is considered from the standpoint of usefulness and is limited to the fact that only those needs are analyzed that are related to the material conditions of society, which have a monetary value.

G. Sidgwick's concept is well-known, according to which there is a difference between partial and total economic benefit, private and social product, and each time the benefits and losses from the position of society as a whole should be taken into account (Sidgwick, 1883). The concept of A. Marshall (1920), which is also called the theory of consumer surplus, is important. Consumer surplus is defined as the difference between the price a buyer is willing to pay and the price he actually pays. This excess is an economic measure of additional satisfaction. In general, the representatives of the neoclassical school studied the surplus of the consumer, not the surplus of the producer, and it is the interests of the former that should be taken into account in assessing economic efficiency. The difference between the concept of an institutional school is that they have linked efficiency gains to lower transaction costs. It is the concept of institutional equilibrium that allows us to consider efficiency at three levels: institutional, microeconomic (classical and neoclassical schools) and macroeconomic (Keynesianism and neo-Keynesianism). The

modern concept in economic theory is called the integrated efficiency of social development, which asserts human development, rather than the accumulation of resources for productive activities and increase material prosperity. The criterion of social progress in modern conditions is the harmonious development of man and the environment. At the macro level, efficiency indicators of the country's level of economic development are used to assess efficiency: the total volume of national production per capita, the sectoral structure of the national economy, the production of basic products per capita, the level and quality of life, the competitiveness of the economy.

Among modern concepts of measuring efficiency at the micro level, i.e. at the enterprise level, there are the following concepts (Harvard business review, 1998): a) «comprehensive data analysis», which features a large information base to describe efficiency, and hence the complexity of calculation; b) «measuring the achievements of the service enterprise», which pays more attention to the types of enterprises in the field of service and services; c) the concept of «tableau de bor», which is based on an analogue of the cockpit, which combines all the indicators; d) the concept of «performance improvement and measurement system», which is based on the principles of combining goals, assessing actions to achieve goals, combining and implementing information from past periods; e) the concept of «achievement measurement model», which provides for the selection of key indicators for management and the process of continuous improvement of units; f) the concept of «balanced scorecard – Maisel's model», which differs from the concept of Kaplan and Norton in that it has a fourth component of worker development, and three components remain traditional, namely: finance, customers, internal business processes; g) the concept of «pyramid of efficiency», the founders of which are K. McNair, R. Lunch, K. Cross and the difference is that the goals and indicators link the strategy of the enterprise with its operational activities; h) the concept of «EP^{2}M model (Effective Progress and Perfomance Measurement)», developed by K. Adams and P. Roberts, who provided that performance indicators should provide feedback to employees who make decisions and are responsible for the implementation of the strategy; i) the concept of «quantum measurement of achievements», which was developed by the consulting firm «Arthur Andersen» in order to optimize the productivity of the enterprise; j) the concept of «measuring the achievements of Ernst & Young», which pays more attention to the composition of the company's development strategy, its goals, and based on them establishes critical success factors; k) the concept of «J. I. Case», which is aimed at achieving the status of a world-class manufacturer; l) the concept of «Caterpillar», the founder of which is the corporation of the same name, which pays more attention to the problems of «today-tomorrow» and less analysis of past results; m) the concept of the internal market «Hewlett-Packerd», which provides for the implementation of technology to assess the effectiveness of activities. Of course, these concepts are the most famous globally, but there are many other concepts.

Analysis of these concepts shows the following:

− in almost all definitions, efficiency is a coefficient that characterizes the degree of return on investment;
− efficiency must have both quantitative certainty and qualitative;
− efficiency should be perceived as a vector that indicates the direction of development and growth of the enterprise;
− in the ratio of the components of the efficiency of the enterprise there are several approaches, namely: results and costs (efficiency), results and goals (feasibility), result and needs (profitability).

As for the theoretical support of export-import activity, its foundation was formed by such economic theories as mercantilism (W. Stafford, T. Mann, D. Stewart, A. de Montchrestien , A. Serra - Herlitz, 1964), the theory of absolute advantages (Smith, 1976), the theory of comparative advantages (R. Torrens, D. Ricardo), the laws of international value and international competition (J. C. Mill), Heckscher-Ohlin theory, the theory of equalization of prices for factors of production (P. Samuelson), the Stolper-Samuelson theorem (W. Stolper, P. Samuelson), «Leontiev's paradox» (V. Leontiev), the model of opportunity costs (G. Haberler), the theory of technological gap (M. Posner), the theory of product life cycle (R. Vernon), the model of intra-industry trade (H. Grubel, P. Lloyd, K. Lancaster, B. Balassa, P. Krugman, P. Armington, E. Helpman), the theory of cross-demand (S. Lindert), the theory of competitive advantage (M. Porter, T. Rybczynski), modern theory of scale effect (M. Kemp, P. Krugman), theory of the Customs Union (J. Wiener; Bhagwati et al.,, 1983). All these theories formed a powerful foundation for the theory of foreign economic activity, in particular export-import activity. Scientists have been studying the effectiveness of export and import

activities for a long time. Such studies were started by H. Anderson (1960) and continued in 1963 by D. O'Connell and J. Benson (O'Connell and Benson, 1963). In modern conditions, the studies of scientists L. Leonidou and C. Katsikeas (1996), M. Peng and A. Ilinitch (1998), L. Leonidou et al. (2013), J. Bruton (1996), P. Chow (1987), J. Eatwell et al. (1987), H. Hesse (2008), A.M.A. Zamil (2019), P. Chetthamrongchai (2020), F. Vigliarolo (2020), E. Cizo et al. (2020), T. Sikora and E. Baranowska-Prokop (2018), J. Wielki et al. (2018) and many others. Based on the basic concepts of these theories and concepts, the effectiveness of export-import activities of the enterprise is defined as a systemic characteristic of this activity, which is expressed by the relative economic result in this activity to costs, taking into account the company's strategy and goals.

But the diagnosis of the effectiveness of export-import activities of the enterprise in addition to clarifying the conceptual content of this efficiency involves the formation of technology for its implementation and the choice of tools.

2. DATA AND METHODOLOGY

In order for diagnostics in the economy to be carried out in an organized manner, it is necessary to develop technology in accordance with the object and subject of diagnostics. There is no generally accepted diagnostic technology in economics, but some stages are considered mandatory, namely: information, analytical, management. The logic of obligatory stages of diagnostics in economics is offered, which is presented in Figure 1.

To diagnose objects in economics, various methods are used, which are classified according to such features as the form of evaluation (quantitative, qualitative), the form of reflection (factual, calculation-analytical, documentary), the level of research (analysis, synthesis), the degree of universality (unified, highly specialized), by the number of criteria (multi-criteria, single-criteria), by the degree of formalization (formalized, informal), by the nature of the studied relationships (linear, nonlinear), by direction (forecast, current, retrospective), by substantiation (theoretical, empirical).

To choose diagnostic tools should consider their mathematical capabilities. Thus, to recognize and identify the current state of the object in the economy, it is necessary to use the tools of descriptive statistics of features, as they allow to determine the position of the feature on the numerical axis by sample mean, sample median, mode, the largest and the smallest value of the feature, percentiles, and also, to calculate the scatter indices that describe the degree of scatter of values relative to their center and characterize the degree of their variability, determine the form of distribution of the values' features, which allows to «see the whole picture» (Ponomarenko, Malyarets, 2009). To measure the levels of object characteristics, it is recommended to calculate integrated indicators using the mathematical method of developing a taxonomic development indicator or a Harrington quality indicator.

It is recommended to use the methods of multidimensional statistical analysis, namely: factor analysis, canonical analysis and multifactor regression analysis to establish the causal relationships in the system of characteristics and identify factors that affect the level of development of characteristics. It is factor and canonical analysis that allows to determine the internal latent factors of development, which provides an opportunity to assess the impact of indicators and their significance, as well as to determine the relationship between characteristics, which in turn are determined by systems of partial indicators. To predict the development of the characteristics of the object in the economy and to determine scenarios of its possible states, it is recommended to use econometric methods, namely to calculate growth curves, which determine the main trend of changes in diagnostic values.

To substantiate the normal state of the object, it is recommended to develop multi-criteria optimization models that allow you to determine the optimal values of diagnostic indicators, taking into account several criteria. Thus, the substantive nature of the functions of object diagnostics in economics and the available mathematical capabilities of economic-mathematical methods and models determine the following list of diagnostic tools: descriptive statistics, methods of constructing Harrington's quality indicator, multidimensional factor analysis, multifactor regression analysis, growth curves, multicriteria optimization models. This set of diagnostic tools is able to fully implement its

functions and develop and make effective management decisions to ensure the normal state of the object in the economy.
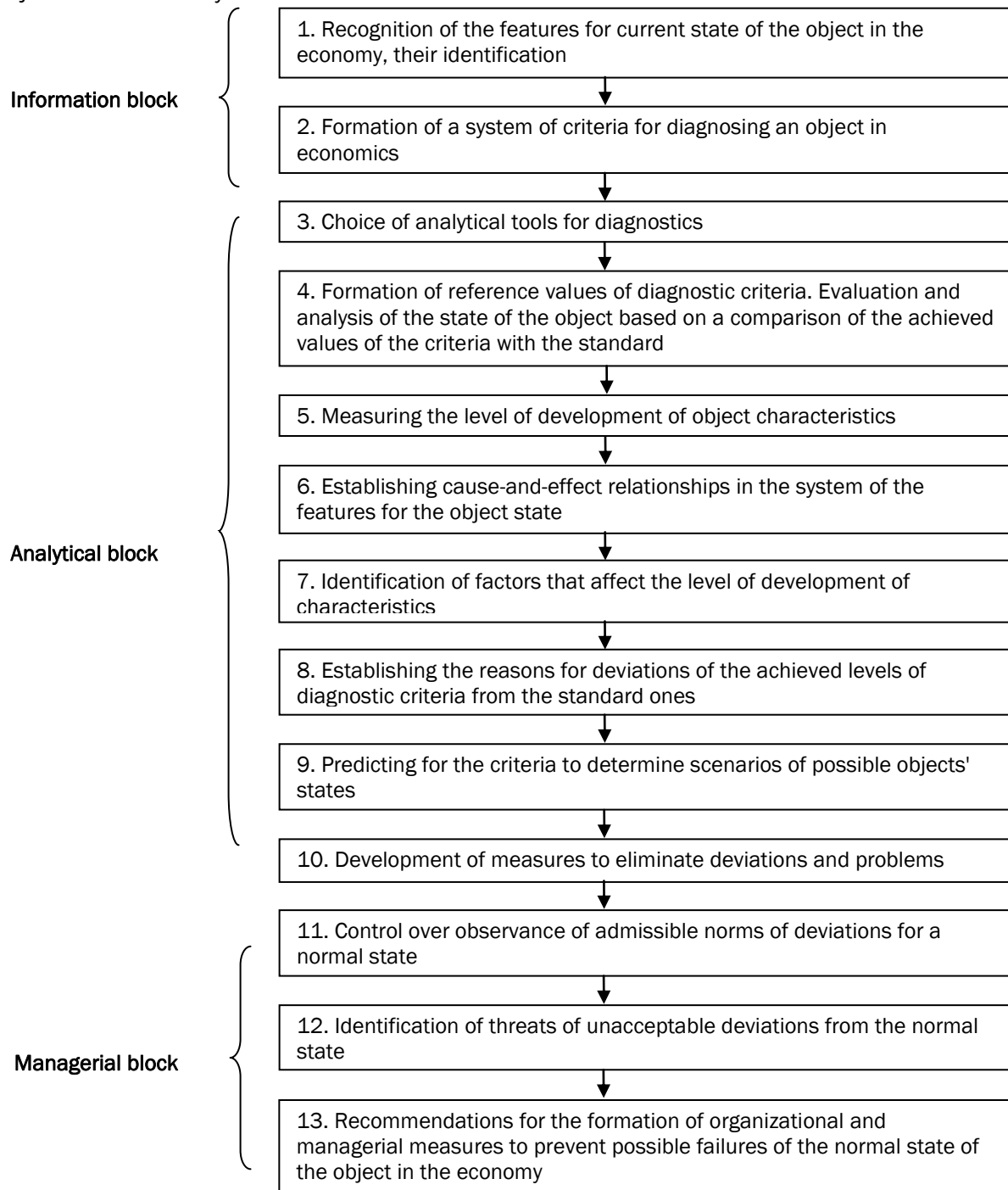
Block	Step
Information block	1. Recognition of the features for current state of the object in the economy, their identification
	2. Formation of a system of criteria for diagnosing an object in economics
Analytical block	3. Choice of analytical tools for diagnostics
	4. Formation of reference values of diagnostic criteria. Evaluation and analysis of the state of the object based on a comparison of the achieved values of the criteria with the standard
	5. Measuring the level of development of object characteristics
	6. Establishing cause-and-effect relationships in the system of the features for the object state
	7. Identification of factors that affect the level of development of characteristics
	8. Establishing the reasons for deviations of the achieved levels of diagnostic criteria from the standard ones
	9. Predicting for the criteria to determine scenarios of possible objects' states
	10. Development of measures to eliminate deviations and problems
Managerial block	11. Control over observance of admissible norms of deviations for a normal state
	12. Identification of threats of unacceptable deviations from the normal state
	13. Recommendations for the formation of organizational and managerial measures to prevent possible failures of the normal state of the object in the economy

**Figure 1**. Technology for the diagnostics of objects in economy

Source: Grigoroudis, et al. (2012), Kolodiziev, et al. (2018), Malyarets et al. (2019), Ogat, et al. (2001), Waluyo, et al. (2019).

It should be noted that the main information tool for diagnostics is a system of criteria. To establish a correct diagnosis of the effectiveness of export-import activities, it's necessary to assess its level. Even a detailed analysis of cost partial indicators, as well as coefficients is not able to correctly diagnose the effectiveness of export-import activities of the enterprise; should have criteria. The criteria in the development of economic-mathematical models are complex and elementary features that

reflect the properties, i.e. the characteristics of the object, and express the quality and quantity for the evaluation of the object. Since the main task of diagnosing the effectiveness of export-import activities of an industrial enterprise is to compare the achieved values of indicators that characterize its condition with the reference (standard) values, the process of their formation is important. In other words, the main task of diagnosing the effectiveness of export-import activities of the enterprise is the systematic measurement of deviations from the reference values of the criteria. The role and importance of standards in the economy are recognized as priority and important. Much attention has been paid to solving problems of formation of standards in the economy by scientists and practitioners. But so far there are no universal tools and generally accepted methodological approaches to the formation of reference values of criteria. There are recommendations, where as effective tools for measuring deviations from normal operation and identify the main causal factors are graphical models that reflect the impact of various economic elements on the efficiency of the enterprise. Indeed, it is impossible not to agree with the statement that in the process of forming the standards of normal functioning of the enterprise it is necessary to take into account the general patterns of its effective operation. It is the consideration of the basic economic laws that allows both to objectively measure the deviations from the reference values of the criteria, and to explain the reasons for a particular state of operation of the enterprise. Thus, an important modern pattern of development of export-import activity of the enterprise in Ukraine is the export-oriented model of economic development. It is known that due to the use of export potential, namely the ability to produce products competitive in world markets, and to export it in sufficient quantities at world prices, the national economy is developing. The export potential, of course, is gradient in all export-import activities, but we should also pay attention to import operations, which are also realized in this activity. The efficiency of export-import activity is determined by the advantage of exports over imports, and in quantitative terms – their positive balance. Another approach to setting benchmarks is to take into account the views of experts. Here the level of qualification, experience of the expert and the corresponding formal procedures which are applied at information processing are important, after all the algorithm of calculation of the generalizing indicator of quality of Harrington is based on the opinion of experts concerning levels of values of indicators.

3. APPLICATION OF THE MODEL

Therefore, to determine the level of efficiency of export-import activity, one should first substantiate the system of partial criteria, which are the leading modern measures of this efficiency, and then model its overall assessment. Guided by the requirements for the criteria and analysis of well-known scientists and practitioners on economics and management of the enterprise showed the feasibility of considering a system of partial efficiency criteria in the following composition: export efficiency ratio (x_1), import efficiency ratio (x_2), overdue liabilities ratio (x_3), the share of exports in the total sales of the enterprise (x_4), the profitability of sales (x_5).To diagnose the effectiveness of export-import activities of the enterprise, such as such a large industrial enterprise as PJSC «Turboatom» (Ukraine), it is crucial to assess the dynamics of its criteria during 2010 – 2018 (Figure 2) (Join-stock corporation TURBOATON - official site). Regar-ding the change in the values of the export efficiency ratio, we have that since 2016 its costs have been increasing, and this is a positive trend (Figure 2).
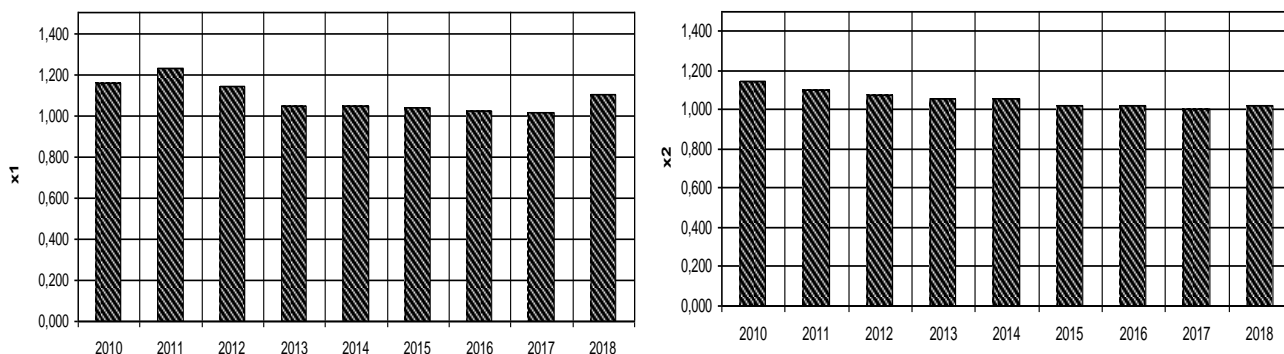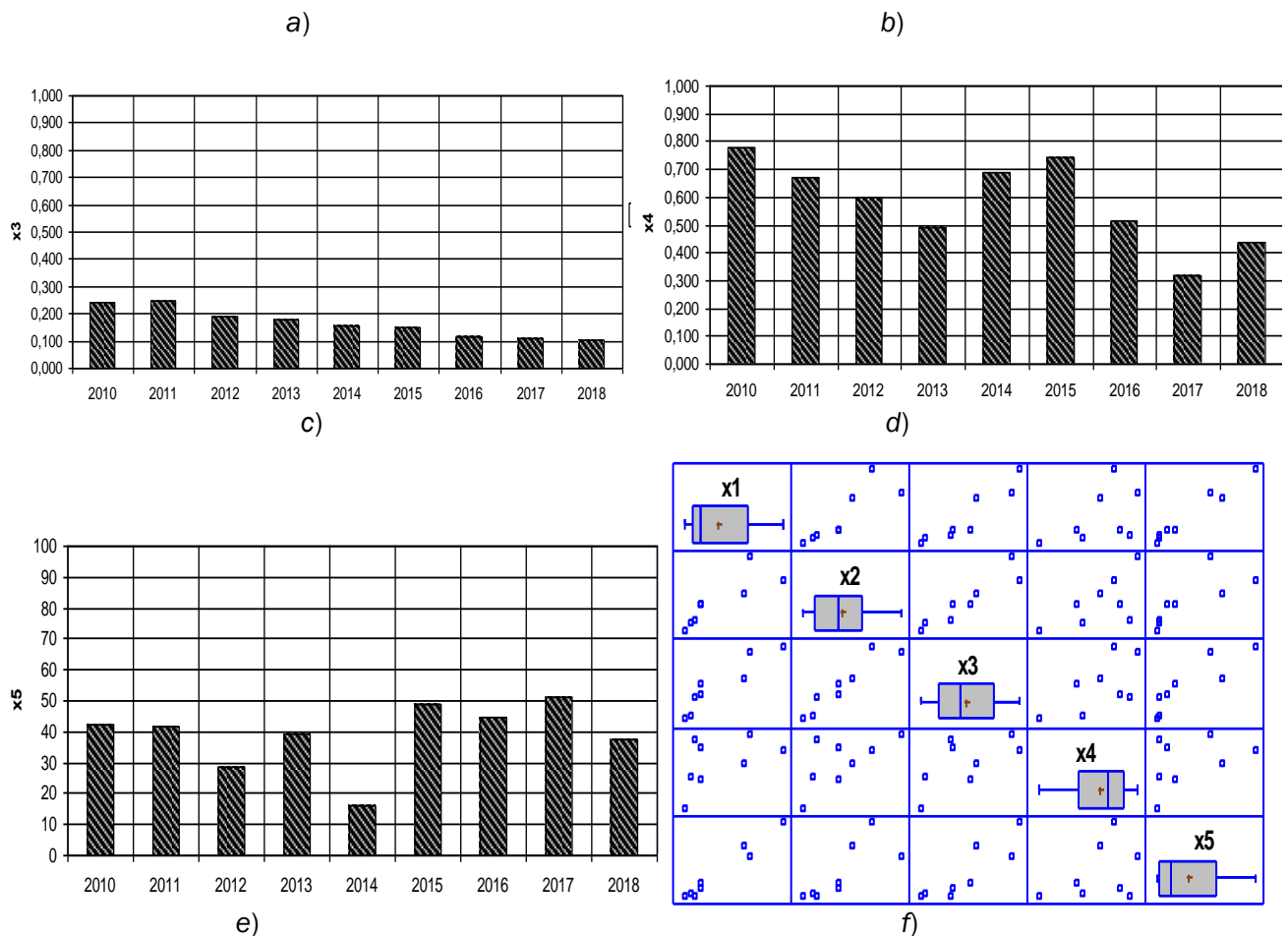
Figure 2. Dynamics of criteria for efficiency of export-import activity of PJSC "Turboatom" (Ukraine) (*a – e*) and their distribution of values (*f*)

Source: Official site of Join-stock corporation TURBOATOM. http://www.turboatom.com.ua/ (10.08.2020)

The efficiency of export-import activity of the enterprise is a multidimensional and multicriteria value, so to determine it it's necessary to reduce the system of features of this activity into one value. Usually, to assess the levels of efficiency of export-import activities of the enterprise use integrated indicators, which can be calculated by various analytical methods. The most common methods of developing integrated indicators in the economy are the convolution of partial indicators as a weighted arithmetic mean, the method of taxonomic indicator of development of V. Plyuta, the method of Harrington's quality indicator. Given the shortcomings and advantages of the most commonly used methods, to measure the level of efficiency of export-import activities of the enterprise, a modified method of constructing a quality indicator of Harrington is recommended. (Ponomarenko and Malyarets, 2009). The stages of implementation of this method are as follows: a) solving the problem of generalization of theoretical and practical knowledge about the system of indicators that reflects the content of the object and the implementation of the tool of descriptive statistics; b) development of a scale of transformations of values of indicators; c) definition of separate functions of transformations of values of indicators; d) establishing the form of the generalized quality function. To diagnose the effectiveness of export-import activities according to these criteria at the enterprise PJSC «Turboatom» during 2010 – 2018 (Join-stock corporation TURBOATON - official site) the value must be converted taking into account both the numerical characteristics of distribution laws and patterns of development of this activity. There are many approaches to this procedure, namely standardization, normalization by various formulas. Given the obvious advantages of the modified logistics conversion function:

$$y_{ij} = \frac{1}{1 + e^{-3\frac{x_{ij} - p_i}{q_i - p_i}}} \tag{1}$$

where q_i – the value of the indicator x_{ij}, at which the conversion function takes a value not less than 0,95; p_i – the value of the indicator x_{ij}, at which the conversion function becomes 0,5 (Ponomarenko, Malyarets, 2009). It should be noted here that the level of the converted values of the criterion depends on the establishment of q_i and p_i. Table 1 presents the main numerical characteristics of the distribution of values of the criteria for the effectiveness of the enterprise's export-import activity; Fig. 2f) – the box-and-whisker plot for this values.

Table 1. Numerical characteristics of the values distribution of the efficiency indicators of the enterprise's export-import activity PJSC «Turboatom» during 2010 – 2018 years

Numerical characteristic	Values of numerical characteristics				
	X_1	X_2	X_3	X_4	X_5
Count	8	8	8	8	8
Average	1,086	1,062	0,173	0,601	13,357
Median	1,046	1,057	0,167	0,636	7,978
Variance	0,006	0,002	0,003	0,023	123,821
Standard deviation	0,078	0,047	0,052	0,152	11,128
Coefficien of variation	7,198%	4,405%	30,116%	25,263%	83,307%
Standard error	0,028	0,017	0,018	0,054	3,934
Minimum	1,013	1,007	0,109	0,320	4,057
Maximum	1,226	1,147	0,250	0,776	33,700
Range	0,213	0,140	0,141	0,456	29,643
Standard skewness	1,099	0,868	0,418	-0,933	1,177
Standard kurtosis	-0,308	0,022	-0,567	0,088	-0,164

Source: own research.

There are also other recommendations for the choice of parameters, namely: based on the opinions of experts on the normative levels of criteria. In our opinion, to establish the parameters q_i and p_i it is advisable to know both the numerical characteristics of the distribution of the values of the criteria, and the known patterns of development of export-import activities of the enterprise. Thus, it is necessary to take into account the natural trends of changes in the criteria that cha-racterize the development of activities, namely the growth of the values of export efficiency ratio (x_1), import efficiency ratio (x_2), the share of exports in the total sales of the enter-prise (x_4), the profitability of sales (x_5) and reduction of overdue liabilities (x_3). Thus, for the cri-teria of efficiency of export-import activity of PJSC «Turboato»m values of parameters q_1 and p_i are as follows: $q_1 = 1,226$, $p_1 = 1,046$; $q_2 = 1,147$, $p_2 = 1,057$; $q_3 = 0,133$, $p_3 = 0,167$; $q_4 = 0,776$, $p_4 = 0,504$; $q_5 = 33,7$, $p_5 = 7,978$. Transformed values have advantages, namely: a) comparable with each other; b) are on a scale from 0 to 1; c) can be used in further mathematical calculations. For example, you can use these five criteria to calculate your overall performance. To do this, it is advisable to use a geometric weighted average: $Y = \sqrt[\sum n_i]{Y_1^{n_1} Y_2^{n_2} Y_3^{n_3} Y_4^{n_4} Y_5^{n_5}}$, denote it I_p. This kind of general criterion of efficiency is explained by the ability to manage the parameters taking into account the laws of enterprise development. Figure 3 shows the dynamics of the level of efficiency of export-import activity of PJSC «Turboatom» during the study period calculated by the usual geometric mean of the converted values of the criteria.
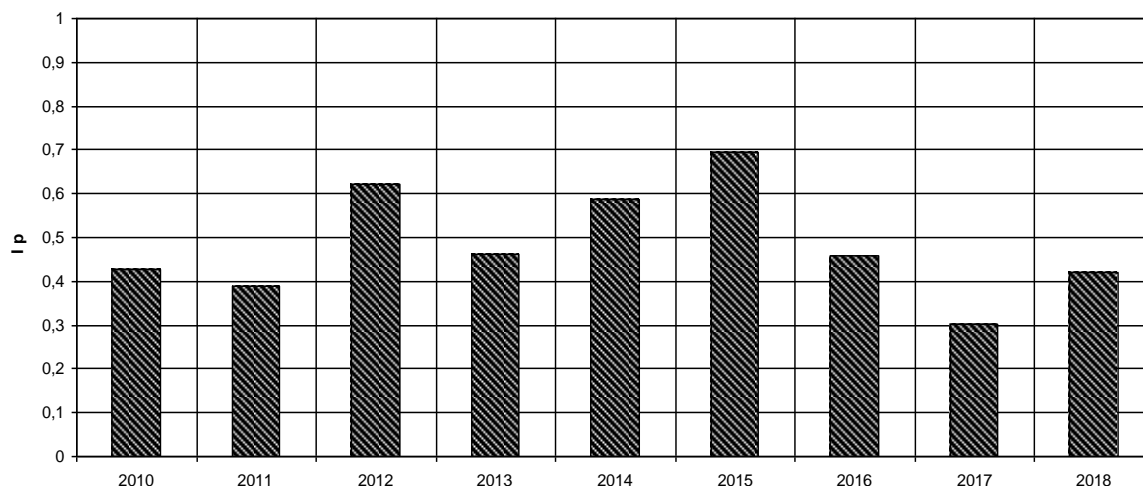
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Figure 3. Dynamics of the general level of efficiency of export-import activity of PJSC «Turboatom» during 2010 – 2018 years

Source: own research.

An important function of diagnosing the effectiveness of export-import activities of the enterprise is to predict the development of its features and analysis of scenarios for this development. To predict the features of the enterprise's export-import activities efficiency, its level and the level of structural dynamics, it is advisable to calculate models of growth curves, which are presented as a function of time $y = f(t)$, given that the influence of other factors is insigni-ficant or indirectly taken into account due to time. The statistical quality of the constructed models of growth curves for the forecast is determined by the criteria of checking the quality of the constructed regression models: the coefficient of determination (R^2), the Fisher criterion (F), the Darbin-Watson criterion (DW).The existence of autocorrelation of residues can significantly distort the predictive values, so if the Darbin-Watson test confirms the existence of autocorrelation of residues in the model, such a model shouldn't be used to calculate the forecast. Using the statistical package Statgraphics Centurion, models for forecasting the values of the criteria of efficiency of export-import activity of the enterprise PJSC «Turboatom» were calculated on the basis of growth curves (Table 2).

Table 2. Models and values of the forecast of criteria of export-import activity efficiency

Forecasting models	Statistical criteria	Predictive values of criteria
$x_1 = \dfrac{1}{0{,}836 + 0{,}061 lnt}$	$R^2 = 0{,}542,\ F = 8{,}28,$ $DW = 1{,}921$	1,024; 1,0179; 1,01245
$x_2 = \sqrt{1{,}318 - 0{,}142 lnt}$	$R^2 = 0{,}986,\ F = 486{,}02,$ $DW = 2{,}021$	0,9957; 0,9889; 0,9827
$x_3 = \dfrac{1}{4{,}242 + 0{,}078 t^2}$	$R^2 = 0{,}963,\ F = 184{,}42,$ $DW = 2{,}08$	0,0832; 0,0733; 0,0648
$x_4 = exp^{-0{,}342 - 0{,}007 t^2}$	$R^2 = 0{,}514,\ F = 7{,}39,$ $DW = 1{,}95$	0,3404; 0,2917; 0,2464
$x_5 = \dfrac{1}{-0{,}007 + 0{,}03 t}$	$R^2 = 0{,}884,\ F = 52{,}93,$ $DW = 1{,}78$	36,4292; 36,1103; 35,8457

Source: own research.

Statistical criteria indicate that the calculated models are suitable for forecasting the criteria. According to the forecast values of indicators of efficiency of export-import activity we have tendencies of decrease of all values and it is a bad tendency and the enterprise should urgently develop the program of actions. Only a decrease in overdue liabilities is a good trend.

One of the important stages of diagnosis is the formation of reference values of diagnostic criteria and assessment and analysis of the state of the object based on the comparison of the achieved values of the criteria with the standards. If there are no legally proposed normative values of criteria, it's recommended to be based on optimal and predictive ones for the formation of their reference values. The problem of determining the optimal values of the criteria of export-import activity efficiency is nonlinear, and its objective function (nonlinear) takes into account the dependence of the general level of development on partial efficiency criteria and is an additive function with weights relative to the criteria. For the enterprise PJSC «Turboatom» the objective function is:

$$I_p = 0{,}3\sqrt{0{,}4084 - 0{,}1348x_1^2} + 0{,}25\frac{1}{0{,}6149 + \dfrac{1{,}6653}{x_2}} + 0{,}2\frac{1}{1{,}6611 + \dfrac{0{,}0798}{x_3}} +$$

$$+ 0{,}15\frac{1}{0{,}8685 + \dfrac{0{,}7162}{x_4}} + 0{,}1\frac{1}{1{,}5557 + 0{,}00039x_5^2}.$$

Limitations in the optimization problem are the values of the criteria that must take into account the forecast and correlation of the values of the exports and imports efficiency coefficients:

$$x_1 - x_2 \geq 0;$$

$$1{,}012 \leq x_1 \leq 1{,}226; \; 0{,}996 \leq x_2 \leq 1{,}147; \; 0{,}065 \leq x_3 \leq 0{,}25; \; 0{,}246 \leq x_4 \leq 0{,}776;$$

$$15{,}84 \leq x_5 \leq 51{,}411.$$

Using the fmincon function of the Matlab software, we'he got the optimal solution $x_1 = 1{,}0174$; $x_2 = 1{,}0174$; $x_3 = 0{,}25$; $x_4 = 0{,}776$; $x_5 = 15{,}84$. The optimal level of efficiency is equal to 0.5118, which is not high, but real, based on the achieved values of efficiency criteria in these conditions of the enterprise's activity. The final diagnosis of the enterprise's effectiveness of export-import activities and the search for the ways to improve it is established by the deviations of each i-th criterion $\Delta_{x_i} = x_i - e_{x_i}$. If the criterion of efficiency according to the natural tendency increasing and $\Delta_{x_i} \geq 0$, then there is a normal state of efficiency according to this criterion, if $\Delta_{x_i} \leq 0$, then we have a problem that needs to be solved urgently.
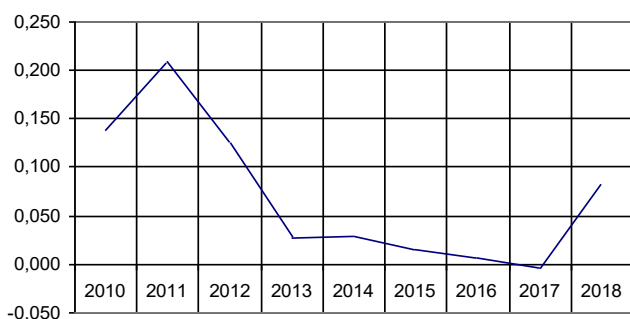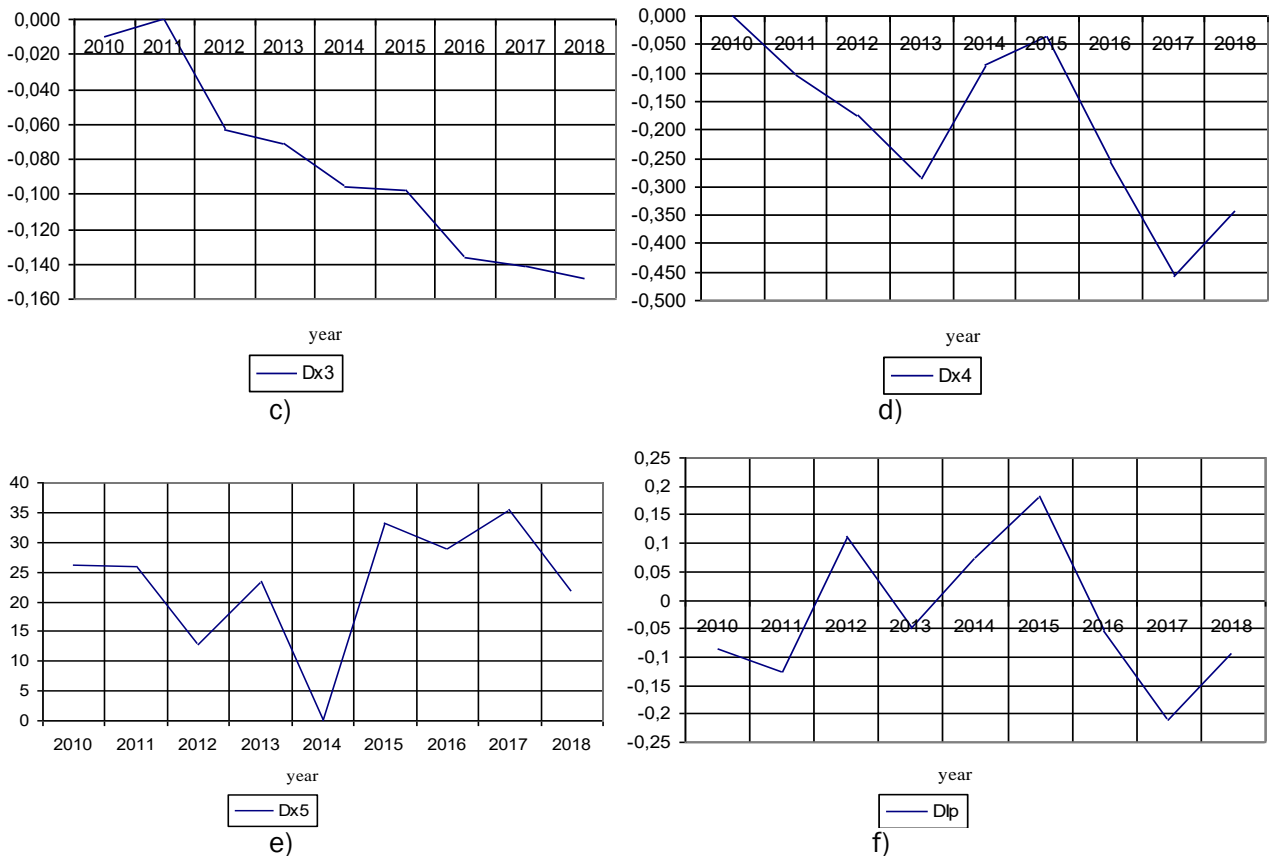

a)
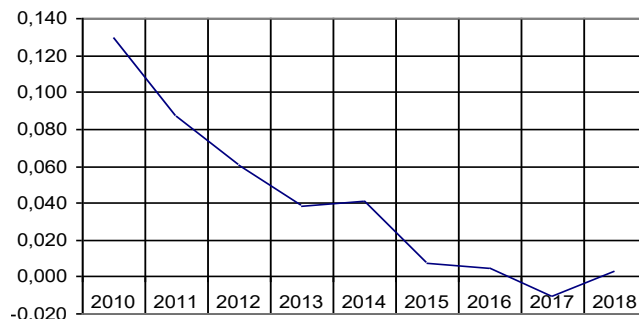
b)

Figure 4. Dynamics of deviations of values of criteria of efficiency of export-import activity of the enterprise of PJSC «Turboatom» from the standards (*a – e*) and the general level of efficiency from optimum in the given conditions (*f*)

Source: own research.

Figure 4 shows the dynamics of deviations of the criteria at the enterprise. The analysis of Figure 4 shows problems with overdue liabilities and the share of exports in the total sales of the enterprise, which lead to failures in the level and trends of overall efficiency in the enterprise.

4. FURTHER CONSIDERATIONS AND DISCUSSION

Implementation of diagnostics of the enterprise's efficiency of export-import activity should take place methodically according to the corresponding stages, it provides complex management of efficiency. However, the content of the stages and the composition of diagnostic tools may be different. The solution to this problem is the validity of the proposals on the content of the stages and composition of diagnostic tools. A sequence of information, analytical and managerial blocks is expedient in efficiency diagnostics technology. Regarding the composition and content of criteria for the effectiveness of export-import activities, the rules should be followed that their number should be 5 - 6 and consist of those that reflect the efficiency of exports separately and imports of goods, as well as the overall efficiency of the enterprise. For unambiguity of the diagnosis of efficiency it's necessary to define its level on an integral indicator of quality of Harrington, thus it is expedient to modify functions of transformation of criteria taking into account numerical characteristics of their laws of distribution. Also, for an objective diagnosis of efficiency, it is necessary to have standards of criteria that reflect the normal operation of the enterprise. The method of forming standards of criteria may be different, but taking into account the predictive and optimal values creates a scientifically objective basis for the standards. Since the dependence of the general level of efficiency on the criteria is a nonlinear function, as well as the presence of a limited region of change the values of the criteria for a particular enterprise, form the

conditions of the nonlinear optimization problem. The found optimal values of efficiency criteria are of great importance both in diagnostics and in management in general.

CONCLUSIONS

The results of diagnosing the effectiveness of export-import activities of the enterprise should be used in the process of developing management decisions, namely strategic management decisions, as it is aimed at long-term goals and opportunities, taking into account strategic alternatives. In modern conditions, the development of strategic management decisions should be carried out using rational technology, the stages of which are the analysis and diagnosis of the problem situation in the enterprise; creation of the forecast of development of a situation; substantiation of strategic goals; development of an evaluation system; development of alternative solutions and diagnostics among them rational; choice of options for managerial influence; creation of scenarios for the development of the situation; expert assessment of the main options for managerial influence; decision-making by a person making decisions; development of an action plan; control over the implementation of the plan; analysis of the results of the situation after the managerial influence. Based on the results of diagnostics, it is advisable to develop management measures to improve the efficiency of export-import activities. Analysis of the optimal values of indicators, forecast values and their comparison with the actual allows to specify the directions of development of management measures and the impact of factors on the level of efficiency of export-import activities of the enterprise.

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