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RESEARCH PAPER

New Statistical and Econometric Approaches to Assessing Financial Processes (Banking Sector, Public Debt, Financial Management)

Zakharin Sergii[1*], Viblyi Petro[2], Bebko Svitlana[3], Nahorna Nadiia[4] & Aloshyn Sergiy[5]

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ABSTRACT

The results of studies on the development of new statistical and econometric approaches to modeling budget policy is presented. The obtained results are applied on the example of tax revenue modeling. The authors note the importance of ensuring transparency and predictability of state financial policy, the realisticness of economic forecasts, because this is the basis of budget modeling. It is also necessary to take into account the various economic cycles that affect the economic dynamics in a particular period of time and in a particular country (or group of countries). Accounting for various factors, including through the use of mathematical methods, will allow to plan reforms with a scientific position. In particular, this is especially true in connection with the introduction of multi-year budget planning. The most important issue of budget policy is the planning of tax revenues (taxes form 90% of budget revenues). To identify the main threats to the tax base, the phenomenon of "tax passes" was used, which is based on an assessment of the effectiveness of a tax credit. The main participants in the formation of the "gross gap" in the value added tax revenues in Ukraine are shown. A correlation and regression analysis of the natural logarithms of the gross domestic product and tax revenues is carried out. This allowed us to determine the elasticity of tax revenues and GDP in Ukraine. A change in GDP directly affects the amount of tax payments to the budget, and the rate of change of indicators is proportional and changes insignificantly. These results allow us to strategically model the reform of discretionary tax policy mechanisms based on a quantitative assessment of tax gaps and the elasticity of tax payments. The authors were able to substantiate some proposals for reforming the budget policy regarding tax revenues.

KEYWORDS: *Model; Budget modeling; Tax system; Value added tax; Econometrics; Statistics; Tax gap.*

1. Introduction

1.1. Problem description

The presence of the foreign capital in any country with a market economy, while practically in all spheres of economic activity, is not an extraordinary phenomenon today. Banking is not an exception. The aggravation of the competition between the domestic and the foreign banking institutions necessitates the recognition and practical application of positive experience in the field of the banking financial management. It should be noted that in foreign practice vast experience in the areas of management is accumulated as with assets and liabilities of banks, financial stability and solvency, quantitative and qualitative parameters of the client base, as well as innovative developments in banking.

In modern economic literature, the development of approaches to risk assessment is characterized by the use of modern mathematical methods such as probabilistic and statistical simulation, mathematical programming, game theory, neural networks, and others. Depending on the mathematical apparatus, the risk assessment models can be classified as the following: firstly, econometric models based on linear and multivariate discriminatory analysis, regression analysis, etc., which allow to assess the probability of occurrence of a risk event; and secondly, neural networks - computer algorithms simulating the work of the human brain in the analysis of risks through the interaction of "neurons". In neural networks use the same input

* Corresponding author: *Zakharin Sergii*
z0679330105@gmail.com

1. *Kiev University of Culture and Arts, Kiev, Ukraine.*
2. *National University "Lviv Polytechnic", Lviv, Ukraine.*
3. *National University of Food Technologies, Kiev, Ukraine*
4. *Chernihiv National University of Technology, Chernihiv*
5. *National Technical University, "Kharkov Polytechnic Institute", Kharkiv, Ukraine.*

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data as in the econometric approach, highlighting the relationship between them by the repetition by trial and error. Optimization models based on mathematical programming methods, which allow minimizing financial losses of the creditor in case of default of the borrower, maximize profit taking into account various constraints, determine the optimal parameters of loan agreements; Fourthly, expert systems used to simulate risk assessment processes carried out by experienced and skilled professionals in making a credit decision. The components of the expert system are a set of logical rules of output, knowledge base, which contains quantitative and qualitative data about the object of decision-making, as well as a module for entering user's answers to system questions; fifth, hybrid systems that combine statistical estimation and simulation. They may be based on causal relationships.

Winning long-term competitive advantages and determining the strategic potential of an enterprise should be based on a real assessment of its position and formulation of development prospects. Strategic development is a complex, multi-level process that must be based on analysis data. This makes it advisable to use such methods that can provide the highest degree of reliability, provide information that will allow us to draw certain conclusions, make predictions and develop a plan of action to ensure the development of the enterprise. This is especially important for businesses that are commercial seaports. The primary task for them is to prevent the realization of aggregate bankruptcy risk.

1.2. Literature review

Today there are a number of fundamental scientific works, in which at the theoretical level the main provisions, on which the scientific idea of the significance of the process of expansion of the foreign capital for any host country is based, are examined. These are the works of M. Alekseenko, O. Vovchak, L. Katranzhy, O. Kireyev, V. Kovalenko, A. Kostiuk, M. Krupka, G. Kulish, I. Larionov and others. The problems of public finance management, including public debt, are devoted to the works of such Ukrainian scientists as V. Bazylevych and L. Balastryk, O. Vasilik, V. Oparin, V. Fedosov, S. Yurii, as well as such foreign researchers as Z. Bodi, R. Merton etc.

The application of statistical and econometric models in financial management was investigated in the scientific works of Batocchio A., Minatogawa V., Chesbrough H., Green H., Nitsenko V., Nyenno I., Kryukova I., Kalyna T., Plotnikova M., Osterwalder A., Pigneur Y., Shafer S., Linder J., Slywotskiy A., Morrison D. etc.

At the same time, this issue requires the constant updating in connection with the post-modification of the conditions of operation, the composition of internal and external risks and other factors that affect the activities of banking institutions.

In addition, it should be noted that researchers have not been sufficiently studied and require a detailed study of the issue of risk assessment and impact on the effective organization of the public finance management. When forming a debt portfolio for the state as a borrower, the risk of changes in the exchange rate of liabilities denominated in the foreign currency is significant. The sequence of constructing a model is to identify the interconnections between the variables, in the choice of methods for assessing the input parameters and in assessing the accuracy of the model. We consider insufficiently used portfolio in the management of the debt of the state denominated in the foreign currency, the potential of portfolio theory to optimize the composition and structure of the portfolio in terms of currencies.

2. Results and Discussion

2.1. Banking sector (as an object of investment)

Increasing the competitiveness of the banking institutions results in their permanent presence in the so-called "tone" from viewing and adjusting the costs. Thus, the banks tend to reduce costs in order to maintain some competitive and attractive prices for the services and products offered, actively implementing cost control mechanisms and analyzing the effectiveness of the financial institution as a whole. At the same time, the requirements of the time put other tasks, in particular, forcing top management of banks to increase the cost of searching and introducing new information and telecommunication technologies, know-how, and developing on-line distribution channels and after-sales services in addition to the existing affiliate network.

On the one hand, the revitalization of competition between the banking institutions stimulates them to expand the range of banking products and services, enhance staff skills, customer service quality, and more. But, on the other hand, unequal competition conditions, often the application of dumping policies of foreign competitors can lead to the gradual displacement

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of the domestic banking institutions from the key areas of their positioning, such as the commercialization of basic banking products and services, primarily designed for mass customers [8; 11; 14].

What are the advantages of the foreign banks? Usually this is the presence of a wide range of banking technologies, effective sales methods, a balanced product line and a kind of established business reputation. Not less important is the fact that the foreign banks, possessing the significant amounts of their own capital, have the opportunity to meet the needs of large customers for longer periods, thus facilitating the access of corporate clients to such sources of funding. As a result, banks with the foreign capital contribute to the growth of the economy in terms of financing some large projects with the high capital expenditures and, accordingly, the needs of the resources involved, including due to their ability to organize and attract syndicated foreign loans. At the same time, it is equally important to create new jobs and increase tax revenues to the state budget. Consequently, in general, this should have a positive impact on the country's economy.

We can not ignore this positive aspect of the expansion of the foreign capital as an increase in the attractiveness of the country's investment of the capital by increasing the interest of foreign investors to its real sector. In other words, the foreign banks in a sense act as leaders of the international investment. This is also confirmed by the fact that such banking institutions, following their clients and entering one or another country, may result in new companies. Consequently, the banks with the foreign capital can serve as an additional factor in attracting the foreign investment to various sectors of the economy of the host country, primarily through the creation of some favorable conditions and a credible atmosphere for their foreign clients [1; 9].

At the same time, despite the fact that the main advantage of the banks with the foreign capital is the possibility of obtaining relatively cheap financing from the foreign parent banks and that allows to offer competitive rates for loans, often they offer their services at higher positions. It is worth accepting that the arrival of the foreign banks contributes to the flow of the capital from countries with low capital productivity and capital surplus to countries with a lack of capital, and the expected rate of return is high.

The growth of lending to the economy is an important prerequisite for the necessary structural reforms. However, the neglect of the aspect that the lending activity of banks with the foreign capital is aimed at stimulating consumption and imports is unlawful. At the same time, "long" and cheap financial resources, which determine the main dominant of the foreign capital, are not actively used to finance the real sector of the economy due to the lack of transparency and high risk of doing business. The increase in the same consumer demand of the population, financed by the bank loans, does not create powerful impulses for the development of domestic production; instead, imports of the consumer goods are increasing and there is a steady rise in prices in the residential real estate market. In addition, the expansion of consumer lending financed through the external loans does not form an adequate financial potential for repayment of external debts as debt buildup promotes the development of the foreign production by the banking sector of Ukraine and its borrowers. Next, we may observe the chain of events: the growth of consumer spending that leads to an increase in the trade deficit, the unwinding of the inflationary spiral and the narrowing of the base for expanded production of fixed assets in the domestic economy. As a result, there is a risk of structural imbalances in the economy because the foreign banks finance those sectors of the economy that are most economically advantageous and useful for them.

At the same time, in the majority of the presence of the foreign capital, the winning components for the economy of the country are more than negative. The influx of the foreign capital into the country increases the capitalization of the banks, the volume of financial resources of the country and, accordingly to these facts, increases the level of monetization of the economy. Foreign banks initiate the application of higher standards of internal control in practice, increase transparency in the banking sector, demonstrate a culture of compliance with applicable law, and direct efforts to build business reputation. Their operation usually helps to reduce the shadow economy, and so on. At the same time, the introduction of the international standards of auditing, accounting, reporting and internal supervision, improvement of corporate culture and transparency of banking activity also improves the protection of consumers' rights to the banking services [10; 26].

Also, the importance of accelerating the development of financial infrastructure, in particular the presence of foreign rating agencies and audit firms, can not be overlooked. This leads to an increase of both banks in the international

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rating and the country as a whole, and as a result, leads to a decrease in the cost of the resources borrowed on world markets, and, consequently, reduces the cost of the domestic loans.

In our opinion, it is also interesting that the participation of the foreign capital may increase the financial stability of the banking system by reducing the influence of internal factors on the stability of its functioning, reducing its dependence on internal political and economic risks. This position is due to the fact that banks with the foreign capital, as a rule, are characterized by higher financial stability compared to the national financial institutions. Thus, they contributed to the stable functioning of the banking sector as a whole.

We believe that the expansion of the presence of the foreign banks in the domestic banking system is generally a stabilizing factor in terms of the exit from the financial crisis. Indeed, the functioning of the foreign banks strengthens the financial stability of the national banking system precisely in the period of local crises, since such banking institutions are able, firstly, to further lend to the business entities of the host country, and secondly, to properly assess the market situation on a global scale, third, actively use the financial capital of their parent structures. But at the same time, in the period of global crises one can not underestimate the activity of the foreign banks from the standpoint of increasing the impact of external shocks on the host side.

We make a legitimate conclusion that the influx into the banking sector of the foreign capital forms some new channels for the impact of external shocks on the economy of the country due to the reduction of opportunities for the government to exercise control functions on the external debt of the country. In addition, the foreign banks can "export" turbulence in some segments of the financial market, which will cause a significant decrease in the value of assets, "infecting" the banking system of the host country. It is clear from this that the associated risk inherent in banks with the foreign capital, and the degree of their impact on the development of the financial sector and maintaining the financial stability, primarily depends on the country of origin of the bank.

Networking of the functioning transnational banks in Central and Eastern European countries increases the risk of penetration of the so-called "effects of infection" on the financial market of Ukraine in case of problems of macroeconomic nature or destabilization of the banking system in any of the countries of the region. In addition, in the event of a critical increase in the liquidity or solvency problems of the subsidiaries of local banks, the parent companies often depart from their activities and do not intend to act as a lender of last resort. It should also be understood that the individual parent banks, having significant losses in the financial market, sometimes did not have the sufficient financial resources to support their subsidiaries. Thus, in a certain part of the foreign banks, attracting funds from foreign partners is an important resource for financing the transactions in domestic markets, what makes such banks vulnerable in conditions of instability at the foreign financial markets [8; 12].

Having the above and the critical analysis taken into account, it should be noted that there is a wide variety of points of view regarding the behavior of the foreign banks in times of economic crises. Thus, the adherents of the foreign capital believed that such banks could provide an important channel for the flow of the capital in order to finance the internal business environment of the host country. Opponents of this position, on the other hand, believed that the foreign banks could lead to volatility in the domestic financial market and not only not to contribute to the inflow of the capital, but vice versa, to accelerate its outflow. What exactly caused this outflow?

In our opinion, this can be explained by the fact that: firstly, the banks are an infrastructure for the movement of the capital, and accordingly, the outflow of funds through the foreign banks can be much easier to the same structures in other countries or to the parent bank; secondly, foreign-owned banks can act as initiators of repatriation of the capital, that is, withdrawal from a more financially favorable daughter to another subsidiary or to a parent bank; and thirdly, the foreign banks have easier access to the international financial markets, which contributes to the growth of operations with the foreign exchange assets and the foreign assets. In addition, the process of the capital withdrawal has an unexpected mass and avalanche nature. The negative effect of such a process is crucial to the financial stability and economic development of the individual country in question.

Additional risks can also be brought about by banks' lending expansion in the domestic market in the event of an increase in household incomes, which naturally pushes the country's economy to a consumer boom. As a result, the rising inflationary pressures the increase the deficit of the balance of payments. Rapid expansion of credit investments generates serious risks both for

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the stability of the banking sector, primarily due to the deterioration in the quality of assets, and the risks to macro-financial stability through the emergence or deepening of macroeconomic imbalances. Indeed, the external loans from the banking institutions and the high credit activity of the last on the domestic market may create risks to macroeconomic stability in the country and financial stability of the banking system. So, if the obligations of banks are of a short-term nature, the foreign currency positions of assets and liabilities of banks do not coincide, and the external loans leads to a credit boom in sectors of consumer and mortgage lending.

At the same time, the relative cheapness and ease of access to the external sources of financial resources served as a solid argument in favor of lending in foreign currency, which intensified dollarization in Ukraine and increased the currency risk. It is worth accepting that the volume of lending in foreign currency depends primarily on the efficiency of the foreign markets functioning, and the interest rate level in the country of the central bank's placement has a negative impact on foreign currency lending in foreign currency in the host country.

Therefore, we are generating large volumes of foreign liabilities of banks precisely by currency risks, including indirect ones, connected with the change of the exchange rate. Such risks apply to the foreign currency loans of borrowers who do not have permanent income in foreign currency. Accordingly, there is a misbalance between the assets and liabilities of banking institutions by terms and types of currencies, accumulating credit risks, and also there is a probability of a chain reaction of destabilization of the financial system of the country due to the indefinite prospects of solvency of bank borrowers. Anything can be a serious impetus to destabilization: as a mass withdrawal of deposits from the banking system, a decline in the level of economic activity in the country, a drop in world prices for products on national exports, and the growth of interest rates on external borrowing [1; 12].

At the same time, during the periods of economic growth, the accelerated increase in the capitalization of banks at the expense of the external sources violates the balance of the external balance by forming a surplus of the financial account of the balance of payments. This situation leads to a revaluation pressure on the national currency and forces the National Bank of Ukraine to redeem the excess foreign currency. The increase in systemic risk in the country may come from the arrival of the foreign banks, which do not have high international ratings, sufficient level of financial reliability and the amount of the financial capital.

In considering this issue, it would be wrong to level the question of the difficulties of banking supervision over the branched transnational structures of banks. With the increase of the foreign capital in the banking sector, the careful preparation of financial supervision bodies, the expansion of international cooperation, the unification of the principles of supervision on the basis of international standards, the introduction of effective monitoring of capital flows, and the development of requirements for the regulation of the cross-border capital movements in order to provide them with a stable character are necessary.

To our mind, in order to prevent a negative impact on the banking sector, the following measures are necessary: firstly, the licensing of the foreign banking institutions through a deep and comprehensive analysis of the ownership structure, business reputation and financial position of shareholders, an assessment of the strategic and operational plan of such a bank; and secondly, strict supervision in accordance with the requirements of the Basel Committee on Banking Supervision, and not only in the branches of foreign and subsidiary banks, but also in their parent institution on a consolidated basis. Such high standards of banking supervision are usually reflected in the profitability of banking activities. However, their implementation will enhance the ability of financial institutions to counteract exogenous shocks, which will form a solid foundation for maintaining the stability of the banking system and the stability of banks' long-term earnings growth.

The main role of supervisory and regulatory bodies in the liberalization of the capital market is to reduce their speculative nature and to provide resilience to the cross-border flows of capital. In addition, regulators should organize some short-term credit flows and, if necessary, curb their volumes by using a basic instrument - reserve requirements for the inflow of speculative short-term capital (short-term foreign loans, deposits, portfolio investments) and long-term incentives.

In Ukraine, a set of measures for macroeconomic responses to the inflow of the foreign capital and the rapid growth of bank loans should be aimed primarily at increasing the level of capitalization of banks, reducing the volume of external

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borrowing, and curbing the risky types of lending activities of banks. But such measures, however, should not be reflected in the amount of investment needed to restructure the economy and increase the competitiveness of the real sector. In order to raise the level of stability of the banking system, to reasonably restrain the expansion of the foreign capital in the domestic credit market and slow down the process of building up external obligations, it is expedient, in our opinion, to introduce the indicator of a bank capital multiplier, in line with the economic norms that regulate the activity of banks in Ukraine. As the maximum possible amount of the bank's debt obligations to non-residents.

To this end, it is worth emphasizing the importance of establishing control over the flows of the short-term loans, and in some cases even introducing measures to curb their volumes by defining temporary reserve requirements in terms of the short-term capital inflows (short-term foreign loans, deposits, portfolio investments) and stimulating long-term ones. Usually measures of this nature are necessary to reduce the speculative nature of the capital.

In order to restrict the rapid release of capital, it is also possible to establish standards according to which foreign banks can not sell it for a period of three years in the event of the acquisition of a national banking institution. At the same time, the provision should be made for such banks to provide a reduced rate of tax on repatriated and reinvested profits in a certain country.

In our opinion, another important issue that needs serious attention is the mandatory avoidance of the excessive concentration of the foreign bank capital and monopolization in one of the segments of the banking services market. To this end, it is necessary to ensure an adequate level of transparency of sources of the foreign investment, to stimulate not only the inflow of the foreign financial resources to the Ukrainian banking system, but also to introduce best practices, first of all, in terms of management and technologies for banking business, the development of new services and products, software that in general, would stimulate domestic banks to increase the level of their own customer service.

2.2. Debt policy

To accomplish this task, we propose to apply the theory of G. Markowitz [15]. The advantage of this theory is that on its basis the structure of the effective debt portfolio, that is, a portfolio with a minimal risk of changes in the exchange rate of liabilities denominated in the foreign currency, may be determined.

The general formulation of the problem in mathematical form is as follows. The debt portfolio of the state consists of debt obligations denominated in the various foreign currencies [4; 25]. Due to the fact that the exchange rate of the foreign currencies relatively to the national currency is constantly changing, the efficiency of the debt portfolio may be estimated using the following quantitative characteristics [3; 6; 18; 21].

First, the expected increase in the exchange rate of the debt portfolio liabilities R_p:

$$R_p = R^T W, \quad (1)$$

where, R – is the vector of expected increases in the exchange rate of the debt denominated in the various currencies; - is the vector structure of the debt portfolio, the individual elements of which are the shares of the debt denominated in the various currencies, in the portfolio. Secondly, the risk of changes in the exchange rate of the debt obligations σ_p:

$$\sigma_p = \sqrt{W^T S W}, \quad (2)$$

where, S – is the covariance matrix of increments of the exchange rate of debt obligations denominated in various currencies that are part of the debt portfolio.

It is logical to consider as an effective such a debt portfolio that meets the specified characteristics of the expected growth of the exchange rate of the debt portfolio liabilities and the risk of changes in the exchange rate of the debt portfolio liabilities [4; 21]. We consider that for the debt portfolio the criterion for choosing its structure is to achieve a minimum level of risk of changes in the exchange rate of the debt portfolio liabilities:

$$\sigma_p \to min \quad (3)$$

We propose to determine the structure of the effective debt portfolio with a minimum risk of changes in the exchange rate of liabilities, using the following algorithm.

1. To form a database on the dynamics of the foreign exchange rates in which Ukraine's nominal government debt is denominated,

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namely: US dollar, euro, Canadian dollar, special drawing rights, Japanese yen:

$$V = \begin{bmatrix} v_{01} & v_{02} & \cdots & v_{0m} \\ v_{11} & v_{12} & \cdots & v_{1m} \\ \vdots & \vdots & & \vdots \\ v_{n1} & v_{n2} & \ldots & v_{nm} \end{bmatrix}, \quad (4)$$

where, v_{it} – rate of i-th currency in time t; and = 1,2, ..., m; t = 0,1,, ..., n.

2. To calculate the growth of the exchange rate of the debt denominated in the foreign currency:

$$r_{it} = \ln\left(\frac{v_{it}}{v_{it-1}}\right), \quad (5)$$

As a result, we obtain a matrix of increments of the exchange rate of the debt obligations R:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & & \vdots \\ r_{n1} & r_{n2} & \ldots & r_{nm} \end{bmatrix}. \quad (6)$$

3. To calculate the expected value of the growth of the exchange rate of debt:

$$E(r_i) = \frac{1}{n}\sum_{t=1}^{n} r_{it}, \quad (7)$$

4. To construct a matrix of the "excess" growth of the exchange rate of the debt obligations N and the transposed matrix of the "excess" growth of the exchange rate of the debt obligations NT:

$$N = \begin{bmatrix} r_{11} - E(r_1) & r_{12} - E(r_2) & \ldots & r_{1m} - E(r_m) \\ r_{21} - E(r_1) & r_{22} - E(r_2) & \ldots & r_{2m} - E(r_m) \\ \vdots & \vdots & & \vdots \\ r_{n1} - E(r_1) & r_{n2} - E(r_2) & \ldots & r_{nm} - E(r_m) \end{bmatrix} \quad (8)$$

5. To determine the matrix of covariance increments of the exchange rate of the debt obligations S:

$$S = N \times NT/12, \quad (9)$$

$$S = \begin{bmatrix} s_{11} & s_{12} & \cdots & s_{1m} \\ s_{21} & s_{22} & \cdots & s_{2m} \\ \vdots & \vdots & & \vdots \\ s_{n1} & s_{n2} & \ldots & s_{nn} \end{bmatrix},$$

де, $s_{ij} = Cov(r_i, r_j) = \frac{1}{n}\sum_{t=1}^{n}(r_i - \overline{r_i})(r_j - \overline{r_j})$. (10)

6. To calculate the matrix of «risk-growth of the exchange rate of the debt» A and the inverse matrix of «risk-growth of the exchange rate of the debt liabilities» A^{-1}:

$$A = \begin{bmatrix} 2s_{11} & 2s_{12} & \ldots & 2s_{1m} & E(r_1) & 1 \\ 2s_{21} & 2s_{22} & \cdots & 2s_{2m} & E(r_2) & 1 \\ \vdots & \vdots & & \vdots & \vdots & \vdots \\ 2s_{n1} & 2s_{n2} & \ldots & 2s_{nm} & E(r_m) & 1 \\ E(r_1) & E(r_2) & \cdots & E(r_m) & 0 & 0 \\ 1 & 1 & \ldots & 1 & 0 & 0 \end{bmatrix} \quad (11)$$

7. To form an auxiliary vector-column B with zero growth of the exchange rate of the debt portfolio $R_p = 0$:

$$B = \begin{bmatrix} b_1 = 0 \\ b_2 = 0 \\ \vdots \\ b_m = 0 \\ R_p = 0 \\ 1 \end{bmatrix}. \quad (12)$$

8. To calculate the structure of an effective portfolio of the debt obligations at $R_p = 0$:

$$W = A^{-1}B, \quad (13)$$

$$W = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_m \\ \lambda_1 \\ \lambda_{12} \end{bmatrix}, \quad (14)$$

where, w_i – are the shares of the debt denominated in currency i in the composition of the effective debt portfolio.

9. To determine the structure of the effective debt portfolios for the range of values of change in the exchange value of the debt portfolio from -5% to 10% in increments 0,5%.

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10. To calculate the risk of changes in the exchange rate of the debt portfolio σ_p for effective debt portfolios:

$$\sigma_p = \sqrt{W^T S W} \tag{15}$$

To build a schedule for the limits of the effective debt portfolios and choose an acceptable variant of the effective debt portfolio with the results of the calculations. The general algorithm and sequence of determining the structure of the effective debt portfolio with a minimum risk of changes in the exchange rate of liabilities is shown in Picture 1. In the case that the shares of the debt denominated in a certain currency in the structure of the debt portfolio have negative values, so that $w_i < 0$, then we should identify the obligation with the smallest value and exclude it from the debt portfolio, and then repeat the calculations.

Our calculations confirm: the optimal debt portfolio will have the following structure: the liabilities denominated in US dollars - 47%, in Canadian dollars - 7%, in special drawing rights - 38%, in Japanese yen - 13%. Regarding the euro, it is advisable to have an open currency position with a 5% limit, that is, to use borrowed funds for lending, such as public-private partnership projects. At the same time, the volume of government loans "tied" to the euro that should be 5% higher than the amount of borrowings denominated in euros.

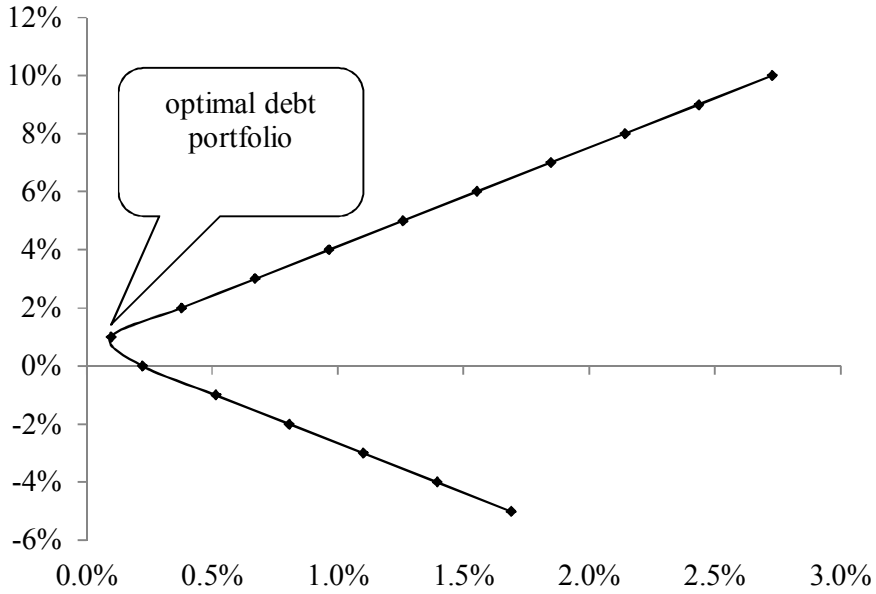

Fig. 1. The boundary of the effective debt portfolios consisting of the liabilities denominated in five foreign currencies (US Dollars, Euros, Canadian Dollars, Special Drawing Rights, Japanese Yen).

The source: calculations by the authors

In the case of a prohibition of open currency position, the structure of an effective debt portfolio, based on the results of calculations, consists of the debt obligations denominated in two currencies: special drawing rights (55%) and Japanese yen (45%), that is, the prohibition of open currency position significantly narrowing possibilities of optimizing the structure of the debt portfolio. On the other hand, the permission for an open currency position creates an imbalance between claims and liabilities denominated in the same currency.

Estimated established data on the expected increase in the exchange rate of liabilities and the risk of changes in the exchange rate of liabilities of effective debt portfolios are shown in table 1.

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Tab. 1. The expected increase in the exchange rate of the liabilities and the risk of changes in the exchange rate of the liabilities of the effective debt portfolios

The expected increase in the exchange rate of the liabilities, R_p	the risk of changes in the exchange rate of the liabilities, σ_p
-5,00%	1,69%
-4,00%	1,39%
-3,00%	1,10%
-2,00%	0,81%
-1,00%	0,51%
0,00%	0,22%
1,00%	**0,10%**
2,00%	0,38%
3,00%	0,67%
4,00%	0,96%
5,00%	1,26%
6,00%	1,55%
7,00%	1,85%
8,00%	2,14%
9,00%	2,43%
10,00%	2,73%

To minimize the risks associated with such imbalances, we propose hedging it based on the use of currency swaps in addition to limiting the open currency position. Table 2 shows the estimated (expected optimal) structure of effective debt portfolios.

Tab. 2. The structure of the effective debt portfolios

	The share of the debt denominated in foreign currencies in the portfolio				
R_p	USA dollar (w_1)	euro (w_2)	Canadian dollar (w_3)	SDR (w_4)	Japanese Yena (w_5)
-5,00%	22,84	-15,54	-7,92	19,19	-17,57
-4,00%	19,11	-12,96	-6,59	16,05	-14,62
-3,00%	15,38	-10,38	-5,26	12,92	-11,67
-2,00%	11,65	-7,80	-3,92	9,78	-8,72
-1,00%	7,93	-5,22	-2,59	6,65	-5,77
0,00%	4,20	-2,63	-1,26	3,51	-2,82
1,00%	0,47	-0,05	0,07	0,38	0,13
2,00%	-3,26	2,53	1,40	-2,76	3,08
3,00%	-6,99	5,11	2,73	-5,89	6,04
4,00%	-10,72	7,70	4,06	-9,03	8,99
5,00%	-14,44	10,28	5,39	-12,16	11,94
6,00%	-18,17	12,86	6,72	-15,30	14,89

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7,00%	-21,90	15,44	8,05	-18,43	17,84
8,00%	-25,63	18,02	9,38	-21,57	20,79
9,00%	-29,36	20,61	10,71	-24,70	23,74
10,00%	-33,09	23,19	12,05	-27,84	26,69

The source: calculations by the author.

2.3. Finance management

Key risks are the cause of changes in the level of financial, technological and other risks. Forming a business model is based on identifying key decisions and creating a matrix of their inefficiencies and the risks that these decisions cause.

The risk indicators are: frequent and significant deviations from the budgeted indicators (sales volume, use of resources, etc.); wide fluctuations in performance from year to year; high dependence on prices and actions, outside the control of the company (eg energy prices, partner behavior); dependence of business performance on some large-scale decisions made under uncertainty; long and complex forecasting and planning procedures; business models that have not been reviewed for a long time, whose decisions are made on the basis of habit rather than logic; frequent cancellation of goods, large inventories of unsold goods, significant discounts on products, services; loss of revenue due to lack of supply, capacity, resources, workers, etc .; expensive, often underused assets; failure to effectively use value chain information when making decisions; failure to absorb technology or practice that is considered effective; lack of effective criteria for evaluating the performance of a partner or employee; the inconsistency between the consequences that the enterprise and the workers face; availability of solutions that are successful in the short term but are detrimental in the long term; frequent conflicts between the company and its partners [5; 17].

A business model audit is the choice of a combination of solutions that offset each other rather than exacerbate risks. Business model risk is proposed to be implemented using information and analytical support, which is a tool for preventing aggregate bankruptcy risk and allows to evaluate consolidated results of the enterprise activity by groups of indicators of financial stability, solvency, business activity, balance sheet structure, profitability bankruptcy likelihood figures for Forest, Springgate, Conan, and Golder models. The spectrum-point method allows to set the risk indicators according to the indicators of the respective groups [20].

We analyze the financial risks and the aggregate bankruptcy risk using the spectrum-point method. It provides for the study of financial ratios by comparing the values obtained with the recommended regulatory values, which play the role of threshold standards [19] The more remote the value of the coefficients from the regulatory level, the lower the degree of financial well-being of the enterprise and the higher the risk of falling into the category of unstable.The selection of financial ratios is carried out with the following criteria: accessibility of information and ease of calculation of estimates; the elimination of repetitive coefficients, that is, bound by an apparent linear dependence [7; 19].

As a result, 16 coefficients were selected to give a complete picture of the financial and economic state of the enterprise. All coefficients are broken down into 5 groups according to the most significant characteristics of this condition. The indicators are then calculated, broken down by risk area, which creates a primary idea of the financial position of the enterprise. The next step is to reduce several indicators of each group to one result parameter (K1.1, K1.2, K1.3 to K1, etc.). Therefore, each side of the enterprise is qualified by some generalized assessment (Table 3).

In Ukraine, strategic plans for developing commercial seaports by 2038 include, for the most part, capacity reconstruction measures. Ports practice of monitoring the implementation of the strategy is simplified and is based on the following single metrics: in financial activities, net income; in marketing and production - volume of cargo processing; in investment and innovation - attracted investments; in personnel - average number of employees.

Building the most effective business model is characteristic of fourth generation ports that cooperate on the basis of the system of international division of labor and organizational integration of corporate structures. This is evidenced by the increasing number of mergers and acquisitions of ports in the world.

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Tab. 3. Summary of financial and aggregate bankruptcy risk analysis SE «Odesa Sea Commercial Port», 2014-2018

Indicator	2014	2015	2016	2017	2018
Integrated solvency indicators					
Financial stability	Relatively stable	Absolutely stable	Absolutely stable	Absolutely stable	Absolutely stable
Repayment capacity	Absolutely stable	Absolutely stable	Relatively stable	Absolutely stable	Absolutely stable
Business Efficience	Non-stable	Non-stable	Non-stable	Non-stable	Non-stable
Balance structure	Absolutely stable	Absolutely stable	Absolutely stable	Absolutely stable	Absolutely stable
Profitavility	Relatively stable	Absolutely stable	Relatively stable	crisis	Non-stable
Integrated bankruptcy probability evaluation					
Lis model	Low	Low	Low	Low	Low
Springate model	Low	Low	Low	Low	High
Konan and Holder model	20%	20%	20%	20%	20%

[1] calculated on the basis of State portal of open data [24].

Consider business models as defined by T. Vashkamadze on the example of the sea commercial ports of Ukraine. In particular, the research methodology relies on the dynamic measurement of current assets, liabilities and operating and financial income. The business model of the company is a potential generator of cash flow, which affects the market value of the organization. At the same time, the value of the company is created by certain internal factors of the model, the result of which is measured by return on equity (ROE). Therefore, based on this indicator, we can analyze the business models of the company and give them an estimate [2; 7; 16; 22, 23].

T.Vashakmadze claims that there is a direct relationship between the value of the company (as a set of discounted revenue streams) and the business model it uses [24]. The return on equity is presented in the form of a three-factor model of DuPont (Du Pont model). This model is the algorithm that forms the basis of the Dupontian financial analysis system, according to which ROE is calculated as the ratio of net profit (PP) to equity (VC).

For the period 2016-2018 the indicators of net sales revenue, gross profit before interest and taxes, profit before tax and net profit deteriorated at SE "Odessa Sea Commercial Port", cash and other current assets decreased. There is no debt on debt at the end of the analyzed period. The positive trends are the increase in receivables, inventories, fixed assets, other non-current assets, equity and the heterogeneous dynamics of changes in interest-bearing liabilities.

Business models can be visualized using matrices, tables and graphs. Researchers identify elements of business model matrices as: value creation system, consumer value, value proposition, profit formula, financial model, revenue streams, cost structure, key assets, key resources, key activity, key partnerships, consumer segment, sales channels.

Tab. 4. Financial data SE «Odesa Sea Commercial Port», 2016-2018, thous. UAH [1]

Indicator	Year		
	2016	2017	2018
Net income	527 399	253 248	164 856
Gross Profit	339 248	44 885	-57 902
Earnings before interest and taxes	409 653	-15 954	-15 758
Profit before taxes	400 082	32 411	34 366
Net profit	303 196	15 721	19 231
Cash	628 425	578 582	471 929
Receivables	193 984	172 389	197 755
Stocks	43 708	63 701	91 749
Other negotiable assets	7 734	14 288	6 162
Fixed Assets	2 180 228	2 027 612	2 286 268

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Non-negotiable assets	17 833	135 386	136 575
Loan capital	0	0	0
Equity	2 986 595	2 948 997	3 126 519
Interest-free obligations	85 317	42 961	63 919

[1] calculated on the basis of State portal of open data [24].

To calculate the data, we also introduce the following rules.

For the estimated return on equity, the effect cannot be negative. Therefore, if the actual value of the indicator is negative, then the value for analysis is calculated as zero. For ease of visualization with the ertzami, we enter the limit value of the relative deviation scale. In this case, it is 3. The results of the 12-factor ROE decomposition for SE Odessa Commercial Port for 2016-2018 are shown in Table. 5.

The following rules must be followed to calculate the relative deviation data:

Rule 1. The coefficient of a company is divided by the arithmetic mean for the following group of coefficients: gross margin, effect on business and management expenses, effect on financial activity, tax effect.

Rule 2. For indicators such as cash management, accounts receivable management, inventory management, other current assets management, fixed assets management, other non-current assets management, debt load, interest-free liabilities, conversely, the average ratio is divided by the ratio calculated for the company.

Tab. 5. Calculation of financial and managerial indicators of SE "Odessa Sea Commercial Port" for 2016-2018 for a 12-factor model ROE [1]

Indicator	Result for analysis			Result for visualizing		
	2016	2017	2018	2016	2017	2018
1	3	4	5	6	7	8
1. Gross Margin, %	64	18	0	2,35	0,65	0,00
2. Managerial and commercial costs effect	1,21	0,00	0,00	3,00	0,00	0,00
3. Financial effect	0,98	0,00	0,00	3,00	0,00	0,00
4. Tax effect	0,76	0,00	0,00	3,00	0,00	0,00
5. Cash management, days	434,92	833,90	1044,88	1,77	0,92	0,74
6. Accounts Receivable Management, days	134,25	248,46	437,84	2,04	1,10	0,62
7. Inventory management, days	30,25	91,81	203,14	3,00	1,18	0,53
8. Management of other current assets, days	5,35	20,59	13,64	2,47	0,64	0,97
9. Management of fixed assets, days	1508,88	2922,35	5061,92	2,10	1,08	0,63
10. Management of other non-current assets, days	12,34	195,13	302,38	3,00	0,87	0,56
11. Debt load	0,000	0,000	0,000	0,00	0,00	0,00
12 . Level of interest-free liabilities in equity	0,03	0,01	0,02	0,74	1,45	1,04

[1] calculated on the basis of State portal of open data [10].

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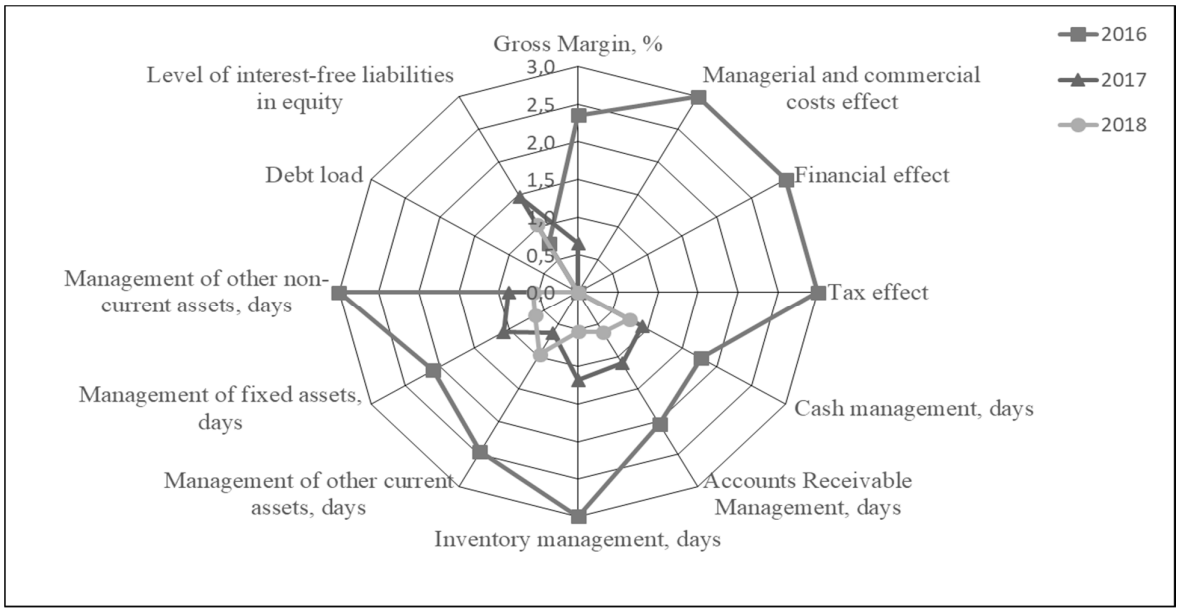

Fig. 1. Erzgam Business Model of SE Odessa Commercial Port for 2016-2018 (developed according to the financial statements of the enterprise)

For the analysis of the activity of the Odessa Sea Commercial Port for 2016-2018, the calculated indicators (see Table 5) can be depicted as a 12-point star - ertsami, which is an effective tool for comparative analysis of business models. Erzgam shows that the further the coefficient from the center, the better. In Fig. 1 graphically depicts a 12-factor ROE model. Tabular forms of visualization are used to systematize the calculated indicators, components of decomposition of business models, factors and components that influence the value creation of the enterprise as the main purpose of functioning of business models.

The tabulated form of the 12-factor ROE model includes gross margin, effect on business and management expenses, effect on financial activity, tax effect, cash management, accounts receivable management, inventory management, other current assets management, fixed assets management, other non-current assets management , debt load, level of interest-bearing liabilities in equity. Erzgam as a form of visualization is convenient to compare and adjust the performance of business models to track the results of the implementation of management strategy.

According to the calculations made in the graph, negative changes have taken place in the business model of the "Odessa Sea Commercial Port" during this period. The values of all indicators, except for the level of interest-free liabilities in equity, decreased. This dynamics is due to the fact that most indicators are dependent on the volume of net income from sales of products, which in turn decreased by 69% in the period 2016-2018. The level of interest-bearing liabilities in equity increased due to the fact that interest-free liabilities decreased by 25%, while the amount of equity increased by 5%.

3. Conclusion

Based on the study, we draw a logical conclusion: the arrival of banks with the foreign capital contributes to the economic growth of the country. This is due to both the increase in the supply of the financial resources, as well as the development of the banking system itself. At the same time, the asymmetry of the interests of the foreign banks and the state's tasks in the development of the national economy, including the national banking system, should not be offset. Therefore, admission to a country of the foreign bank capital must be carried out under mandatory system management and regulation of risks associated with the expansion of the foreign banks.

Authors has deepened the scientific and methodical approach to optimizing the structure of the public debt portfolio in terms of currencies by the criterion of the minimum risk of changes in the exchange rate of debt obligations. Such an approach may involve the targeting of the borrowed funds for lending to the public-private partnership projects within the limits of the open currency position that will optimize the debt of the state and improve its sovereign rating.

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Business model risk is proposed to be implemented using information and analytical support, which is a tool for preventing aggregate bankruptcy risk and allows to evaluate consolidated results of the enterprise activity by groups of indicators of financial stability, solvency, business activity, balance sheet structure, profitability bankruptcy likelihood figures for Forest, Springgate, Conan, and Golder models. The spectrum-point method allows to set the risk indicators according to the indicators of the respective groups. We analyze the financial risks and the aggregate bankruptcy risk using the spectrum-point method. It provides for the study of financial ratios by comparing the values obtained with the recommended regulatory values, which play the role of threshold standards. The more remote the value of the coefficients from the regulatory level, the lower the degree of financial well-being of the enterprise and the higher the risk of falling into the category of unstable. The selection of financial ratios is carried out with the following criteria: accessibility of information and ease of calculation of estimates; the elimination of repetitive coefficients, that is, bound by an apparent linear dependence.

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