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Modeling the financial flows impact on the diagnosis of an enterprise's economic security level

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The article presents theoretical and applied aspects of modeling the financial flows' impact on the diagnosis of the economic security level of the enterprise with the main components of security. The functioning of enterprise's financial flow management models and the economic security level diagnostics applied models (the model of structural and functional diagnostics and the model of simulation modeling) are evaluated. The economic security loan repayment influence model and a set of criteria for assessing the effectiveness of financial flows are considered.

Keywords: *modeling; diagnostics; enterprise; financial flows; economic security.*

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1. Introduction

The full-scale war of the Russian Federation against independent Ukraine localized the forced echoes of the financial crisis for the aggressor country. However, this cause-and-effect relationship gave a chance to transform the competition with the renewed market of oligopolistic competition for Ukraine itself. This type of competition is the most suitable for the development of our modern country since, in the conditions of oligopoly, a small number of industrial enterprises with stable financial requirements can operate, in which the limit of fluctuations in prices for finished products and their level of economic security will depend only on the degree of coordination between competitors.

However, the development of most industries in the country is now incompatible with small businesses because it is impossible to independently restore the financial condition of leading sectors of the economy participating in market entities operating only in small businesses. In this situation, the emphasis is placed on non-price competition, which has the advantage but creates tremendous obstacles for small businesses. Although this type of competition can be intermediate and eventually replaced by pure competition, in which the industry will be able to produce unique, innovative products under strict price control. This pure competition will stabilize the state of economic security of the leading entities of the real sector of the economy in a short time. Also, most enterprises in the state will be able to try to function with an oligopolistic type of competition and with a later transition to pure competition since the formation of an effective system of financial flows management at the economic entity is better laid in the conditions of oligopoly, which allows to manage the amount of "chaos" qualitatively. The stability of this model for oligopolistic needs allows one to select the inevitable consequences of the proposed methods of financial chaos management, structuring the composition and sequence of practical actions [1].

Under crises, wars, and forced transformation of the market, the subjects of the real sector of the economy need additional financial flows and qualitative development and construction of business plans based on strategic planning and analysis of the indicators of practical activity of the enterprise for the future.

Therefore, there is a need to change and update the financial flow management system at enterprises using completely new alternative management methods to rationally justify the model of regulating the movement of integrated financial flow and its impact on the main components of the economic security level of strategically essential enterprises for the state.

2. Theoretical aspects

In the country, martial law was defined as a special legal regime introduced in the context of a threat to national security. Strategic prospects of enterprise management and ways of its further development under martial law directly depend on the solution to the problem of timely and qualitative diagnostics and control of the level of its current economic protection. Every business entity faces this issue if it seeks to continue to function with acceptable financial and economic results in a crisis or post-crisis period, to which the martial law imposed by the country is equated when the level of market uncertainty is maximum due to the imposition and prolongation for an indefinite period of the largest nonsignificant of various identified risks that comprehensively burden all business activities. In this case, the set of target tasks to be solved with the protection mechanism will be the most important.

A comprehensive enterprise security system will always be based on minimizing external and internal threats that affect its financial and economic condition. However, in wartime, it is most important to diagnose economic security level of the enterprise with its main components: level of financial, credit, and investment security, which most quickly fix the impact of changing financial flows in the context of maintaining operating economic and investment activities.

A significant contribution to the development of the theory of financial flows was made by such domestic and foreign scientists as G. Almeida, O. Baranovsky, U. Baumol, V. Burns, I. Blank, R. Braley, E. Brigham, O. Vasylyk, V. Vyshnevsky, O. Yermoshkina, L. Kostyrko, J. Madura, S. Myers, V. Oparin, A. Podderogin, A. Peresada, L. Harris, D. Khan, etc. However, such important issues as the formation of an integrated approach to the creation of financial flow management systems and their impact on the level of components of economic security of the enterprise, the definition of criteria for assessing the effectiveness of financial flow management systems in a chaotic market, improving the organizational and economic mechanism for managing the financial flows of an entity with an unstable financial condition in times of crises and wars remain unresolved.

In general, it should be assumed that the diagnosis of economic security of the enterprise during martial law is the process of identifying and qualitative and quantitative assessment of the magnitude of the confrontation of the impact of negative phenomena that affect not only the financial and economic results of entrepreneurial activity and business but also the national security of the state as a result of the developed systems of diagnostics, verification, and quality control of the impact of multi-vector financial flows on them. Significant deviations of the financial and economic indicators of enterprises from the normative values under martial law can firstly cause usual economic damage and a gradual decrease in economic security level, and subsequently, a complete loss of integrated economic protection in a case when measures to neutralize the impact of negative factors on the financial and economic activities of the enterprise are untimely or ineffective.

3. Purpose and methodology of the study

The article outlines aspects of modeling the financial flow's impact on economic, financial, credit, and investment security enterprises. These aspects will be helpful for applied use in controlling the state of protection of domestic enterprises that operate independently, primarily with the re-profiling of their main activities, or were forced to join various defense production associations during a full-scale war in the country.

3.1. Applied methodology of diagnostics of economic security of the enterprise

The state of economic security and, above all, financial, credit, and investment security always correlates with satisfactory or unsatisfactory financial flows, which affects the financial condition of the enterprise, and is reflected in the degree or level of its financial protection. Like any other category, "economic credit and investment security," being dynamic in time and influenced by financial flows, requires the necessary diagnostics, i.e., the development of a system of assessment measures aimed at determining the magnitude of deviation of the fixed current protection from the permitted level of the general state of economic security.

Many domestic and foreign scientists have already tested this general methodology for assessing the integrated level of economic security of an enterprise (without its components and local impact of individual financial flows), which proposes to evaluate the economic security level based on determining the aggregate criterion by weighing and summing up personal functional criteria. These criteria are calculated by comparing the amount of possible damage to the enterprise and the effectiveness of measures to prevent this damage, where the aggregate standard of economic security ($k_{\Sigma ES}$) is calculated by the formula [2]:

$$k_{\Sigma ES} = \sum_{i=1}^{n} k_i \times d_i, \tag{1}$$

where k_i is the value of a separate (single) criterion for the i-the functional component, d_i is the specific weight of the significance of the i-the functional part, n is number of functional components of economic security of the enterprise.

It is also possible to assess the overall economic security of the enterprise by proposing a sequential algorithm of the following stages: 1) selection (establishment) of economic security indicators; 2) normalization of these indicators; 3) application of expert evaluation (ranking) of weight coefficients of single indicators; 4) calculation of single weighted indicators; 5) expert assessment (ranking) of the weight coefficients of group indices; 6) calculation of the group index and the integrated index of economic security. That is, if we set z_{ij}, which would characterize a particular state of the structural component of economic security, then integral indicator (index) of economic security (I_{es}) for a particular business entity will take the form [3]:

$$I_{es} = \sum_{i=1}^{n} \sum_{j=1}^{m} a_{ij} \times z_{ij} \tag{2}$$

where a_{ij} is weighting coefficients of the j-the indicator for the i-th component of economic security of the enterprise, z_{ij} is set of normalized values of structural elements of financial protection of the enterprise.

After introducing the range of the financial security index $0 \leqslant I_{es} \leqslant 1$, it was noted: if all values of z_{ij} are within the threshold values, then $I_{es} = 1$ and, conversely, if all values of z_{ij} are outside the threshold values, then $I_{es} = 0$.

The integral indicator of economic security of the scientist I. O. Koshkina is based on the calculation model of Y. A. Fomin [4] but adapted to the diagnostic assessment of the financial protection of the enterprise and is directed not to two but to three states — normal, pre-crisis and crisis:

$$IIES = \frac{1}{2} \times \left(\frac{N+P_1}{2} - \frac{C+P_2}{2}\right)^T \times \hat{M}^{-1} \times \left[2\bar{X} - \left(\frac{N+P_1}{2} + \frac{C+P_2}{2}\right)\right], \tag{3}$$

where N is vector of values characterizing the normal state of the enterprise; C is vector of values representing the crisis state of the enterprise; P_1 and P_2 are vectors of values characterizing the pre-crisis state of the enterprise; $\hat{M}^{-1}$ is inverse covariance matrix connecting typical, crisis, and pre-crisis values; $\bar{X}$ is vector characterizing the economic security indicators of the enterprise under study.

According to this method, the state of economic security of an enterprise is diagnosed as follows. If $IIES > 0$, then the state is normal; if $IIES \approx 0$, then the state is in crisis, the method of maximum likelihood of pattern recognition theory is used to calculate $IIES$ [4]. In addition, this method is based on the fact that to assess the synergistic potential of economic security, the indicator $IIES$ is taken in dynamics for several comparable periods and forms the function F_{IIES}, which is constructed in such a way that it would be possible to calculate at equal time intervals, Δt is the value of $IIES_t$. Moreover, according to the first derivative of the function F_{IIES}, the trends in the development of the state of economic security of the enterprise are estimated. However, the study of the behavior of this function has negative aspects. This observation function is valid only when the integral indicator of economic security is measured at regular intervals.

M. Kapustin [5] approached the assessment of risks that affect the state of protection of the enterprise by the formula:

$$R = V \times I, \tag{4}$$

where R is risk, V is the cost of the protection object, I is probability of the hazard.

A business entity always faces business risk, which affects the state of its economic security. Correct income distribution is a prerequisite for a business's stable development and security. The profit share in income determines the growth rate of equity capital of the business entity as primarying target function of the company, which can be "shadow" and "non-shadow." Moreover, most often, the "shadow" activity with different vectors of financial flows is a consequence of the conflict between the enterprise and the state regarding the withdrawal of entrepreneurial activity of this production and economic structure into the shadow of taxation. In this situation, the income business is distributed in such a way that the normalized equation of the closed system income distribution of the "non-shadow" activity of the enterprise is as follows [6]:

$$g^{+} + g^{-} = 1, \tag{5}$$

where g^{+} is the enterprise's profit share; g^{-} is the share of financial outflows from the enterprise, which include taxes and interest payments on borrowed and equity capital.

In turn, the equation of withdrawal funds percentage from the enterprise is equal:

$$g^{-} = s + s_e, \tag{6}$$

where s is the total tax rate; s_e is the equivalent rate of capital payment.

In practice, these agreed-on values of the fractions g^{+} and g^{-} in equation (5) are used as nominal values. If $g^{+} + g^{-} > 1$, then the economic entity in any case forms a "shadow" income, which at first can increase the value of the diagnosed level of economic security, and later, in case of detection by the state authorities of elements of "shadow" activities, rapidly reduce its value, even below the permissible value. Otherwise, if $g^{+} + g^{-} < 1$, then in the conditions of the global economy, it is believed that the enterprise's business activity is generally lagging in development and may completely cease to exist — then it makes no sense to diagnose economic security level.

The method of estimating the integral indicator (index) of the state of economic security according to the practice of scientists N. S. Riznyk and I. A. Vorobyova, according to [7], can be stated as:

$$I = \sqrt[n]{\prod_{j=1}^{n} (1 + x_{ij})} - 1, \tag{7}$$

where x_{ij} is standardized security state indicator, which is the ratio j-the threshold indicator of the safety state to the actual indicator of the safety state of the i-the object of study; n is number of indicators under investigation.

The accuracy of this method will depend on an array of correctly defined threshold indicators of the state of economic security and a variety of actual indicators. The analysis showed that the disadvantage of this method is generally insignificant since it depends only on the natural error of the statistical sample of the previously mentioned grouped arrays. However, if most indicators have a significant error in individual calculations, the aggregate impact on the integral indicator will be affected. Therefore, in the range from 0 to 1 (from highly critical to ideal state), more attention is focused on the accuracy of determining the intermediate conditions of economic security with a possible step less than 0.236.

Regarding the assessment of the sustainability of economic security of the enterprise, one can also give preference to the coefficient method and methods of mathematical statistics, which together make it possible to establish threshold values of retrospective security levels already in the broader range than $[0; 1]$ by the complex indicator of the profitability of enterprise resources by elements of its weighted average of the form [8]:

$$\bar{x}_i = \sqrt[T]{x_i^1 \times x_i^2 \times \ldots \times x_i^T}, \tag{8}$$

where $\bar{x}_i$ is average profitability of the i-th resource of the enterprise; T is year number in the analysis.

The complex indicator of the profitability of enterprise resources (Σx_{comp}) is calculated by the formula:

$$\Sigma x_{comp} = \left[\sum_{i=1}^{n} \left(1 - \frac{\bar{x}_i}{x_{average}} \right)^2 \right]^{\frac{1}{2}}, \tag{9}$$

where $x_{average}$ is the average statistical indicator for the industrial sector.

However, retrospective security plays a relevant role only in establishing a financial safety margin for the temporary stability of economic parameters of the past period. They quickly lose their significance in the dynamics of the base year in the reporting period. They may well not correspond to the enterprise's current state of economic security, not to mention its future state, which is a significant drawback.

Scientists Y. M. Petrovich, A. F. Kit, and V. V. Kulishov also assessed economic security. However, their approach is preferable for assessing a narrower category, which is essentially close to the allocated category "economic security" based on various types of financial stability of the enterprise with an equivalent type of name of economic security level. The relative assessment according to this method for the i-the criterion of the j-th counterparty, which affects the state financial security O_{ji} of the economic entity is calculated by the formula:

$$O_{ji} = \frac{O_i}{O_{max}}, \tag{10}$$

where o_i is score of the j-th counterparty by the i-th economic security criterion, o_{max} is the maximum possible score.

Given the aggregate assessment of the reliability of the j-th counterparty, which is a weighted average, if the weights of counterparties differ from each other, the evaluation of the reliability of interaction with the entire set of counterparties (R_g), (which is recommended to be calculated as their arithmetic mean), will affect economic security level of the enterprise. According to this influence, the following groups of economic security can be distinguished: at $R_g = 1$ — absolute security, at $0.75 < R_g < 1$ — regular security, at $0.50 < R_g < 0.75$ — unstable state, $0.25 < R_g < 0.50$ — critical state and at $0 < R_g < 0.25$ — crisis state.

The method of distances was used to determine the integral safety indicator, allowing the relative assessment of the indicator and its corresponding weight to determine the required integral indicator accurately. L. P. Artemenko and A. S. Polishchuk used a similar scoring system for assessing economic security level of an enterprise [9], giving preference to the expert method of calculating the weighted average values of estimates with the introduction of the coefficient of the significance of individual functional components of security and the definition of a comprehensive indicator of economic security by the formula:

$$x_i \times \beta_i = \frac{1}{n} \sum_{j=1}^{n} x_{ij} \times \beta_{ij}, \tag{11}$$

where x_{ij} is score assigned by the j-th expert for the i-th indicator, β_{ij} is weighting coefficient of the j-th expert for the i-th indicator, n is number of experts calculated as $n = 0.5 \times (3/b + 5)$, where b is the acceptable probability of expert error in the range $0 < b \leqslant 1$.

In general, in domestic and foreign practice, the most common method for diagnostic assessment of economic security level is based on the conversion of all indicators of the level of each of the components of economic security into relative judgments, determining the weight of each of the features and calculating their integral assessment as a weighted average. However, the analysis showed that there might be a relationship between some indicators that record the financial flows impact and that affect the state of economic security of the enterprise. For this purpose, the correlation coefficient and correlation matrix are used in practice. Pearson's correlation coefficient is a numerical characteristic of the joint distribution of two random variables, expressing their relationship according to Pearson's consistency criterion:

$$R_{XY} = \frac{M\left[(X - M_X)(Y - M_Y)\right]}{\sigma_X \sigma_Y}, \tag{12}$$

where R_{XY} is correlation coefficient, which takes values in the interval $-1 \leqslant R_{XY} \leqslant 1$; X and Y are random variables; M_X and M_Y is a mathematical expectation of X and Y; σ_X and σ_Y are standard deviations of X and Y.

To determine the mutual influence of several variables, a correlation matrix is constructed:

$$R = \begin{pmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nn} \end{pmatrix}, \tag{13}$$

which indicates the coefficients in pairs for all variables.

After selecting the necessary coefficients, the effective score (O_p) is calculated by the formula:

$$O_p = 100 \times \frac{k_n - \underline{k}}{\overline{k} - \underline{k}}, \tag{14}$$

where k_n is current value of the indicator, $\underline{k}$ is indicator's lower limit, $\overline{k}$ is indicator's upper limit.

Since in the scientific literature mainly only critical values and norms of indicators are set, at which the increase (decrease) of indicators relative to them is considered positive, the limits are chosen so that the critical value of the indicator corresponds to zero (lower limit), and its norm value -50. The value of the integral safety indicator (I_s) in this situation is found by the formula:

$$I_s = \frac{\sum_{i=1}^{n} O_i \times p_i}{100}, \tag{15}$$

where o_i is score of the i-th indicator, p_i is the weight of the i-th indicator.

According to its value, the conclusion about the safety of the enterprise is made by the rule "golden division" or other nodal values. The correlation matrix is filled for all selected indicators that affect the security state of the enterprise. This method is based on discarding those indicators whose dependence on others will be higher than 0.8 (the average between high and very high correlation is chosen). Later, the minimum number of indicators on which other indicators depend is selected.

To determine the weight of the indicators, one need to calculate the module sums of all elements of the correlation matrix row except for the diagonal ones. The smaller this sum is, the less dependent the indicator is on the others; therefore, it will be given more weight. To reach this conclusion, one should calculate a column of values $\frac{1}{x}$, and the weight (p_i) is calculated by the proportion:

$$p_i = \frac{s_i}{\sum_i s_i}, \tag{16}$$

where s_i is the corresponding element of the column $\frac{1}{x}$.

Also, when assessing economic security, it was investigated that the value of the coefficient in the array of coefficients that can be used to analyze the aggregate economic protection should not depend on the order of shares of industries in the total output of industry, which satisfies such a calculation model [10, p. 50]:

$$0 \leqslant k_j = 1 - m \sum_{i=1}^{m} |d_{i,j} - 1/m| \,/2 \times (m-1) = 1 - \sum_{i=1}^{m} |m \times d_{i,j} - 1| \,/2 \times (m-1), \tag{17}$$

where k_j is coefficient of the diversity of types of economic activity, j is structure of economic activity types ($j = 1, 2, \dots, n$), $d_{i,j}$ is coefficients that define the structure of species' economic activity ($0 \leqslant d_{i,j} \leqslant 1$, $\sum_{i=1}^{m} d_{i,j} = 1$, $i = 1, 2, \dots, m$), and if the structure of economic activities enterprises is homogeneous, as in the example of industrial enterprises, then $d_{i,j} = 1/m$ for all values i, j.

It was proved that in the case of a mono-sectoral economy $k_j = 0$, and in the case of equity of $d_{i,j}$ in some particular j regions of the country, there is a situation that $k_j = 1$. If not all $d_{i,j}$ are the same, and the structure is not mono-sectoral, as in the case of industrial enterprises, the value of this coefficient is in the range of $0 < k_j < 1$. Moreover, the level of economic security of individual regions or enterprises can be defined as the combined action of a set of economic factors and conditions.

In addition, the weakness of one of them can be compensated by the strength of others, that is, the integrated level of economic security of the enterprise (L_{ES}) can be determined as a function of many variables by the general formula [11]:

$$L_{ES} = F(X_i) = \alpha_1 \times f(x_1) + \alpha_2 \times f(x_2) + \ldots + \alpha_n \times f(x_n), \tag{18}$$

where $x_1, x_2, \ldots, x_n$ are leading performance indicators of the enterprise; $f(x_1), f(x_2), \ldots, f(x_n)$ are local functions of dependence of economic security level on the relevant indicators activities of the enterprise; $\alpha_1, \alpha_2, \ldots, \alpha_n$ — share the importance of each indicator for economic security, provided that $\sum_{i=1}^{n} \alpha_i = 1$; i is number of indicators.

The priority coefficients of each group of indicators are determined mainly by the expert method, which, in our opinion, does not always give sufficiently accurate results during the emergency diagnosis of the economic security level of an enterprise.

Thus, we can see that most scientists focus on the diagnosis of integrated economic security in general without modeling and assessing the financial flows impact on a separate component of economic security level of the enterprise and without fixing the effect of the receipt or withdrawal of financial flows.

3.2. Modeling the impact of loan repayment processes on the state of financial and credit security of enterprises

In modeling the financial flows' impact on the state and level of current financial, credit, and investment security of enterprises, the relevant role is played by the processes of repayment of loans and the mechanism of their modeling, particularly conversion and consolidation modeling [12].

Installment loans are widespread in wartime. Loans in installments are loans with partial payments. We must replace one capital (loan) with equivalent capital and interest payments to find the payment. In this case, the principle of equivalence of capital is used in the form:

$$K \times O(0,N) = \sum_{n=1}^{N} (K_n + I_n) \times O(n,N), \tag{19}$$

where K is loan amount (capital); K_n is n-th capital installment, $n = 1, \ldots N$; I_n is n-th interest installment, $n = 1, \ldots, N$; $O(n,N)$ is the interest rate from time n to time N.

The types of interest rates can be as follows:

1) simple capitalization with a constant interest rate:

$$O(n,N) = 1 + r \times (N - n), \tag{20}$$

2) simple capitalization with variable interest rate:

$$O(n,N) = 1 + r_{n+1} + \ldots + r_N, \tag{21}$$

3) compound capitalization with a constant interest rate:

$$O(n,N) = (1 + r)^{N-n}, \tag{22}$$

4) compound capitalization with variable interest rate:

$$O(n,N) = (1 + r_{n+1}) \times \ldots \times (1 + r_N), \tag{23}$$

where r_n is the interest rate of the n-th neighborhood.

There are $2N$ unknowns in equation (19) that cannot be determined from a single equation. Upon repayment of the loan, the loan balance must be zero. Now we obtain the second equation of the form:

$$K = \sum_{n=1}^{N} K_n. \tag{24}$$

We can assume that contributions can be valorized or indexed. Valorized contributions form an arithmetic series of the form:

$$K_n = K_1 + (n - 1) \times \Delta K, \quad n = 2, \ldots, N. \tag{25}$$

where ΔK is the amount of gross capitalization.

However, the indexed contributions will form a geometric series of the form:

$$K_n = K_1 \times (1+k)^{n-1}, \quad n = 2, \ldots, N, \tag{26}$$

where k is the indexation rate of capital contributions.

Similarly, we assume that these contributions are indexed or valorized:

$$I_n = I_1 + (n-1) \times \Delta I \tag{27}$$

or

$$I_n = I_1 \times (1+I)^{n-1}, \quad n = 2, \ldots, N, \tag{28}$$

where ΔI is the amount of interest payments valorization, I is the indexation rate of interest payments.

From the system of equations (19) and (25)–(28), we determine all interest payments.

Often enterprises face loan restructuring, particularly a loan conversion, which also affects the economic security of enterprises, mainly its components — the financial and credit security level.

Suppose the market interest rate rises higher than expected. If the market interest rate falls below the interest rate specified in the agreement, the borrower suffers losses — the actual loan is lower than the interest accrued. In that case, the bank incurs losses, as it has to pay higher interest on the actual payments than the interest on the loan.

The credit conversion procedure (credit union) is based on the principle of capital equivalence. It covers the following phases: determination of pre-conversion credit contributions, technical credit, and resolution of post-conversion credit contributions. Models of financial flows in the form of different types of credit contributions are presented in Table 1.

Thus, the volume and type of credit are the other identity of financial flow that directly affect the enterprise's level offers of financial and credit security.

4. Results and discussion

4.1. Study of the financial flows impact on the level of financial, credit, and investment security of the enterprise

The main factors influencing the formation of financial flows at the enterprise are internal factors: life cycle of the enterprise, depreciation policy, seasonality of production and sales, duration of the operating cycle, the financial model chosen by the enterprise, and external factors: financial market conditions, taxation system of the enterprise, the attraction of foreign investments, a system of settlement operations, availability of financial credit, etc.

Characteristics of financial flows are divided into static and dynamic. The meaningful formulation of the strategic management task of financial flows should ensure the consideration of this process as dynamic. One of the proposed models of strategic management of financial flows is based on the static Damodaran market value model, which considers internal and external constraints. The objective function in this model is considered to be the maximization of the market value of the enterprise of the type [13]:

$$\left\{ \begin{array}{c} \Delta V_t(\xi_{t-1}) = \max\left\{ f_t(\xi_{t-1}, w_{i,t}) + \overline{\Delta V_{t+1}}(\xi_t) \right\} \\ 0 \leqslant IR_t(w_{i,t}) \leqslant \xi_{t-1} \end{array} \right| \left. t = 1, 2, 3, \ldots, T \ \text{ with the } \ w_i \in \{U_i\} \right\}, \tag{29}$$

$$\left\{ \Delta V_t(\xi_0) = \max\left(\sum_{j=1}^{3} \Big(\frac{IR_{tj}}{1+\eta_{in,t}} - \frac{PI_{t+1,j}}{(1+\eta_{in,t+1})^{t+1}} \Big) \mu_j \right) \right| \left. \begin{array}{c} \{\mu_j = 0, \ \text{if } U_j = 1,2,3; \\ \mu_j = 1, \ \text{if } U_j = 0\} \end{array} \right\}, \tag{30}$$

where $\Delta V_t(\xi_0)$, $\Delta V_t\left(\xi_{t-1}\right)$ is the increase in the market value of the enterprise as a result of the decision at steps t and $t-1$; $\overline{\Delta V_{t+1}}(\xi_t)$ is the total maximum increase in the market value of the enterprise in the future due to the decisions made in the previous period, current choices, and possible future decisions; $f_t\left(\xi_{t-1}, w_{i,t}\right)$ is the decision-making function of the i-th type in the t-th period, determined by the initial state of the system ξ_{t-1}; IR_t is the required investment for the implementation of management

Table 1. Types of calculation models for the types of determination of loan contributions [12].

Type of loan installments determination	Calculation Model and Notation
Determining loan installments before conversion	$P_0 \times [1 + r \times N] = \sum_{n=1}^{N}(R_n[1 + r(N - n)])$, where P_0 is amount of loan, N is the number of installments, r is fixed interest rate. If the contributions are indexed, then, $R_n = R_1 \times (1 + i)^{n-1}$, $n = 2, \ldots, N$, i is the indexation rate of contributions.
Definition of a technical loan	$X_t = R_t + \sum_{n=t+1}^{N} \frac{R_n}{1+r\times(n-t)}$, where X_t is loan amount (the cost of a technical loan), t is time $(1 < t < N)$.
Determination of technical loan installments with simple interest rate and a fixed interest rate after conversion	$X_t \times [1 + s \times M] = \sum_{m=t+1}^{t+M} [S_m \times (1 + s \times (t + M - m))]$, where M is the number of installments, s is fixed interest rate, S_m is contribution amount, $m = t + 1, \ldots, t + M$. If the contributions are indexed with fixed interest rate, i, then $S_m = S_{t+1} \times (1 + i)^{m-t-1}$, $m = t + 2, \ldots, t + M$.
Determination of technical loan installments with simple interest rate and variable interest rate after conversion	$X_t \times (1 + s_{t+1} + \ldots + s_{t+M}) = \sum_{m=t+1}^{t+M} [s_m \times (1 + \sum_{l=m+1}^{t+M} s_l)]$, where s_m is variable interest rate for $m = t + 1, \ldots, t + M$. If contributions S_m are indexed with rate i, then $S_m = S_{t+1} \times (1 + i)^{m-t-1}$, for $m = t + 2, \ldots, t + M$. Recurrent equations: $O_{t+M} = 1, O_{t+M-1} = 1+s_{t+M} = O_{t+M}+s_{t+M}, \ldots, O_{m-1} = O_m+s_m$ give the possibility of simple programming.
Determination of technical loan installments with compound interest and a fixed interest rate after conversion	$X_t \times (1 + s)^M = \sum_{m=t+1}^{t+M} [s_m \times (1 + s)^{t-M-m}]$, where M is the number of unknown contributions S_m, which are paid at moments $m = t + 1, \ldots, t + M$. After indexing with interest rate i $S_m = S_{t+1} \times (1 + i)^{m-t-1}$ for $m = t + 2, \ldots, t + M$.
Determination of technical loan installments with compound interest rate and variable interest after conversion	$X_t \times \prod_{l=t+1}^{t+M} (1 + s_l) = \sum_{m=t+1}^{t+M} [s_m \times (1 + s_{m+1}) \ldots (1 + s_{t+M})]$, where s_m is variable interest rate for $m = t + 1, \ldots, t + M$. When determining the contributions S_m, it is recommended to program the interest rate coefficient. If the interest coefficient is expressed through a recurring formula, you can get all the coefficients by copying the corresponding formula. A recurrent system of formulas: $O_{t+M} = 1, O_{t+M-1} = 1+s_{t+M} = O_{t+M}+s_{t+M}, \ldots, O_{m-1} = O_m+s_m$ give the possibility of simple programming.

$w_{i,t}$ in the t-th period, $\{U_j\}$ is the set of possible solutions that form the set of possible controls $\{w_{i,t}\}$, which depends on the initial state of the system, i.e., the previous decision, and determines the possibility of making decisions in the future; $\eta_{in,t}$, $\eta_{in,t+1}$ is coefficient that takes into account the change in the value of money in the t-th and $t+1$ period; μ_j is a variable that reflects the presence in the management $(w_{i,0})$ of the decision to refuse investment $(U_j = 0)$ or to create, operate or liquidate the j-th of activity $(U_j = 1)$; $PI_{t+1,j}$ is possible lost income in period $t + 1$.

The model's limitations are internal and external parameters, the set and levels of which vary depending on the complexity of the system, internal and external requirements, and institutional features of the system's functioning and development:

$$\left\{ \begin{array}{c} R_{in,d}^{\min} \leqslant X_{dt}\left(f(U_{1t} + U_{2t} + U_{3t})\right) \leqslant R_{in,d}^{\max} \\ K_{in,jt}^{\min} \leqslant FF_j\left(f(U_{1t} + U_{2t} + U_{3t})\right) \leqslant K_{in,jt}^{\max} \\ R_{ex,k,t}^{\min} \leqslant M_{kt} \leqslant R_{ex,k,t}^{\max} \end{array} \right\}, \tag{31}$$

where $R_{in,d}^{\min_{in,d}^{\max}}$ are constraints that reflect the proportions of $X_{dt}(f(U_{1t}+U_{2t}+U_{3t}))$ between items balance sheet (results formation, distribution, and use financial flows); $K_{in,jt}^{\min_{in,jt}^{\max}}$ is limitation of compliance with the scope of indicators inbound i outgoing financial flows; $R_{ex,k,t}^{\min_{kt}{}_{ex,k,t}^{\max}}$ are restrictions due to the trends in the development of the external environment of Macro- and Meso-level [13, p. 17].

The search for new models for effective management of financial flows makes it possible to avoid some additional costs at the enterprise and achieve an acceptable level of economic security. Regulation of the movement of financial flows in a full-scale war, no matter how difficult, still gives hope for timely and maximum provision and reproduction of the socio-economic development processes of the state and its regions and individual strategic enterprises. Tactical tasks of financial flow management should be aimed at increasing incoming financial flows, ensuring their practical use through optimization of their distribution, reducing costs associated with the generation and distribution of financial flows, and their impact on the economic security of the enterprise as a whole.

Since most enterprises in modern conditions cannot exist only at the expense of self-financing, the "financial security" category for a deeper understanding should be transformed into financial and credit security of the business entity, emphasizing a particular state of its creditworthiness. Financial and credit security of an enterprise is a state of protection of the financial activities of an economic entity, which may sometimes practice both full and partial self-financing with the use of overdrafts or credit lines by agreement, subject to repayment of some form of short-term loan to the end of the reporting period, as well as in the presence of an overdraft, to write off a certain amount of funds from the settlement account of the enterprise over their balance on the bill to form a debit balance; or to function using medium and long-term loans, while stably maintaining a sufficient level of solvency and creditworthiness within the limits of acceptable credit risk under the influence of threatening factors of internal and external environments [14].

The economic security of the enterprise with the participation of investment inflows was studied by G. V. Kozachenko, V. P. Ponomarev, and O. M. Lyashenko [15]. In their opinion, the criterion indicator for assessing the economic security level of an enterprise structure is the value (Y_{ES}):

$$Y_{ES} = \frac{GI^t}{I_{ES}^t}, \tag{32}$$

where GI^t is the gross investment of the enterprise in the t-th year, I_{ES}^t is the enterprise's investment in the t-th year necessary to ensure its economic security.

This index indicates that the more funds are directed to support the economic security of the economic entity, the higher its level will be. The model of the form (32) is simplified and only sometimes suitable for accurately diagnosing the enterprise's integrated level of economic security. However, it captures the generalized impact of financial investments.

Therefore, to assess the financial flow's impact on the diagnosed level of financial, credit, and investment security enterprise is critical to set analytical tools mechanism formation that can most accurately capture this impact. This mechanism should include: 1) the optimal choice of groups of indicators of the financial condition of the enterprise, which fall under the influence of individual financial flows suitable for systematic diagnostic assessment of the constituent levels of protection; 2) identification of ranges of normative values selected indicators towards the expansion, partially adjusted in the direction of ensuring maximum protection of entrepreneurial activity; 3) checking the actual calculated values of the indicators of these groups for the number of their deviations from the standard normative values; 4) deciding on the number of indicators that satisfy (or do not satisfy) the range of normative values; 5) introduction of a method for diagnosing economic security level of the enterprise or its components.

The recommended list of indicators that will record the financial flow's impact on the diagnosed state of the enterprise's economic security components is shown in Figure 1 [14].

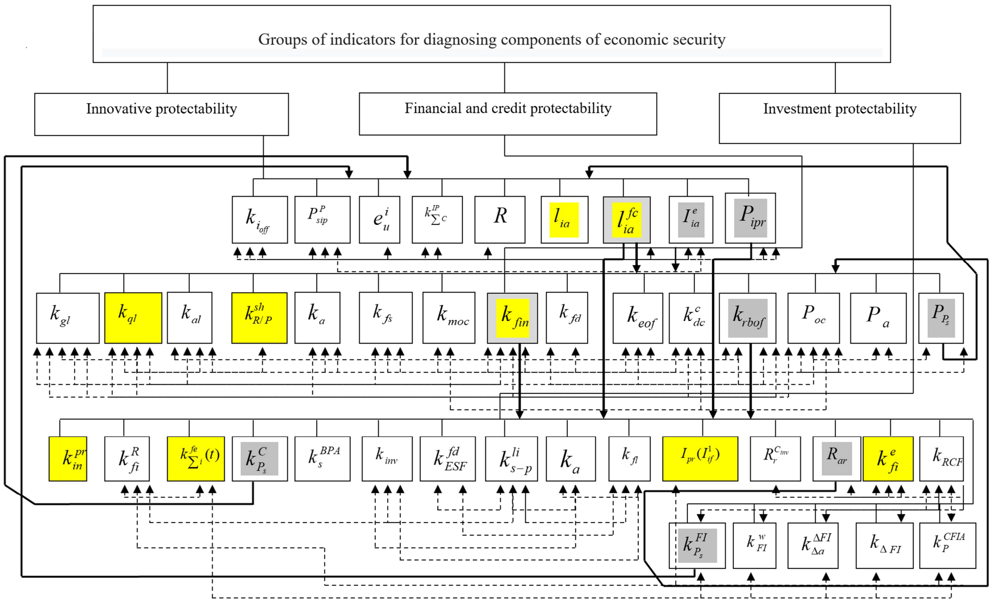

Fig. 1. Selection of indicators for structural and functional diagnostics economic security of the enterprise. Conventions: ◄- - -► is interrelationship between indicators within one economic security component; ──► is relationship between the relevant component indicator and other parts of economic security; [grey box] is a sample of indicators for express diagnostics; [yellow box] is a selection of indicators recording the influence of financial flows.

In the selection of evaluation indicators of innovation enterprise protection is recommended to include: coefficient of innovative offer ($k_{i_{off}}$), parameter of profitability of sold innovative products by net profit (P^{P}_{sip}), value of useful efficiency from introduction of innovations (e^{i}_{u}), coverage ratio of the total costs of innovation project ($k^{IP}_{\Sigma C}$), absolute risk of innovation project (R), level of inventive activities (l_{ia}), level of financing and crediting of innovative activities (I^{fc}_{ia}), integral parameter of efficiency of innovative activity (I^{e}_{ia}), indicator of profitability of innovation project owing to investments (P_{ipr}).

In differentiated selection of state indicators of the financial credit security of the enterprise, it is recommended to include: 1) a group of liquidity (solvency) indicators: coefficient of general liquidity (coverage ratio current) (k_{gl}), coefficient of quick liquidity (k_{ql}), coefficient of absolute liquidity (immediate solvency) (k_{al}), coefficient of ratio of short-term accounts receivable and short-term accounts payable ($k^{sh}_{R/P}$); 2) a group of financial sustainability indicators: coefficient of autonomy (financial independence) (k_{a}), coefficient of financial stability (k_{fs}), coefficient of maneuvering of own capital (k_{moc}), coefficient of financing (k_{fin}), coefficient of financial dependence (k_{fd}), coefficient of ensuring current assets at the expense of own funds (k_{eof}), coefficient of concentration of debt capital (k^{c}_{dc}), coefficient of ratio of borrowed and own funds (k_{rbof}); 3) a group of profitability indicators: profitability of own capital (P_{oc}), profitability of total assets by net profit (P_{a}), profitability of sold products by net profit (P_{P_s}).

For some financial and credit security indicators range of normative values in the post-crisis period can be expanded, allowing to treat the result of the diagnostic assessment of the current financial and credit objectively, taking into account the consequences caused by various crisis phenomena.

The structuring of indicators of the investment component of the economic security of the enterprise involves the division into the following groups: 1) indicators for assessing the level of investment attractiveness and diversification of the enterprise financial risk: integrated coefficient of probability of preservation of investment attractiveness of enterprise (k^{pr}_{in}); coverage ratio of risk from financial and investment activities of enterprise (k^{R}_{fi}); 2) indicators of evaluation of financial and investment activity: coefficient of ratio of financial expenses to total amount of investments received by enterprise for the reporting period ($k^{fe}_{\Sigma i}(t)$); coefficient of ratio of obtained credits to the amount of sold products at enterprise ($k^{C}_{P_s}$); coefficient of suitability of state of essential production assets that do not need immediate additional investments for updating (k^{BPA}_{s}); 3) financial sustainability indicators assessment with the participation of investments: coefficient of investing (k_{inv}); coefficient of financial dependence on external sources of financing (k_{ESF}^{fd}); 4) indicators-estimates of financial independence: coefficient of special-purpose designation of long-term investments with the participation of investments (k_{s-p}^{li}); coefficient of autonomy (financial independence) (without control of consideration of ensuring of following expenses and payments at the enterprise (because of removal of restrictions on credit risk) and income of future periods with recommended expansion of the upper range of normative values) (k_a); coefficient of financial leverage (k_{fl}); 5) assessment indicators of efficiency of financial and economic activity: profitability index (income per unit of invested funds) ($I_{pr}(I_{if}^1)$); rate of return on capital investments ($R_r^{C_{inv}}$); accounting rate of return (R_{ar}); coefficient of effectiveness of financial and investment activities (k_{fi}^e); 6) indicators for assessing the quality of cash flows: coefficient of reinvestment of cash flows (k_{RCF}); coefficient of profitability of the cash flow by investment activities (k_P^{CFIA}); 7) indicators of the dynamics of the volume of financial (if necessary, natural, (gross, net) investments): coefficient of relative rate of change of current financial assets ($k_{\Delta FI}$); relative rate of change of the coefficient of absolute liquidity with the participation of current financial investments ($k_{\Delta a}^{\Delta FI}$); specific weight of current financial investments of enterprise in the total amount of assets at the reporting date (k_{FI}^w); coefficient of the relation of financial investments to the volume of sold products for the reporting period ($k_{P_s}^{FI}$).

It is recommended to include the leading security level indicators that will record the financial flows impact and the quality of financial and credit activities of the economic entity:
1) Coefficient of quick liquidity (k_{ql}) with the normative range $[0.6 - 1.5]$:

$$k_{ql} = \frac{C_c^{en} + C_c^{ef} + D_l^G + D_l^{sb} + C_{fi}}{CO}, \tag{33}$$

where C_c^{en} are cash and cash equivalents in national currency; C_c^{ef} are monetary cash and cash equivalents in foreign currency; D_l^G is accounts receivable for goods, works, services; D_l^{sb} is accounts receivable for settlements with the budget; C_{fi} are current financial investments, CO are current obligations.
2) Coefficient of ratio of short-term accounts receivable and short-term accounts payable with the norm $[\approx 1]$:

$$k_{R/P}^{sh} = \frac{D_l^d}{K_l}, \tag{34}$$

where D_l^d is short-term receivables; K_l is short-term accounts payable.
3) Coefficient of financing with a norm $\geqslant 1$:

$$k_{fin} = \frac{OC}{LO + CO}, \tag{35}$$

where OC is equity capital; LO is long-term liabilities; CO is current liabilities.

Leading indicators that impact multi-vector financial flows on the assessment of the state of investment protection of the enterprise can be attributed to:
1) integrated coefficient of probability of preservation of investment attractiveness of enterprise:

$$k_{in}^{pr} = \sum_{i=1}^{n} \beta_i \times z_i > 0.5, \tag{36}$$

where β_i is the proportion of the real significance of the i-th feature of investment attractiveness of the enterprise to the maximum score; z_i is the probability of retention and signs of investment attractiveness of the enterprise under the aggregate condition $\sum_{i=1}^{n} z_i = 1$;
2) coefficient of ratio of financial expenses to the total amount of investments received by enterprise for the reporting period:

$$k_{\Sigma i}^{fe}(t) = \frac{FL(t)}{\Sigma I(t)} \leqslant 1, \tag{37}$$

where $FL(t)$ is financial expenses of the enterprise for the period t; $\Sigma I(t)$ is general amount of investment received by the enterprise during the period t;

3) profitability index (income per unit of invested funds):

$$I_{pr}(I_{if}^1) = \frac{CFI^{cr}}{IC^{cr}} > 1, \quad (38)$$

where CFI^{cr} is the present value of the cash flow of income; IC^{cr} is investment costs;
4) coefficient of effectiveness of financial and investment activities:

$$k_{fi}^e = \frac{NP}{POC + LR + OR - LP - D_p - OP - T_{inc} - E_i} > 0, \quad (39)$$

where NP is net profit of the enterprise; POC is own capital proceeds; LR is loans received; OR is other receivables; LP is payment of loans; D_p is dividends paid; OP is other payments; T_{inc} is income tax from ordinary business; E_i is interest expenses.

The state of identification of the financial flows' impact on the innovative protection of the enterprise will be influenced primarily by the indicator of level of inventive activities (l_{ia}) and the indicator of level of financing and crediting of innovative activities (l_{ia}^{fc}) (see Figure 1). The last one can be calculated as the ratio of the total amount of funds received to finance innovation activities for a certain period ($F_t(t)$) to the number of funds to be invested in the innovative product ($F_n^i(t_1)$) for the planned period, that is:

$$l_{ia}^{fc} = \frac{F_t(t)}{F_n^i(t_1)}. \quad (40)$$

If $l_{ia}^{fc} \geqslant 1$ means that the funds that will be received or are already in the enterprise are sufficient for carrying out innovation activities within a predetermined time interval. With such a normative value, this indicator positively impacts the state of innovation security of a business entity. Otherwise, it will negatively affect the level of both innovation protection and overall economic security.

4.2. Applied methodology of structural and functional diagnostics and simulation modeling of economic security level of the enterprise under the influence of financial flows

Development of a method of structural and functional diagnostics of economic security level of an enterprise as part of system diagnostics allows deepening the diagnostic assessment of the activity of the production structure for a selected array of structural elements in the context of quantitative measurement of the degree of economic protection.

The integrated level of economic security of the enterprise (R_{ES}), which affect the levels of innovation, financial and credit-investment security, with an acceptable calculation error ($\pm\Delta$) can be presented in the form:

$$R_{ES} = \sqrt[3]{R_{in} \times R_{fc} \times R_{inv}} \pm \Delta. \quad (41)$$

Taking into account the relative magnitude of the total destabilizing impact of factors on each component of economic protection, formula (41) is transformed into a functional dependence of the type [15]:

$$R_{ES} = \sqrt[3]{\left(L_r^V - \sum_{j=1}^{k} \frac{|\Delta_j^{in}|}{N_j^{in}} - \varepsilon_1\right) \times \left(L_r^V - \sum_{j=1}^{l} \frac{|\Delta_j^{fc}|}{N_j^{fc}} - \varepsilon_2\right) \times \left(L_r^V - \sum_{j=1}^{m} \frac{|\Delta_j^{inv}|}{N_j^{inv}} - \varepsilon_3\right)} \pm \Delta, \quad (42)$$

or rolled up:

$$R_{ES} = \sqrt[n]{\prod_{i=1}^{n} \left(L_r^V - \sum_{j=1}^{z} \frac{|\Delta_j^i|}{N_j^i} - \varepsilon_i\right)} \pm \Delta, \quad (43)$$

where $|\Delta_j^i|$ is absolute deviations by the modulus of the calculated values of the recommended indicators from their normative values, which are involved in the process of diagnosing the state of economic security in terms of innovation, financial and credit, and investment components; N_j^i is normative values of recommended group indicators that are involved in the process of diagnosing the state of economic security along similar elements; ε_i is a value of additional destabilizing impact, which occurs if the enterprise objectively exists or economic crimes are proved and disclosed as a result of illegal actions (for each component of the security state value ε_i is calculated individually); n is number of diagnosed elements of economic security ($n = 3$); z is the number of selected indicators for diagnosing the state of economic security of the enterprise (in the case of each component of financial security, their number may be different, and it is investigated that the optimal number of these indicators to cover the full range of threats from internal and external environments on the state of economic security for innovation component will be $z = k$, where $k = 9$; for the financial-credit component $z = l$, where $l = 15$; for credit investment component $z = m$, where $m = 20$); $\pm\Delta$ is permissible error during the calculation of economic security level of the enterprise, which does not change the qualitative state of financial protection within the limits of fixing the corresponding low, medium or high level (Figure 2).

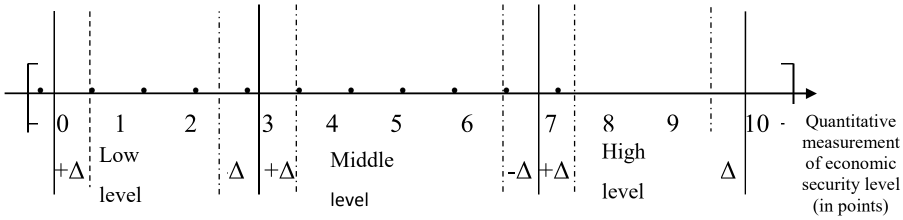

Fig. 2. Local scale of measuring the level of economic security of the enterprise.

However, in addition, it is necessary to optimize the number of indicators that will record the impact of different vectors of financial flows; the main thing is to find the flow of funds that maximizes the market value of the enterprise over time according to the formulas (1)–(3).

After calculating the spectrum of indicators on the example of actually operating enterprises, it was found that their level of financial strength is maximally correlated with the level of financial and credit protection by the number of indicators that positively recorded the financial flows impact (33)–(35), and which satisfied the normative values, that is, zero deviations from the reference values. In parallel, simulation modeling can be used to diagnose the enterprise's integrated level of economic security and its components, particularly the level of financial and credit or investment protection.

For example, based on the simulation modeling below, the identifiers are set depending on the calculated deviations of the actual indicators from the range of normative values to determine the level of financial and credit security of the enterprise (see Figure 1). We can see the transformation of the vector of actual simulated values of the calculated indicators (first column from left to right) into the vector of estimated deviations (second column). The vector of established identifiers (third column) is calculated on a rule — if the variations of the indicators from the range of normative values are zero, then the identifier is "1", otherwise — "0" for the presence of a standard array of recommended indicators for the process of diagnosing financial and economic indicators responsible for analyzing the state of financial and credit security.

$$\begin{pmatrix} 1.1 \\ 0.8 \\ 0.1 \\ 0.9 \\ 0.5 \\ 0.5 \\ 0.3 \\ 0.9 \\ 1.5 \\ 0.2 \\ 0.7 \\ 0.8 \\ 0.2 \\ 0.3 \\ 0.4 \end{pmatrix} \Rightarrow \begin{pmatrix} 0 \\ 0 \\ 0.1 \\ 0 \\ 0 \\ 0.1 \\ 0 \\ 0.1 \\ 0 \\ 0 \\ 0.2 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \Rightarrow \begin{pmatrix} 1 \\ 1 \\ 0 \\ 1 \\ 1 \\ 0 \\ 1 \\ 0 \\ 1 \\ 1 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}.$$

The level of financial and credit security with the participation of simulation modeling for the simulated enterprise according to the activity results will be equal to $R_{fcz} = 11$ in our case due to the summation of the elements-indicators third vector-column. From the point of view of diagnostic assessment, this characterizes the fact that the entity at the time of diagnosis is either in the phase of increased financial and credit security, compared to the worst results, but not yet at the maximum level of 15 units, or is moving to a state of insufficient financial and credit security, which will deteriorate further. With this method of simulation diagnostics, an enterprise's current quantitative level of financial and credit security can be determined, but with a significant error in making decisions on the diagnostic assessment results and identifying its further dynamic trend. The maximum range of the local scale of measurement of this level will directly depend only on the number of introduced indicators that participate in the diagnostic process. However, this is not an optimal and universal measure since, in market conditions during crises and wars, the state of each component of the economic security of the production structure can be assessed by a different number of indicators.

To assess the level of investment security, a more precise method of structural and functional diagnostics for a separate component of economic security can be used for an actual enterprise according to the formula (42) or (43). The data for some strategic defense industry enterprises are taken as an example:

$$\begin{aligned} V_{inv} &= \frac{0.026}{0.501} + \frac{0}{1} + \frac{0}{0.4999} + \frac{0.1319}{0.4} + \frac{0}{1} + \frac{0}{0.5} + \frac{0}{1} + \frac{0}{0.5} + \frac{0}{1} + \frac{0.3711}{1.0001} \\ &+ \frac{0}{0.15} + \frac{0}{0.11} + \frac{0}{1} + \frac{0}{1} + \frac{0.8673}{1} + \frac{0.9074}{1.0001} + \frac{0}{0.25} + \frac{0}{0.15} \\ &= 0.052 + 0 + 0 + 0.330 + 0 + 0 + 0 + 0 + 0 + 0.371 + 0 + 0 \\ &\quad + 0 + 0 + 0.867 + 0.907 + 0 + 0 = 2.527; \\ R_{inv} &= 10 - 2.527 = 7.473. \end{aligned}$$

For a need to more accurately record the financial flows impact at the level of individual components of economic security, it is possible to introduce software that will cover the diagnosis of the entire range of financial indicators and the apparatus of economic and mathematical modeling, making the diagnostic process effective and optimal in time.

5. Conclusion

The country's economy largely depends on the continuous development of each enterprise and the improvement of its management process during periods, particularly crises and wars. The most relevant direction is to increase production efficiency by identifying existing financial resources, their vectors of movement, and their impact on the economic security of business structures.

The parameters of financial flows are always closely interconnected with the external environment since the environment's signs are the basis for forming certain types of resources. The factors of the external environment, in combination with internal ones, determine possible additional sources of formation of financial flows, directions, their volumes, regularity, and speed of movement; determine the conditions and rules for the use of specific financial instruments and make them effective the process of economic and mathematical modeling of the financial flows impact on the diagnosis of economic security level of the enterprise and its components.

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Моделювання впливу фінансових потоків на діагностику рівня економічної безпеки підприємства

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У статті представлені дослідження та обгрунтування теоретичних питань та прикладних аспектів моделювання впливу фінансових потоків на діагностику рівня економічної безпеки підприємства за участі основних складових захищеності. Оцінено функціонування спектру економіко-математичних моделей управління фінансовими потоками на підприємстві та прикладні моделі діагностики рівня економічної безпеки: модель структурно-функціональної діагностики та модель імітаційного моделювання. Розглянуто моделювання впливу сплати кредитів на стан економічної безпеки підприємства та сукупність критеріїв оцінки ефективності фінансових потоків, що формують особливості фінансово-господарської діяльності у різних умовах та відповідають за стан фінансово-кредитної, інвестиційної та інноваційної безпеки підприємства.

Ключові слова: *моделювання; діагностика; підприємство; фінансові потоки; економічна безпека.*