



## Informational and Analytical Systems for Forecasting the Indicators of Financial Security of the Banking System of Ukraine

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### Abstract

The article is devoted to the modern development of high technologies and computer technology greatly enhanced the development of automated banking systems of banking sector organizations and allowed the synthesis of information and communication technologies for their formation.

The main purpose of the article is to select the main indicators for assessing the level of financial security of the banking system of the state and identify promising areas of its development using forecasting models. In the process of research such analytical functions have been used: polynomial, exponential, power and logarithmic. The authors believe that the information and analytical provision of the financial security of the bank is an information provision that combines, on the one hand, information work, that is, ways, means and methods of collecting the necessary information, and on the other - analytical work, which includes forms and methods of information analysis and processing, which ensures an objective assessment of the situation and the adoption of a balanced management decision. As

a result, forecast models were built for each of the indicators and also, it has been found that most indicators of the banking system of Ukraine in 2021-2023 will remain at “unsatisfactory” and “critical” levels. In conclusions it was proposed to introduce measures that would be aimed at improving the reliability and stability of the banking system of Ukraine.

**Keywords:** Financial Security, Information–Analytical System, Banking System; Banking Security; Forecast Models; Financial Stability; State.

Journal of Information Technology Management, 2023, Vol. 15, Issue 2, pp. 1-13.

Published by University of Tehran, Faculty of Management

doi: <https://doi.org/10.22059/jitm.2023.92315>

Article Type: Research Paper3

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Received: December 15, 2022

Received in revised form: January 28, 2023

Accepted: February 29, 2023

Published online: May 23, 2023



## Introduction

In today's challenges, namely in the presence of crises in the world economy caused by the pandemic COVID-19 and the corresponding quarantine restrictions, more and more attention is paid to financial security not only of the state but also of the banking system, as one of its integral components. After all, one of the most important indicators, which most clearly reflects the efficiency of the economy of any country is the state of its financial and credit sector, namely the banking system. As is known, the banking system is a set of components that are combined to ensure a common goal, namely, aimed at accumulating financial resources and ensuring their efficient circulation. Therefore, forecasting the activities and determining the directions of further development of the banking system, in terms of ensuring its financial security, in a crisis in the economy continues to be relevant in today's conditions (Poltorak A. Et. al, 2019).

## Literature Review

Theoretical and practical foundations of financial security of the banking system are reflected in the works of the following domestic scientists: Abuselidze, G., M. Ermoshenko, N. Pedchenko, O. Baranovskyi, O. Vasylchyshyn. However, despite the significant amount of research in this area, the question of determining the main indicators for a comprehensive assessment of the financial security of the banking system and the application of models for their forecasting remains open.

According to M. Ermoshenko "financial security is the state of the financial and credit sphere, which is characterized by balance, resistance to internal and external negative

influences, the ability of this sphere to ensure the effective functioning of the national economic system and economic growth" (Ermoshenko M., 1998).

Kerimova, S., & Boyko, S. (2020), considering the financial security of banks, points out that "the financial security of banks is such a state of banking institutions, which is characterized by balance and resistance to the influence of external and internal threats, its ability to achieve set goals and generate a sufficient amount of financial resources to ensure sustainable development».

Domestic scientist O. Baranovsky suggests considering the financial security of the banking system in three aspects: "first, from the point of view of the financial consequences of its (their) activity for the country as a whole and individual clients and counterparties. Secondly, from the point of view of preventing and averting clear and potential threats to the financial condition of the entire banking system of the country, the National Bank of Ukraine and domestic commercial banks. Thirdly, from the point of view of ensuring a set of conditions for protecting the sustainable development of the banking system in general and individual banks in particular".

So, summarizing the approaches of domestic scientists to the definition of the concept of financial security, we can conclude that the majority of scientists are inclined to the fact that the financial security of the banking system is, first of all, the state of the banking system, which ensures the stability of the banking system under the influence of internal and external negative factors, ensuring its uninterrupted functioning and development of the banking sector, but most appropriately, in my opinion, this concept reveals O. Baranovskyi, using more than one approach to its explanation, which together makes it possible to assess the level of financial security of the state's banking system, taking into account all available factors influencing its activity Baranovsky O. (2014).

## **Methodology**

Analyzing and systematizing the research of domestic scientists to define the concept of "financial security of the banking system" we can conclude that the vast majority of scholars believe that the financial security of the banking system - is primarily a state of the banking system, which ensures the stability of the banking system under internal and external negative factors, ensuring its smooth operation and development of the banking sector, but the most appropriate, in my opinion, this concept reveals O. Baranovskyi, using more than one approach to its explanation, which together allows to assess the level of financial security of the banking system, taking into account all available factors influencing its activities.

In the course of the research, the value of indicators for assessing the financial security of the banking system was calculated, in accordance with the procedure for their calculation in the Guidelines for calculating the level of economic security of Ukraine. Based on the current values of these indicators, their forecasting was performed using analytical equalization to

determine the general trend of changes in the levels of the time series. The selection of functions for forecasting was carried out according to the trend. The adequacy of each of the obtained equations was evaluated using the approximation coefficient. For indicators in which there was no clear trend, the method of linear filtration was used, as well as the moving average method.

## Results and Discussion

Determinants of financial security of the banking system are financial stability and resistance to negative factors and threats, as well as the level of efficiency of financial and economic activities of commercial banks (Pedchenko N.S. et. Al., 2020).

According to the Guidelines for calculating the level of economic security of Ukraine, “financial security is a state of country’s financial system, which is characterized by the creation of the necessary financial conditions for stable socio-economic development of the country, ensuring its resilience to possible financial shocks and imbalances, to preserve the integrity and unity of the country’s financial system”. Banking security is one of the components of financial security and is defined as “the level of financial stability of the country’s banking institutions, which ensures the efficiency of the country’s banking system and protection from external and internal destabilizing factors regardless of its operating conditions” (Methodical recommendations concerning calculation of level of economic safety of Ukraine, 2013).

On the basis of the indicators given in the Methodical Recommendations of the Ministry of Economic Development of Ukraine on the calculation of the level of economic security, we will assess the financial security of the banking system of Ukraine in 2014-2020.

Table 1. Indicators of financial security of the banking system of Ukraine in 2014-2020

Indicator	2014	2015	2016	2017	2018	2019	2020	Deviation 2020/2014, +/-
Share of overdue debt on loans in the total amount of loans granted by banks to residents of Ukraine, %	13,50	22,10	24,20	53,73	52,85	50,32	41,0	27,5
Ratio of bank loans and deposits in foreign currency, %	152,66	168,65	134,50	109,36	117,04	83,5	68,5	-84,16
The share of foreign capital in the authorized capital of banks, %	32,50	43,30	48,84	51,32	50,0	50,34	38,0	5,5
Ratio of long-term (over 1 year) loans and deposits, times	2,83	3,89	4,13	3,28	3,76	3,75	3,33	0,5
Return on assets, %	-4,07	-5,46	-12,60	-1,94	1,69	4,26	2,54	6,61
Ratio of liquid assets to short-term liabilities, %	86,14	92,87	92,09	98,37	93,52	94,35	88,55	2,41
The share of assets of the five largest banks in the total assets of the banking system, %	32,58	29,41	21,79	61,67	63,67	60,3	74,0	28,82
The ratio of total assets of the banking system to GDP, %	96,77	80,30	74,37	62,51	54,03	37,57	63,5	-33,27
Return on assets of state-owned banks, %	-3,10	-3,58	-21,04	-2,84	1,19	2,94	1,94	5,04

Source: calculated by the authors by <https://bank.gov.ua/ua/statistic/supervision-statist/data-supervision#4>

According to the calculations, we can see that the dynamics of such an indicator as “the share of overdue debt on loans in the total amount of loans granted by banks to residents of Ukraine” since 2014 has a tendency to increase and in 2020 is 41,0%, which is 27,5% more than in the same period of 2014. This indicator is a disincentive and indicates the quality of the loan portfolio of the banking system, but it should be noted that according to Guidelines, 7% is already considered a critical limit. Therefore, we can conclude that there is a significant deterioration in the quality of the loan portfolio of commercial banks in Ukraine, in this regard, it is necessary to form insurance reserves of the banking sector, which leads directly to an increase in its costs (Gudz et al., 2020).

The next indicator that characterizes the level of financial security of the banking system is the “ratio of bank loans and deposits in foreign currency” – is considered an indicator of mixed type, as it can be as a stimulant and disincentive. In the first case, the increase in the value of this indicator to 90% is positive, because it indicates an increase in the level of banking security of the state, in the other case, namely, an increase in this indicator beyond 110% is evidence of threats in the banking sector, which is negative. According to the calculated data, we see that this indicator is characterized by unstable dynamics during the study period, having, namely, a destabilizing effect on the level of financial security of the banking system of Ukraine. Within the optimal, the indicator was in 2017 and 2019 at the level of 109,36% and 83,5%, respectively. In 2020, the value of the indicator is close to critical and is 68,5%, which indicates a systematic increase in the dependence of the domestic banking system on currency risks. Regarding the indicator “ratio of long-term (over 1 year) loans and deposits”, it is a disincentive and characterizes the level of coverage of long-term loans through long-term deposits. During the analyzed period, the value of this indicator is critical and in 2020 is 3,33 times, which is 0,5 times more than in the same period of 2014, which indicates the threat of shortage of resources in the long run to meet the needs both legal entities and individuals in loans.

Regarding the “share of foreign capital in the authorized capital of banks”, according to the Guidelines, it belongs to the indicators of mixed type and according to the calculations has a destabilizing effect on the level of security of commercial banks in Ukraine. In 2014-2019, according to the obtained values of this indicator, the level of banking security was characterized as dangerous and averaged 46,05%, and according to the results of 2020 it is satisfactory and is at the level of 38,0%. However, it should be noted that with the beginning of the crisis in 2014, began the mass withdrawal of domestic banking institutions from the market due to the loss of their solvency. As a result, banking institutions with foreign capital had much more opportunities in terms of their financial support. In this regard, the banking system of Ukraine has a fairly high level of dependence on foreign capital.

The next important indicator in assessing the level of financial security of the banking system is the “return on assets”, which is also defined as a mixed type indicator and characterizes the level of profitability of the banking system relative to the weighted average

assets of commercial banks. Until 2017, the value of this indicator was negative and significantly exceeded its critical limits and indicated the unprofitability of the banking system, but since 2018 it has seen a significant increase to 1,69%, and in 2020 – to 2,54% and has unsatisfactory value. Also, in this aspect, we should consider such an indicator as “return on assets of state-owned”, the value of which has long been negative and indicates the downturn in the state share of the banking sector. However, in the following years, state-owned banks managed to increase their profitability and support their further activities.

Another indicator of mixed type in accordance with the Guidelines is the “ratio of liquid assets to short-term liabilities” whose value during 2014-2020 is close to optimal and in 2020 is 88,55%, which is 2,41% less, than for the same period in 2014, which indicates the liquidity and solvency of the banking system.

Regarding the “share of assets of the five largest banks in the total assets of the banking system”, within the study period, its growth is observed every year and in 2020 is 74,00%, which is 28,82 percentage points more than the same period of 2014 and is critical. That is, the concentration of the domestic banking sector is mainly due to commercial banks with a state share.

No less important indicator, the use of which is appropriate in assessing the level of banking security is the “ratio of bank assets to GDP”, the value of which should be close to 100%. However, during 2014-2020 the dynamics of this indicator is unstable and has a mainly declining trend, which indicates that the level of independence of the banking system of Ukraine is violated.

Thus, as a result of research, it can be concluded that the banking system of Ukraine is characterized by a “dangerous” level of its financial security, so it is advisable to forecast its main indicators to determine which of the indicators will have the most negative impact on its further provision.

Based on the calculated indicators, we will forecast the financial security indicators of the banking system of Ukraine using analytical alignment of time series to determine the general trend of changes in the levels of the time series.

In the process of analytical alignment, financial security indicators of the banking system of Ukraine are taken as Y and replaced by calculations based on a certain function, which is called a trend equation.

Depending on the previous analysis, previously calculated, data and the nature of its dynamics within the studied years, we determine the type of function, which can be linear, quadratic or power.

If within the studied period the data are characterized by a relatively stable growth, it is advisable to use a linear function, the equation of which has the form  $Y=a+bt$ , where t – characterizes the change in time.

In that case, if, on the contrary, the increase in data in a series of dynamics is not stable, but tends to increase or decrease, then the alignment can be carried out by the following functions:

polynomial, or parabola, the equation of which has the form –  $Y=a_0+a_1t+a_2t^2$ ;

exponential –  $Y=a_0e^{a_1t}$ . This function will be used to equalize such an indicator as “the ratio of bank loans in foreign currency”;

power, the form of which is characterized by the following equation:  $Y=a_0t^{a_1}$ . This equalization should be applied to indicators such as: “share of foreign capital in the authorized capital of banks” and “ratio of liquid assets to short-term liabilities”, as this function contains a stepwise approximation, which gives a good result if for the dependence contained in of the studied data, the constant rate of their growth is characteristic;

logarithmic function, the equation of which:  $Y=a_0\ln(t)+a_1$ . This function should be applied to such indicators as: “share of overdue debt on loans in the total amount of loans granted by banks to residents of Ukraine”, “return on assets”, “share of assets of the five largest banks in the total assets of the banking system”, “ratio of total assets of the banking system to GDP” and “return on assets of state-owned banks”. This alignment will be applied to the above indicators, because the logarithmic approximation is able to well describe both positive and negative values, which are first characterized by rapid growth or decline, and then their gradual stabilization.

To estimate the adequacy of each of the equations, the approximation coefficients ( $R^2$ ) should be calculated. The higher the obtained value of the coefficient, the higher the accuracy of the selected equation and its reliable characteristics. The obtained value of  $R^2$  should be as close as possible to unity, which will indicate the ability of the selected model to accurately reflect the development trend, that is, the reliability of forecasting results.

Table 2. Alignment by analytical functions

№	Indicator (factor)	Type of approximation	Forecast model	$R^2$
1.	Share of overdue debt on loans in the total amount of loans granted by banks to residents of Ukraine, %	Logarithmic	$y = 20,45\ln(t) + 11,90$	0,707
2.	Ratio of bank loans and deposits in foreign currency, %	Exponential	$y = 200,7e^{-0,14t}$	0,891
3.	The share of foreign capital in the authorized capital of banks, %	Power	$y = 35,41t^{0,211}$	0,692
4.	Return on assets, %	Logarithmic	$y=5,1193\ln(t) - 8,3718$	0,5547
5.	The share of assets of the five largest banks in the total assets of the banking system, %	Logarithmic	$y = 23,48\ln(t) + 20,45$	0,615
6.	The ratio of total assets of the banking system to GDP, %	Logarithmic	$y = -24,6\ln(t) + 97,03$	0,783

Source: calculated by the authors

For one of the syndicators, namely “the share of foreign capital in the authorized capital of banks” there is no clear trend, but there are fluctuations throughout the period. In this case, it is advisable to use the method of linear filtering (moving average), which allows to smooth the fluctuations of the data, which will allow you to more clearly show the nature of dependence. This method is characterized by the averaging of data elements, which allows you to use the result as an average value for approximation. It is also advisable in this case to use the method of moving average, the formula of which is as follows:

$$Pd = P0 \square SMA \quad (1)$$

where  $P0$  – is the ratio of long-term (over 1 year) loans and deposits of the base year;

SMA (Simple Moving Average) – the average three-year moving rate of change in the ratio of long-term (over 1 year) loans and deposits for 3 years preceding the corresponding year of the medium-term forecasting period (Table 3).

The formula of the moving average is as follows:

$$SMA = \sum_{i=1}^n T_i \quad (2)$$

where  $T_i$  determines the growth rate of the ratio of long-term (over 1 year) loans and deposits of the  $i$ -th period (up to the previous year);

$n$  is defined as the SMA period.

Table 3. The ratio of long-term (over 1 year) loans and deposits, times

Value	Year	Indicator	Index of the indicator to the previous year	Average for 3 years
Actual	2014	2,83		
	2015	3,89	1,375	1,375
	2016	4,13	1,062	1,218
	2017	3,28	0,794	1,077
	2018	3,76	1,146	1,001
	2019	3,75	0,997	0,979
	2020	3,33	0,888	1,011
Forecast	2021	3,32	0,997	0,997
	2022	3,30	0,996	0,996
	2023	3,31	1,001	1,001

Source: calculated by the authors

Having selected the type of functions for all indicators of financial security, depending on the characteristics of their dynamics, we calculate their forecast values for 2021-2023 (Table 4).



Table 4. Forecast values of financial security indicators for 2021-2023

Indicator	Years		
	2021	2022	2023
Share of overdue debt on loans in the total amount of loans granted by banks to residents of Ukraine, %	54,42	56,83	58,99
Ratio of bank loans and deposits in foreign currency, %	65,48	56,93	49,49
The share of foreign capital in the authorized capital of banks, %	54,91	56,30	57,56
Return on assets, %	2,27	2,88	3,42
The share of assets of the five largest banks in the total assets of the banking system, %	69,28	72,04	74,51
The ratio of total assets of the banking system to GDP, %	45,88	42,98	40,39

Source: calculated by the authors

Thus, the forecast of indicators of the level of financial security of the banking system for 2021-2023 will look like this – table 4. According to the forecast, we see that most indicators will continue to remain at “unsatisfactory” and “critical” levels. The most negative impact on the level of financial security of the banking system continues to be caused by such indicators as: first, “the share of overdue loans in the total amount of loans granted by banks to residents of Ukraine”, which indicates a further deterioration of the loan portfolio of commercial banks in Ukraine, is negative. Second, “the ratio of bank loans and deposits in foreign currency”, which indicates the increasing dependence of the domestic banking system on currency risks and “the ratio of long-term (over 1 year) loans and deposits” – in the course of their commercial banks lent more intensively customers than attracted deposits, in connection with this imbalance is likely to be non-payment by borrowers of debts on loans, which becomes a prerequisite for the risk of default on deposits. Third, the “share of foreign capital of banks” will tend to increase, which may be due to the fact that banks with foreign capital are more financially resilient to those crises that occur in the middle of the country, therefore, accordingly, “return on assets of state-owned banks” will decrease and possibly become negative, which will indicate the loss of the state share of the banking sector.

In this regard, it is necessary to introduce measures to improve the reliability and stability of the banking system of Ukraine, the content of which is as follows:

improving the quality of the loan portfolio of Ukrainian banks, which can be implemented through constant monitoring of banks that conduct aggressive credit policy in the banking market, as well as by ensuring effective monitoring of the borrower’s financial condition, which will control the dynamics of doubtful debts and prevent new (Polova et.al., 2020);

ensuring the so-called “monetary sovereignty” of the banking system of Ukraine, by gradually reducing the share of banks with foreign capital to the optimal level. After all, financial support of the state share of the banking sector is important for the domestic banking system, as state banks are in the role of financial channels through which the penetration of state policy into the real sector of the economy, which creates the necessary conditions for improving financial security (Kasych et.al.,2020);

increase the share of income assets of banks in their overall structure, to get more income, banks need to take into account not only the factors that determine the amount of interest on active operations (NBU discount rate, inflation rate, loan term, etc.), as well as demand in the credit services market;

apply financial planning in the process of banks, which will serve as one of the reserves to ensure the growth of profits and its rational distribution and use (Kulchytska et.al., 2019).

In our opinion, the implementation of effective work in these areas will ensure the reliability and competitiveness of the domestic banking system, as well as increase its financial security in terms of those indicators that are currently at a “critical” level and need immediate stabilization.

## **Conclusion**

As a result of research, we can conclude that the security of banks in Ukraine should be carried out at two levels: at the level of an individual bank based on the implementation of banking management measures and at the level of the banking system based on government measures to minimize negative internal and external threats to the bank and the banking system in general. After all, the identified trends in financial security indicators of the banking system allowed us to assess the positive and negative results of its activities and note that in this aspect the banking system is at a "dangerous" level. Therefore, in the face of modern challenges, measures to improve the financial security system should be aimed primarily at improving the economic condition of the banking system, namely to increase its profitability. In this regard, the paper identified key measures to achieve this goal.

The forecast of indicators for assessing the level of financial security of the banking system was made, according to which the main priority areas for improving the banking sector were identified, namely, it is necessary to take the necessary measures to improve the quality of the loan portfolio of Ukrainian banking institutions.

It should be noted that assessing the level of financial security of the banking system is a necessary process, because from adequate assessment depends on the timely adoption of effective management decisions to minimize the action negative factors and threats to the financial stability of commercial banks, which, in turn, affects the level of financial security of the country as a whole

## **Conflict of interest**

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article

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**Bibliographic information of this paper for citing:**

Davydenko, Nadiia; Lutsyk, Yuliya; Buriak, Alina & Vovk, Liudmyla (2023). Informational and Analytical Systems for Forecasting the Indicators of Financial Security of the Banking System of Ukraine. *Journal of Information Technology Management*, 15 (2), 1-13. <https://doi.org/10.22059/jitm.2023.92315>

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