

Empirical Study of the Economic Security Rating of the Bank of Uzbekistan

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Abstract: In recent years, as the economy of Uzbekistan develops, he has been actively promoting structural economic reforms and modernization of the bank's functioning to improve the standard of living and well-being of people. It is necessary to study methods of improving the structure of the economic security rating based on increasing the level of financial stability of the bank. The purpose of the article is to develop theoretical aspects and practical recommendations for the development of methods to ensure the economic security of the bank. Methods and techniques of probability theory and mathematical statistics, as well as econometric modeling are used in the development of this problem. The article considers the probability of an event, which consists in the fact that the bank will be safe for a certain period of time in order to function taking into account the influence of random factors, i.e. regularly and timely perform all functions, as well as by modeling the parameters of the equations it becomes possible to monitor and predict the economic security of the bank in the future. **Conclusions:** In recent years, the bank's economic security rating in Uzbekistan has shown an upward trend, as evidenced by the bank's financial stability forecasting methodology, according to which the bank's economic security is determined by the probability of an event consisting in being able to function safely for a certain period of time, taking into account the impact of random parameters, and according to the results of the study, appropriate forecast recommendations and proposals for decision makers have been prepared, it is necessary to take into account the adjustment of banking services, as well as the level and structure of the bank's economic security rating. **Improvements:** This study attempts to create a system of indicators for assessing the bank's economic security rating. In addition, an empirical study is being conducted to assess the rating of ensuring the economic security of the bank and the banking services sector. Based on empirical research, proposals are put forward from the point of view of the existing form of banking services and the use of information technologies in order to determine the rating of ensuring the economic security of the bank and optimizing the structure of banking services.

Keywords: Economic security rating, Economic insolvency, Influence of random factors, Banking system, Financial stability, Economic threat.

Introduction

The most important task of the state economic policy of Uzbekistan is to ensure the stability and proper level of economic security of the economy and its individual sectors. The banking system, as the most important branch that covers the economic interests of all subjects of the national economy, plays a huge role in the development of investment, savings, payment and transactional relations between economic agents. The failure of the banking system to perform its functions paralyzes economic ties in the country and acts as a threat to economic security (Grafova I. & Emelyanov R., 2016). This determines the dependence of the economic, and often the political situation, on the state of economic security of the banking system.

The formation of a banking system that is resistant to various shocks is one of the most urgent directions of the development of the economy of Uzbekistan. In recent years, the economy of Uzbekistan has had a certain financial stabilization. At the same time, there are problems that have not been properly resolved. They concern, first of all, the banking system. Some of them are so acute that they pose a threat to the security of the entire economy, not just the banking system (Natocheeva N., 2004). Destructive factors are the catalysts of economic threats. The slow pace of structural transformations in the economy, the raw materials orientation of export industries, their close relationship with the foreign economic situation, the unstable development of the international trade market, the influence of political forces, negatively affect the structure of the domestic banking market focused on export industries.

The weakness of the resource base, the economic insolvency of customers, the lack of the necessary volume of long-term deposits, under-capitalization, were a serious obstacle to the safe development of the banking system (Ezangina I. & Popova S., 2016). Destructive, crisis-forming processes that continue in the banking sector are aggravated by the low level of development of banking competition, underdevelopment of the financial market, lagging behind international standards, insufficient development of modern banking technologies.

The rates of financial stabilization differ in different segments of territorial reproduction processes, which leads to imbalances in the regional development of commercial banks. Non-transparent ownership structure; poor asset quality; insufficient qualification of banking specialists; poor management quality, including weak effectiveness of risk management systems; do not smooth out emerging internal contradictions (Melnik D., 2018).

The domestic banking supervision system does not provide a sufficiently objective assessment of the real financial condition of commercial banks, the quality of internal control is not at the proper level, there is no corporate governance quality rating, there is no financial security rating (Vedernikova T., 2016). These negative processes lead to a weakening of the regulation of financial relations in the banking system.

In recent years, an important area of successful development of the banking system has been the introduction of international banking standards, which include the recommendations of the Basel Committee on Banking Supervision and the Financial Action Task Force on Money Laundering (FATF). The main purpose of applying these standards for the banking system of Uzbekistan is to maintain their financial stability and economic security both in the domestic and foreign markets.

The global pandemic has revealed the need to modernize the methods of ensuring economic security by the banking system. Due to the insufficient effectiveness of existing methods, as well as their fragmentation and fragmentation, the financial stability of the banking system deteriorated significantly during the global pandemic, and the excessively aggressive credit policy pursued by commercial banks contributed to the formation of an additional group of factors of financial instability of banks in

Uzbekistan. It is obvious that for effective functioning in the market, as well as for maintaining economic security, new methods of ensuring the economic security of banks are needed (Andreeva E., 2013). In modern realities, a system of methods for ensuring economic security by the banking system is needed, capable of identifying signs of threats at the initial stage and making timely decisions to minimize their manifestations and reduce the likelihood of negative consequences.

In recent years, the banking system of Uzbekistan has been affected by various threats from the external and internal environment. The banking system is the most vulnerable and susceptible to external negative impacts, so the state needs to be ready to develop mechanisms to prevent threats of various scales and duration at the macro, meso and micro levels. The deepening of market relations and the process of globalization have led to a change in the status of the banking system of Uzbekistan: first, banks have gained access to global financial markets; secondly, new conditions for their participation in international competition have been formed, which contributes to improving the image of banks; thirdly, the banking system has received a favorable opportunity to adopt the best international experience in the formation of its own banking products, services and technologies. All these aspects create a favorable environment for ensuring the economic security of the banking system as a whole.

However, ensuring the economic security of the banking system, as one of the important components of national security, requires solving such serious problems as instability in the foreign exchange market and low public confidence in banks, a small share of long-term bank lending and insufficient financing of the real sector of the economy, poor quality of the loan portfolio and the growth of risks and imbalances in banking.

Integration processes, the implementation of an open economic policy of Uzbekistan, as well as the interdependence of banking structures of different countries necessitate the development and improvement of mechanisms to ensure the economic security of the banking system of Uzbekistan, its confrontation with external and internal threats. In the economic literature, a large number of works are devoted to the study of the improvement of the banking system as one of the main economic agents. However, the issues of developing appropriate mechanisms to increase economic security due to the impact of external and internal environmental factors have not received sufficient coverage. This indicates not only the high relevance of the research topic, but also the practical importance of developing mechanisms to ensure the economic security of the banking system of Uzbekistan.

The relevance of the topic is due to the need for a theoretical and methodological study of the problems of economic security of banks in conditions of increasing risks of legalization of illegally obtained income through the banking system and identification of factors determining the financial stability of commercial banks; the specifics of the application of modern methods of managing the economic security of the bank; analysis of the features of the introduction of a risk management system in banks, as well as risk-oriented banking supervision; identification of directions for further development of the banking system from the standpoint of ensuring its economic security; development of practical recommendations for the development of the economic security management system in the banks of Uzbekistan.

Literature review

Kornienko M. (2005) conducted a study on the study of tools for improving the economic security of commercial banks, substantiating the economic mechanism for protecting the flow of capital into the shadow turnover, strengthening control over their movement, suppressing channels and schemes used in shadow turnover. The study developed an economic mechanism to protect the flow of bank loans into the shadow turnover, including the creation of an information customer base in conjunction with the bodies of the Ministry of Internal Affairs; the prevailing channels, schemes, tools and modes of

withdrawal of bank capital into shadow circulation (one-day firms, bribery of employees, unjustified provision of tax benefits) are established, the relationship between them is traced, an estimate of annual losses is given.

An in-depth analysis of threats to the economic security of commercial banks and the proposed approaches to improvement can serve as a conceptual basis for further development of the scientific foundations of the security strategy in the banking sector.

Svetlova V. (2010) studied the mechanism of protection of the system of ensuring the economic security of commercial banks from the influence of various threats and updating the tools for their implementation. The study has developed a conceptual model of the system for ensuring the economic security of commercial banks, the main elements of which are: the formation of an effective internal control system to prevent intentional bankruptcy, the selection and evaluation of relevant indicators, their thresholds, methods and tools for effective counteraction and neutralization of threats; updated and tested tools to ensure the economic security of commercial banks (compliance control, an algorithm for conducting analytical procedures to identify signs of fictitious bankruptcy, the use of risk management to reduce losses, optimization of information flows); a system of indicators of economic security of commercial banks' activities is proposed and their threshold values are justified depending on the types and methods of illegal encroachments on the security of banking activities, which made it possible to justify the application of measures of influence on the financial and economic activities of banks by the subjects of counteraction.

Storozhuk I. (2010) conducted a study on the study of the conceptualization of the model of institutional and economic tools for ensuring financial stability of a commercial bank as a basic structure in the system of economic security factors. The study proves that a portfolio approach to measuring and reducing credit risk will reduce the amount of reserved capital compared to the amount obtained by simple summation of instruments and counterparties, which does not take into account the correlation relationships between them; a set of financial stability indicators has been identified and threshold values of boundary conditions have been determined, which to a certain extent affect the assessment of the economic security and reliability of a commercial bank.

The values of the financial stability indicator are recognized as good or above the average level, provided that its value is less than or equal to 1,5 when the boundary conditions of economic security are met; average or below the average level, provided that its value is in the range from 1,6 - 2,0, when the boundary conditions are met; unsatisfactory - provided that the value of the financial stability indicator is above 2; financial stability cannot be classified above the "average" if the threshold imperative of at least one of the indicators of the boundary conditions of security is not met during two reporting periods; a set of indicators for assessing the portfolio of assets of banks is determined, which consists of the following basic elements: assessment of the quality of loans that make up the loan portfolio; determination of the portfolio structure based on the quality of loans and assessment of structural shifts based on studying its dynamics; determination of the amount of reserves sufficient to cover loan losses based on the analysis of the structure of the loan portfolio, and directions for optimizing the bank's loan portfolio have been developed.

Natocheeva N. (2004) studied the theoretical provisions and methodological recommendations for the formation of the financial security rating of commercial banks based on the prediction of internal economic threats. The study formulated the economic threat to financial security as a risk, the qualitative characteristics of which show the peculiarities of the emergence and implementation of threats to commercial banks; clarified the classification of threats by introducing additional criteria for the time of exposure, the specifics of the activity and the quality of exposure; a system of indicators of

internal economic threats to financial security is proposed and justified, taking into account the specifics of the activities of commercial banks; scientific approaches to improving the efficiency of the organization of the financial security system of commercial banks are formulated, based on an integrated approach, interaction, coordination of efforts and orientation of all services and departments to a common goal; recommendations for a phased reorganization of the existing financial security system of commercial banks and improvement of its strategy are proposed; a step-by-step assessment of the impact of the main external and internal factors that destabilize the safe operation of commercial banks has been developed; a toolkit for the financial security rating of commercial banks has been created based on monitoring the developed system of indicators and forecasting internal economic threats.

The advantage of the proposed method for determining the financial security rating of commercial banks, according to the criterion of forecasting internal economic threats, is the simplicity of calculations, visibility, which allows you to assess the level of financial security, increases the efficiency of making and effectiveness of management decisions. This gives advantages: firstly, to gain time to recognize the growing threat, to carry out specific measures to prevent a decrease in the level of financial security; secondly, by providing a high level of financial security, maintaining the image of a safe bank to attract new investors, depositors, thereby increasing the capital of a commercial bank.

However, despite the presence of a significant number of fundamental and applied works on certain aspects of ensuring the economic security of the banking sector, the problem of integrated management of this central element of banking activity has not been studied in sufficient detail from the point of view of its implementation both at the level of the banking system as a whole and at the level of each specific commercial bank.

Method

For the purposes of determining the security of the bank, the probability that the bank will function safely in the future is much more important. Therefore, in this paper, the bank's security is determined by the probability of an event, which consists in the fact that the bank will function safely for a certain period of time, taking into account the impact of random (economic) factors, i.e. regularly and timely perform all its functions.

In our case, the random variable R depends on time, i.e. $R = R(t)$. For example, if we calculate the rating value R based on the monthly balances of the bank, then the value R will take random values at fixed points in time (t_k) corresponding to the last days of each month.

Let's define the probability of safe functioning of a commercial bank as the probability that the value of the rating value R at time t will be greater than some critical value R_{kp} (Abdullaev A. Y., 2015).

The value of P_k is the lower boundary value of the rating and characterizes the state of the bank, which has completely lost its solvency and liquidity, i.e. has exhausted its own capital as a result of losses incurred in the amount of its own capital. The values of the bank's balance sheet parameters corresponding to such a state are calculated using the bank's model for twelve months and then using the numerical values of these balance sheet parameters, the ratings values for each month are calculated. The value of R_{kp} is calculated as the arithmetic mean of the calculated ratings values and is equal to $R_{kp} = 0,36$.

For further reasoning, it is necessary to accept the hypothesis about the distribution law of the random variable R_t . The following laws of distribution of random variables are most widely known:

- uniform distribution law;
- binomial distribution law;
- Poisson distribution;

- normal distribution law or Gauss law.

Consider a random variable $\theta^{(n)}$ which is equal to:

$$\theta^{(n)} = \theta_1 + \theta_1 + \theta_3 + \dots + \theta_n$$

For this random variable, the mathematical expectation is a_n , and the standard deviation (SD) is σ_n . Then the formula for normalizing this random variable will be written as:

$$\mu^{(n)} = 1/\sigma_n(\theta^n - a_n)$$

The Moivre-Laplace theorem states that the distribution law of a normalized random variable at n tends to the Gauss law (Lloyd, E. & Lederman W.).

A.M.Lyapunov proved that the distribution law of the normalized sum is $\theta_1 + \theta_1 + \theta_3 + \dots + \theta_n$ independent random terms is close to the Gauss law (the normal distribution law) if n is large, and the ratio

$$\sum_{k=1}^n (\theta_k - a_n)^3 : \left(\sum_{k=1}^n D\theta_k \right)^{3/2} \quad (a_n = M\theta_n) \text{ few.}$$

This condition is violated if the variance of a small number of terms significantly exceeds the variance of the remaining terms, which for this reason will disappear after normalization. The Lyapunov condition is also violated in some special cases, for example, in the case leading to Poisson's law.

If after normalization the Gauss law is obtained, then it means that before normalization there was a Gauss law, but with arbitrary mean and variance. So, the sum of many independent random terms is distributed according to Gauss' law, regardless of how the terms were distributed.

Since the value of R is the sum of the values of R_i , and those, in turn, are also the sum of a sufficiently large number of terms (the sum of balances on various balance accounts), then with sufficient reason we can talk about the normal distribution of a random variable R .

The normal distribution is known to be determined by two parameters. These parameters represent the moments of the first and second order, or the mathematical expectation mR and the variance DR of a random variable R .

The probability density formula of a random normally distributed quantity "x" is written as:

$$f(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{-(x-a)^2/2\sigma^2} \quad (1)$$

Graphically, this function has a bell-shaped appearance, the peak of the bell falls on the mathematical expectation of a random variable, and the greater the variance of the random variable, the more flat the curve of the distribution density function has (Abdullaev A. Y., 2015).

There is also a practical way to check whether a random variable belongs to a particular distribution law. For this purpose, the so-called χ^2 criterion serves. Using this criterion, it is checked whether the random variable "x" in question satisfies the given distribution law $F_0(x)$. This criterion is called the consent criterion.

Hypothesis $H_0(F_x(x)=F_0(x))$ rejected, if $\chi^2 \geq \chi^2_a$.

$$\chi^2 = \sum_{k=1}^k (M_i - np_i)^2 / np_i$$

χ^2 - there is a measure of the deviation of the true distribution from the given one.

The value of χ^2 is determined by special tables depending on the number of degrees of freedom of the specified accuracy (value a).

In our case, the random variable R depends on time, i.e. $R = R(t)$. The time function $R(t)$, which takes random values for each fixed t , is called a random process. For example, if we calculate the rating value

R based on the monthly balances of the bank, then the value R will take random values at fixed points in time t_k corresponding to the last days of each month.

To solve the problem of determining the probability of safe functioning of the bank for some time (from the current moment to the time T_{np}), it is necessary to predict the value of a random variable R at the time T_{np} (to obtain the value of $R(T_{np})$).

The function $R(t)$ is determined from the available information about the values of R over the past period of time as a set of points $(R_1, t_1), (R_2, t_2), \dots, (R_n, t_n)$. The resulting function can be rolled forward for a certain time, i.e. to predict the mathematical expectation of a random variable in the future with a certain error.

Using the least squares method, it is possible to solve the problem of drawing the best straight line through a set of points $(R_1, t_1), (R_2, t_2), \dots, (R_n, t_n)$. If the sample distribution is normal, then the estimate of the least squares method coincides with the estimate of the maximum likelihood method (Abdullaev A., 2015).

Valid for the sample $(R_1, t_1), (R_2, t_2), \dots, (R_n, t_n)$ R_i has a normal distribution with mathematical expectation:

$$mR = a + b * t \tag{2}$$

and the variance of DR.

The Gauss-Markov theorem states that the least squares method estimate has minimal variance in the class of all linear unbiased estimates of parameters a and b.

The error of prolongation of the function $mR(t)$ will be equal to the square root of the variance of the random variable. In this case, the prediction error will be the greater, the longer the prediction period. The standard deviation of the value R prolonged for a time interval Δt is determined by the formula:

$$KO = \sqrt{DR + DR * (\Delta t * b)^2} \tag{3}$$

To find the coefficients a and b from equation (2), the following matrix expression is used:

$$\begin{pmatrix} a \\ b \end{pmatrix} = \begin{pmatrix} n & \sum t_i \\ \sum t_i & \sum t_i^2 \end{pmatrix}^{-1} \times \begin{pmatrix} \sum R_i \\ \sum R_i t_i \end{pmatrix} \tag{4}$$

where n is the number of values of R_i ; t_i are the time points corresponding to the values of R_i , ($i = 1, 2, \dots, n$).

Solving equation (4), we determine the values of the coefficients a and b:

$$a = \frac{\sum R_i * \sum t_i^2 - \sum R_i * t_i * \sum t_i}{n * \sum t_i^2 - (\sum t_i)^2} \tag{5}$$

$$b = \frac{n * \sum R_i * t_i - \sum R_i * \sum t_i}{n * \sum t_i^2 - (\sum t_i)^2} \tag{6}$$

The variance of a random variable R is determined by the formula:

$$D_k = \frac{1}{n - 1} * \sum (mR_i - R_i)^2 \tag{7}$$

And the value of the standard deviation (SD) of a random variable R from its mathematical expectation mR is defined as:

$$\sigma = \sqrt{D_R} \tag{8}$$

To determine the multiple correlation coefficient, it is necessary to use the following dependencies:

$$KR = \frac{\sum (a + bt_i)^2}{\sum R_i^2} \tag{9}$$

Now, knowing the mathematical expectation of the value R and its variance at the time T_{np} (forecast date), i.e. the values that completely determine the normal distribution of $N(R, mR, DR)$, it is possible to determine the probability (p) that the random variable R , distributed according to the normal law, will be at the estimated time in a certain range of values:

$$p(c \leq R \leq d) = \frac{1}{\sqrt{2\pi}} \int_c^d e^{-(R-mR)^2/2\sigma^2} dR_i \quad (10)$$

The forecasting interval is selected from the conditions of the bank's complete loss of liquidity and solvency, i.e. the complete depletion of its own capital.

As it was shown above, with a decrease in the R rating value below 0,36, the bank has exhausted its own capital and, according to the rules of effective functioning, should be closed. Thus, the lower limit of integration is $c = R_{kp}$, and the upper limit is d - infinity.

Probability (p) can be expressed in terms of the probability integral:

$$F(t) = \sqrt{\frac{2}{\pi}} \int_0^t e^{-\frac{s^2}{2}} ds \quad (11)$$

To determine the values of this probability integral, there are detailed Laplace tables for the integral function of the normal distribution, according to which the probability values are determined. If the following substitution is made in the expression for determining probability (10): $s = \frac{R-mR}{\sigma}$, then the probability of finding a random variable R in the interval from (c) to infinity can be expressed through the tabular function $F(t)$ as follows:

$$p(c \leq R \leq \infty) = F\left(\frac{\infty - mR}{\sigma}\right) - F\left(\frac{c - mR}{\sigma}\right); \quad F\left(\frac{\infty - mR}{\sigma}\right) = 0,5$$

$$p(c \leq R \leq \infty) = 0,5 - F\left(\frac{c - mR}{\sigma}\right) \quad (12)$$

Thus, the probability value we need is determined by the ratio (12) using a table to determine the values of the function $F\left(\frac{c-mR}{\sigma}\right)$.

The resulting probability value will be the same value that determines the probability of a commercial bank maintaining its solvency and liquidity, i.e. the probability of safe functioning (Abdullaev A.Y., 2015).

Findings and discussions

The condition for ensuring the economic security of banks is the prevention and protection from economic threats. The concept of "economic security" should correspond, firstly, with a focus on a civilized and efficient banking business. Domestic banks are not yet able to satisfy customers in high-quality banking services. This situation is unsafe because there are threats from foreign banking service providers (Abdullaev A.Y., 2015).

Secondly, the stable functioning of banks is fraught with the danger of stagnation. Banks operate in a constantly changing economic system, and in order not to be a brake on it, banks must develop. Moreover, the pace of development of banks should be adequate to the pace of development of the economic system or even ahead.

Thirdly, the implementation of threats always carries losses. In order to reduce them, the primary condition for ensuring the economic security of banks should be the prevention of economic threats, not protection against them, since losses from unforeseen and unexpected threats are more significant than from predicted threats.

Ensuring the economic security of banks provides for the presence of entities to influence objects in order to solve strategic and operational security tasks, carry out organizational measures, compensate for losses, ratings. The rating of economic security of banks consists in deriving a free assessment of the level of economic security. The main criterion for such an assessment of banks is the qualitative indicators of their safe operation. The rating formation is focused on the dynamics of indicators (indicators) and involves the development of categories of safe state of banks. The final result of the assessment is the assignment of banks to one or another security category (Abdullaev A.Y., 2015).

The paper develops a step-by-step assessment of the impact of destructive threat factors on economic security. The main stages of such an assessment are: identification of factors; determination of the degree of their impact and differentiation of economic security at the stage; establishment of an acceptable level of impact; impact assessment; assessment analysis and development of measures to reduce this impact.

For a qualitative assessment of the impact of factors, economic security is differentiated into five stages: stable, unstable, threatening, critical and extreme according to the degree of increase in the impact of destructive factors. Each stage is characterized by a change in the values of indicators and represents a deterministic model of the relationship between the effective indicator of the level of economic security at a particular stage and the factor indicator. By the level of economic security, the author understands the totality of the stages of economic security at a particular time for a particular bank. Since a scientifically based mechanism for differentiating the permissible level of the impact of destructive factors on the danger to which the activities of commercial banks are exposed has not yet been developed (Abdullaev A.Y., 2015).

The economic security strategy is implemented on the basis of a system of criteria and indicators of economic security (indicators). Criteria for the economic security of banks can be: classification of banks according to the degree of problems; establishment of a system of limits; assessment of the financial condition of banks in crisis conditions.

Within the framework of banking supervision and control, the classification of banks according to the degree of problems divides them into four groups according to the degree of increase in problems and threats, which relate mainly to four aspects: the presence of unpaid customer documents, the amount of the bank's own funds (capital); shortcomings in accounting and reporting and not providing the required reporting forms on the current date. However, not all of these signs of problems can be indicators of economic security. Indicators (indicators) include the lack of funds in the correspondent account of the bank and the lack of own funds (capital) of the bank.

In the system of economic security of banks, indicators must meet the requirements of the system: firstly, reflect the main areas of activity of banks; secondly, be in relationship with the process of their development. Methodically, indicators should meet the following requirements: be fairly simple and specific, defined and visual, compatible with the current accounting system and provide for the possibility of tracking and control (monitoring).

When developing threshold values of indicators, a key role belongs to the dynamics of changes in indicators, which reveals positive and negative trends, and is determined either by the growth rate or the rate of decline of individual indicators. Analysis of trends in indicators allows us to judge the increase or decrease of threats and the reaction of banks to their approach or removal. This leads to a logical conclusion, which is as follows: firstly, the growth or decline rates of indicators give an idea of the approach or removal of threats and a characteristic of the stage of economic security of banks at which they are at a certain point in time; secondly, by the dynamics of changes in indicators, it is possible to judge the financial condition of banks and their "feedback", i.e. the measures taken to approach or remove threats (Abdullaev A.Y., 2015).

When developing the parameters of economic security indicators, the reference is the statement about an acceptable level of economic security at which banks will be able to develop safely.

The economic security of banks is conditioned, among other things, by its organization, which is provided within banks to one degree or another by all departments and services available in the bank. However, the security service and the internal control service are directly involved in ensuring safe working conditions of the bank. The activities of the security service are focused on identifying, preventing and suppressing encroachments of criminal structures on property, intellectual property, protected personnel and information. But it does not follow from this that the economic security of banks is insured against the impact of threats, since threats may not be related to property, personnel, information. This means that the range of threats under consideration is wider than those against which the security service provides protection.

The Internal Control Service is focused on protecting the interests of investors, banks and their clients by monitoring compliance by the bank's employees with the legislation, ensuring an appropriate level of reliability, minimizing banking risks. The Internal Control Service monitors internal threats. Protection of banks from external threats is partly carried out by collection units, financial management, analytical support service, legal department. There is no consistency between them, there is duplication of functions of departments and services, they do not work for a single goal - ensuring the economic security of all bank activities.

Analysis of the existing organization of economic security of banks has shown that the range of economic threats is not fully covered by the bank's services, indicators are not monitored, the level of economic security is not determined. The management of banks does not include the task of ensuring economic security among the priorities. The absence of a system of interaction, coordination of efforts, and an integrated approach to solving problems of ensuring economic security does not create conditions for forecasting economic threats (Abdullaev A., 2015).

There is a need to improve the strategy of economic security of banks. It is conditioned by the essence of the process of economic security and forecasting of economic threats, which implies the prospect of further activity and development of banks. The content of the economic security strategy is determined by the internal policy of the bank and the dynamics of changes in indicators, taking into account the specifics of the bank's activities. The strategy should be fixed in the strategic plan of the bank on the basis of long-term goals of their safe development.

In the long term, the economic security rating is based on the use of a probabilistic model. Knowing the joint distributions of probabilistic output indicators for various internal states of the bank, as well as a priori distributions of possible internal states, which together determines the probabilistic model of the object, using the apparatus of mathematical statistics, it is possible to evaluate the economic security rating. At the same time, the remaining internal states will act as side effects, which, although they affect the behavior of indicators, are not related to the rating of economic security (Abdullaev A.Y., 2015).

The internal state of the bank from the point of view of economic security depends on the impact of internal economic threats. As a tool for forecasting the emergence and growth of internal economic threats and the corresponding level of economic security of banks. The following algorithm is used to rank commercial banks by bank security rating:

1) using the obtained values of R_i and t_i according to formulas (5-9), the values of the following values are calculated: coefficients a and b ; standard deviation (RMS); multiple correlation coefficient KR ;

2) then the forecast time T_{np} is selected, i.e. the period before which the probability of safe functioning of the bank will be determined and calculated: the predicted value of the rating $R_{np} = a + b * T_{np}$; the standard deviation of the value R_{np} (b_{np}) according to the formula (3).

The calculation results for each bank are summarized in Table 1.

Table 1. Determination of the probability of bank security

No bank	Parameter equations, (a)	Parameter equations, (b)	Medium quadratic deviation, (σ)	Ratio correlations, (r _m)	Forward-looking meaning rating, (R _{pr})	Forward-looking meaning SD, (σ _{pr})	Function argument, (s)	Meaning probabilities, (p)
1	a ₁	b ₁	σ ₁	r ₁	R _{pr1}	σ _{pr1}	s ₁	ω ₁
2	a ₂	b ₂	σ ₂	r ₂	R _{pr2}	σ _{pr2}	s ₂	ω ₂
3	a ₃	b ₃	σ ₃	r ₃	R _{pr3}	σ _{pr3}	s ₃	ω ₃
4	a ₄	b ₄	σ ₄	r ₄	R _{pr4}	σ _{pr4}	s ₄	ω ₄
...
n	a _n	b _n	σ _n	r _n	R _{prn}	σ _{prn}	s _n	ω _n

3) the value of the probability integral F(s) is determined by the tables Laplace. The value of $s = \frac{c-R_{np}}{\sigma}$, $c = R_{np}$.

The probability (p) that the bank will be solvent until the time T_{np}, i.e. it will not suffer bankruptcy, is determined by substituting the tabular value of the probability integral into formula (12). These calculations are performed for each bank, and then the banks are lined up in the list in order of decreasing probability (p).

The method described above for determining the probability of safe functioning of sixteen banks by the algorithm.

Monthly balances of these banks for the period from January 1, 2020 to January 31, 2020 are used for calculations. Banks were selected for the purposes of the study.

Table 2 shows the results of calculations of the following values: a and b are the values of the coefficients in equation (2) for approximating the value of R; σ is the value of the standard deviation of the value of R; CR is the multiple correlation coefficient; R(t+3) is the predicted value of the value of R for three months ahead; σ(t+3) is the predicted value of the standard deviation; s is the value of the argument of the probability integral function; p is the probability of safe operation of the bank for three months.

Table 2. The results of the probability of the security of the functioning of commercial banks

No	Parameter equations, (a)	Parameter equations, (b)	Medium quadratic deviation, (σ)	Ratio correlations, (r _m)	Forward-looking meaning rating, (R _{pr})	Forward-looking meaning SKO, (σ _{pr})	Argument functions, (s)	Meaning probabilities, (p)
1	0,6487	-0,0061	0,1386	0,030	0,7768	0,1389	1,3887	0,899715
3	0,6821	0,0040	0,1137	0,8723	0,7849	0,0040	3,3776	0,996802
12	0,6496	-0,0067	0,1386	0,031	0,5488	0,1389	1,3890	0,898941

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2	0,6481	-0,0060	0,1378	0,027	0,7693	0,1381	1,3880	0,901108
4	0,6828	0,0043	0,1143	0,8429	0,7856	0,1143	3,3783	0,998578
5	1,0639	-0,0331	0,1651	0,4047	0,7149	0,1659	0,9398	0,821768
6	0,6448	-0,0096	0,0891	0,1613	0,4930	0,0891	1,3815	0,916459
7	0,6832	0,0046	0,1145	0,8425	0,7568	0,1146	3,3787	0,999997
9	1,0644	-0,0336	0,1659	0,4050	0,7068	0,1667	0,9404	0,819997
8	0,6447	-0,0095	0,0888	0,159	0,4927	0,0888	1,3812	0,916432
11	0,6826	0,0042	0,1141	0,8688	0,7852	0,1141	3,3781	0,998163
10	0,6482	-0,0061	0,1379	0,028	0,7799	0,1385	1,3883	0,901129
13	0,6499	-0,0063	0,1389	0,033	0,5491	0,1389	1,3892	0,898998
14	0,6824	0,0041	0,1139	0,8691	0,7849	0,1139	3,3779	0,997164
15	0,6829	0,0045	0,1143	0,8432	0,7567	0,1143	3,3785	0,999893
16	0,6483	-0,0060	0,1382	0,029	0,7801	0,1387	1,3884	0,900901

*Source: authors' calculations

Table 2 shows a list of commercial banks as the probability of their safe operation decreases during the three months following December 31, 2020.

Table 3. Security rating of commercial banks in accordance with the probability of their safe functioning

Place in the rating	№ bank	Probability of safety	
		$p(a \leq P \leq \infty)$	%
1	7	0,999997	99,99
2	15	0,999893	99,99
3	4	0,998578	99,99
4	11	0,998163	99,99
5	14	0,997164	99,99
6	3	0,996802	99,99
7	6	0,916459	91,65
8	8	0,916432	91,64
9	10	0,901129	90,11
10	2	0,901108	90,11
11	16	0,900901	90,09
12	1	0,899715	89,97
13	13	0,898998	89,90
14	12	0,898941	89,89
15	5	0,821768	82,18
16	9	0,819997	82,00

Table 3 shows that the safety of the functioning of banks ranked in the security rating from 1 to 6 is not in doubt; the safety of the functioning of banks ranked in the rating from 7 to 13 may cause concern. The bank, ranked in the security rating from 15 to 16, is in a critical position from the point of view of security.

After achieving a balance in all indicators, the decision-maker makes a comparative assessment of the consequences of the decisions taken on alternative options. If not one of the alternatives does not satisfy the decision-maker from the point of view of economic values, then he re-accesses the database

and implements models with a qualitatively new array of information. He will repeat this procedure until a satisfactory calculation option is reached. The structure of the database provides for the possibility of reflecting all the necessary data, taking into account the economic conditions and content systems of each commercial bank.

The following designations are used in the figure: 1 - decision maker; 2 - database; 3 -algorithms for analyzing retrospective data on the development of the bank's economic security; 4 - algorithm for the bank's economic security, taking into account the equity factor; 6 - algorithms for calculating the parameters of equations, standard deviation and multiple correlation coefficient; 7 - algorithm for predicting the value of the bank's economic security rating; 8 - algorithm for predicting the standard deviation of the rating by banks; 9 - checking the balance and acceptability of the results; 10 - model results for analyzing and evaluating the consequences of decisions taken; 11 - algorithm for predicting the safe functioning of the banking sector.

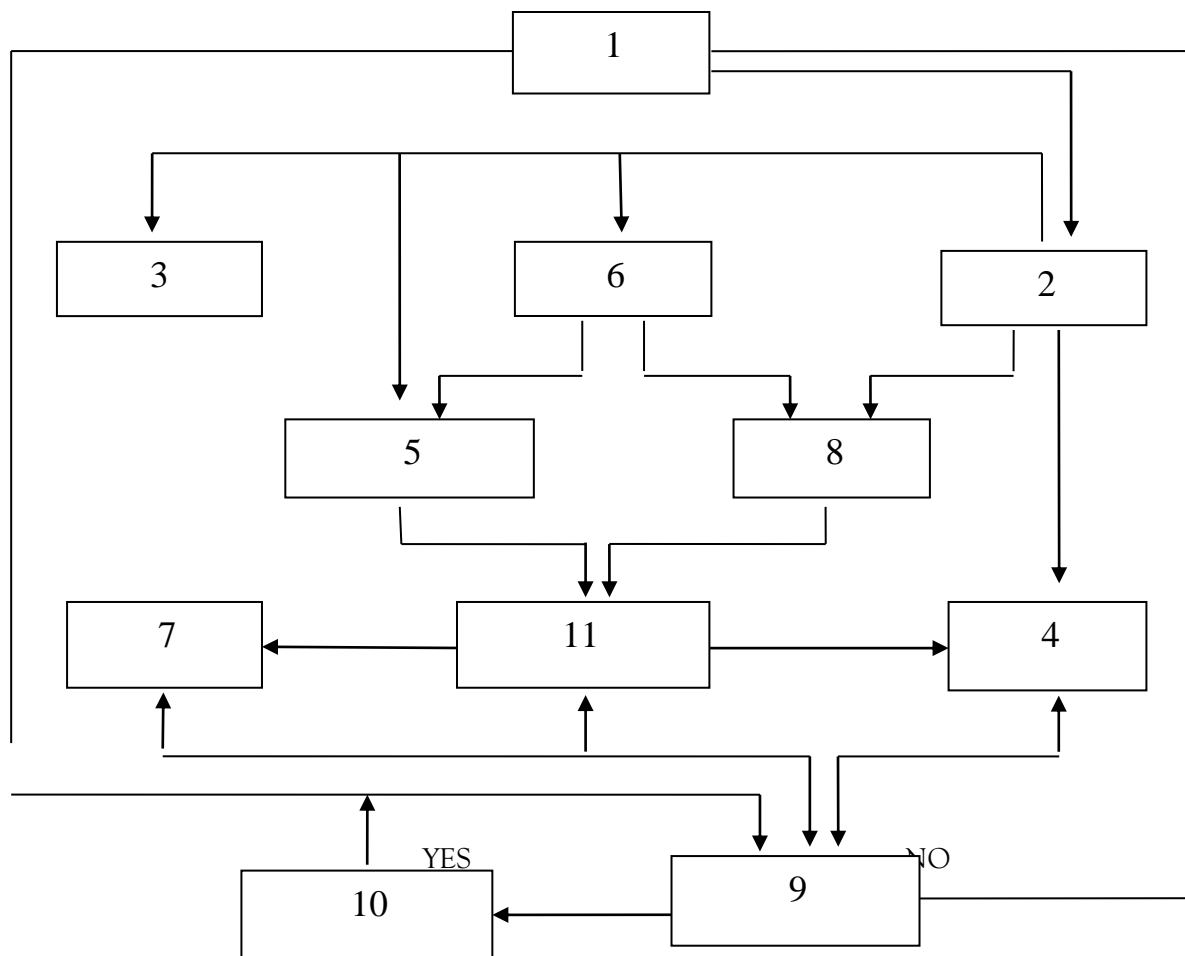


Figure 1. Mechanism for assessing the rating of the safe functioning of the banking sector

*Source: authors' calculations

In general, the results of the analysis of the retrospective of the economic security of banks by various types show that the development and implementation of algorithms in them are of fundamental importance. In this regard, there is a great interest in the algorithm of the long-term functioning of the banking sector, taking into account economic security in the two-level system "branch - main office". To

implement these tasks, a system of algorithms for the safe development of the banking sector should be developed on a PC.

Conclusion

In this paper, the methodology of forecasting the financial condition of a commercial bank is substantiated, according to which the economic security of the bank is determined by the probability of an event consisting in the fact that the bank will function safely for a certain period of time in the future, taking into account the impact of random parameters.

The advantage of the proposed method of determining the rating of economic security of banks, according to the criterion of forecasting internal economic threats, is the simplicity of calculations, visibility, which allows you to assess the level of economic security, increases the efficiency of making and effectiveness of management decisions. This gives advantages: firstly, to gain time to recognize the growing threat, to carry out specific measures to prevent a decrease in the level of economic security.; secondly, by providing a high level of economic security, maintaining the image of a safe bank to attract new investors, depositors, thereby increasing the bank's capital.

An integrated approach to considering the bank as a complex dynamic system functioning in changing market conditions allowed us to give a detailed definition of the bank's economic security rating, reveal the content of its economic security rating and apply research methods widely used in the theory of management of complex systems. This approach has also determined the basic principles of building a bank's economic security rating, which gives its users not only a comparative assessment of the current state of banks, but also allows them to judge the bank's economic security of their financial position in the future.

The developed methodology for determining the safety rating of banks can be used by counterparty banks, bank supervisory authorities, rating agencies both to compare the safety of banks relative to each other at different points in time, and to determine the probability of safe functioning of individual banks in the future.

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