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IMPACT OF CHANGES IN MACROECONOMIC INDICATORS ON BANKING INDICATORS IN UKRAINE

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Abstract
In the conditions of a changing economic environment, it is important not only to analyze the main indicators of the banking system, but also to clearly define the main factors that determine them. The aim of the article is to study the mutual influence of the main performance indicators of the banking system of Ukraine and macroeconomic indicators of Ukraine at the present stage of its operation to outline the main factors that will promote the formation of a methodology for studying the essence of the basic processes in the functioning of banks, identifying obstacles to their development and developing effective mechanisms to improve their further activities. As a result of the study, the authors developed a multifactor model of the influence of factors on the performance of banks and used the method of canonical correlations to find the maximum correlations between groups of variables. There is a close correlation between the performance of banks and macroeconomic indicators of the country. The results of the canonical analysis confirmed that the relationship between the selected performance indicators and the selected determinants should be studied in terms of individual performance indicators of banks to form a system of scenarios for the development of these indicators depending on selected factors using the scenario method. The possibility of achieving positive changes in the banking system of Ukraine by influencing the resulting indicators of each of the significant equations through the management of specific significant factor variables is analyzed. Correlation-regression and scenario analysis makes it possible to state that the state policy should be pursued to manage a given set of factors that have a positive impact on banks' performance, promote bank capital growth, number of legal entities, average monthly salary, stability of the National Bank of Ukraine discount rate, etc.

Keywords: *bank, performance indicators of banks, macroeconomic indicators, factors influencing banking activity.*
JEL Codes: *G 21; O 11.*

Introduction

The banking system is a basic and extremely important component of the financial system of any country. Banks in the process of their operation actively influence the socio-economic relations that take place in the country. The development of banks in Ukraine has become a stimulus for the formation of new market relations, a basic element of the movement of financial resources, without which the functioning of a market economy is impossible. The efficiency of all branches of the country's economy depends on the reliable and efficient work of banks.

Banks in Ukraine are dynamically changing and developing, which is reflected in the fluctuations of indicators that characterize their activities. Banks' performance indicators are closely interrelated with the country's macroeconomic indicators, reflecting both internal and external causal links between economic processes. Outlining the main factors influencing the activities of banks is very important in terms of forming a

methodology for their research, and the main - understanding the essence of the basic processes of their operation, to form effective mechanisms for their further development. The structuring of the most influential factors can serve as a basis for identifying obstacles to the development of banks and the formation of sound forecasts of their future operation.

A large number of researchers studied the activities of banking institutions, who studied both the peculiarities of their functioning in a changing economic environment and directly the results of banks. For example, Wahyudi S., T., Nabella R. S., and Sari K. conducted a study of the relationship between competition and the efficiency of the banking sector in Indonesia, which led to the conclusion that bank competition that leads to a monopolistic market structure stimulated banks to achieve higher profits and put bank projects and financing at high risk. Competition has had a negative correlation with bank efficiency because competition encourages banks to focus on profit rather than efficiency, engage in risky financing/projects, and undertake high lending activities (Setyo Tri Wahyudi, Rihana Sofie Nabella and Kartika Sari, 2021). Nguhen Phu Ha in his article "Impact of macroeconomic factors and interaction with institutional performance on Vietnamese bank share prices". A new contribution of this study is the application of interactive factors between macroeconomics and bank performance (i.e., Equity Capital (E), Deposit Amounts (D), Loan Amounts (L), Non-performing Loans (NPLs), Leverage (LEV), Capital Adequacy Ratio (CAR), Return on Assets (ROA), and Stock Beta (Beta)) in evaluating their impact on bank share prices. Applying the econometric method of Two-Stage Least Square (2SLS) and the quarterly financial data of 13 listed banks from Q1/2009 to Q3/2020, the regression results show that GDP improvements can foster an increase in bank share prices, and this impact is strengthened if banks have good performance of ROA, CAR, and with strict control of NPLs. The R also has a positive impact on bank share prices, and the price level increases if NPLs, LEV, and Beta are controlled at optimal levels (Nguyen Phu Ha, 2021). The results of the study by Salamat W., Momani M., Batayneh K. "Firm-specific, macroeconomic factors and stock price risk for Jordanian banks" show, that trading volume (TV), dividend yield (DY), and Gross Domestic Product (GDP) have a positive effect on stock price volatility, while stock price volatility is statistically negatively affected by return on assets (ROA), dividend payout ratio (DPR), and price-earnings ratio (PE). On the other hand, money supply (MS) does not affect stock price volatility. Paying more dividends can reduce stock risk and, in turn, reduce stock price volatility (Wasfi Al Salamat, Mohammad Q. M. Momani and Khaled Batayneh, 2021). We also conducted some research, the aim of which was to characterize the real stage of realization of asset operations of the Ukrainian banks. For this aim, an analysis of the Ukrainian banks' activities from 2011 through 2016 was made (Tkachuk, 2017).

Despite the significant amount of research on the state and problems of bank development, issues related to the study of the mutual influence of key performance indicators of Ukrainian banks and macroeconomic indicators of Ukraine's development at the present stage of its development remain unexplored. Thus, this study is relevant and has theoretical and practical value.

The aim of the article is to study the mutual influence of the main performance indicators of the banking system of Ukraine and macroeconomic indicators of Ukraine at the present stage of its operation to outline the main factors that will promote the formation of a methodology for studying the essence of the basic processes in the functioning of banks, identifying obstacles to their development and developing effective mechanisms to improve their further activities.

In the process of research, the methods of economic-mathematical analysis were used: the method of canonical correlations, correlation-regression analysis, as well as the scenario method. For correlation-regression analysis it is important that the phenomena

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and processes studied have a mathematical expression, so to study the peculiarities of the banking system of Ukraine and the formation of its results we use basic macroeconomic indicators (GDP in actual prices; Average monthly wages per employee; prices; NBU discount rate; Population; Number of business entities; Number of legal entities) and data on the performance of Ukrainian banks (Number of banks; Number of banks with foreign capital; Number of banks with 100% foreign capital; Bank assets; Loans to customers; Loans to entities; Loans to individuals; Bank capital; Bank liabilities; Funds of entities; Funds of individuals; Net profit/loss).

The study period is 10 years and covers the period from January 1, 2011 to December 31, 2020, divided quarterly. All data is taken from open sources.

Scientific knowledge obtained as a result of studying the impact of changes in macroeconomic indicators on the performance of the banking system of Ukraine will expand the methodology of research in the banking sector in Ukraine, as well as provide significant practical benefits: the results of the study will make it possible to direct the state policy of macroeconomic factors management to increase the efficiency of the banking system in Ukraine.

Results

Factors influencing the activity of the banking sector reflect both internal and external processes in the economy of the state and significantly determine the results of banking activity.

In practical activity, the outline of the main factors that determine the results of the banking sphere is important in the aspect of forming the methodology of its research, and most importantly - in understanding the essence of all processes, intending to form effective mechanisms of its development.

The structuring of such factors can serve as a program to identify obstacles to the development of the banking system in the state and a separate subject of banking activity in particular.

The development of a multifactorial model of the influence of factors on the performance indicators of the banking system requires further development in this direction.

Determining and monitoring factors affecting the results of the banking system provide a toolkit for analysis, but usually it is carried out with the help of an economic and mathematical modeling apparatus. As a rule, correlation-regression analysis is used to build multifactorial models of the influence of factors on performance indicators. The specified method makes it possible to determine the strength and influence of the system of factors on one effective indicator of the banking system. However, the primary task of building a system of factors, in our opinion, is to assess the influence of factors not on one effective indicator of the banking system (for example, the capital of banks), but on several, which ensures greater realism and validity of the obtained research results. Conducting such research is carried out using canonical correlations analysis.

The method of canonical correlation analysis was first published by the American economist H. Hotelling (1936) (Hotelling H., 1936). Canonical correlation analysis finds linear relationships between two sets of variables, it is a generalized version of pairwise correlation (Yarovy A., Strakhov E., 2015). At the same time, it is not required that there is no correlation both in the group of performance indicators *Y* and in the group of factor characteristics *X* (Fig. 1).

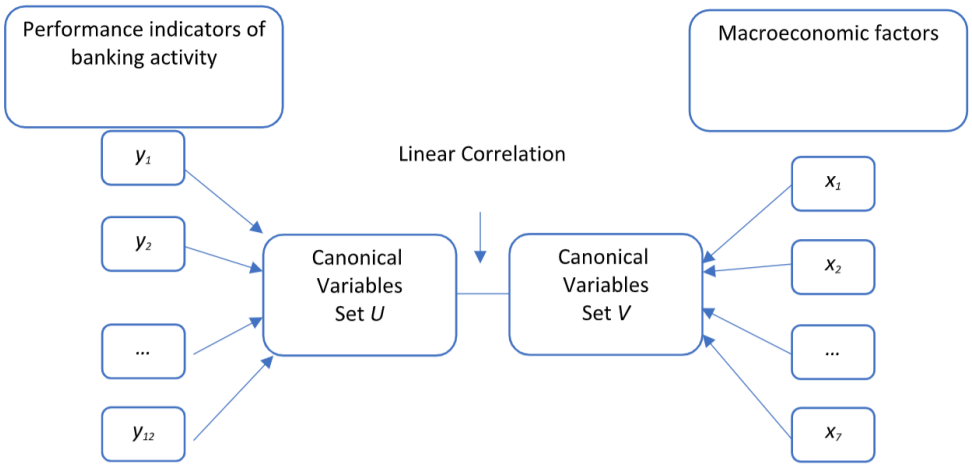

Figure 1. Illustrative representation of relationships between factor and dependent variables in canonical analysis

**Source: Compiled by the authors.*

The calculation algorithm of the method of canonical correlations is built in such a way that the initial variables are replaced by their linear independent combinations. The main purpose of using this method is to find maximum correlations between groups of variables. In addition, the method of canonical correlations makes it possible to reduce the volume of initial data due to the elimination of insignificant factors.

Let's consider the possibilities of the method of canonical correlations in relation to the construction of a system of factors and performance indicators of the banking system of Ukraine.

The analysis of the dynamics of the specified indicators to determine the direction of cause-and-effect relationships leads to the conclusion that the variables of the first group, which characterize the criteria for changing the performance indicators of the banking activity of Ukraine, are dependent variables (Number of banks; Number of banks with foreign capital; Number of banks with 100% foreign capital; Assets of banks; Loans provided to clients; Loans provided to economic entities; Loans provided to individuals; Capital of banks; Liabilities of banks; Funds of economic entities; Funds of individuals; Net profit/loss) and are defined as Y1, Y2, ..., Y12, respectively. The indicators of the second group are factorial, independent (GDP in actual prices; Average monthly wage per employee; Consumer price index; Accounting Rate of the NBU; Population; Number of business entities; Number of legal entities) are defined as X1, X2, ... X7 respectively.

The mathematical formalization of the method of canonical correlations in our case consists in finding such linear combinations of canonical variables $U = \sum_{i=1}^{12} \alpha_i y_i$ та $V = \sum_{j=1}^{7} \beta_j x_j$, so that the correlation between *U* and *V* is maximal. The dependence between canonical variables is measured by the canonical correlation coefficient R.

Using the method of canonical correlation (Fig. 2), we will check the relationships between two sets of variables (vectors) *Y* and *X*.

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N=41	Canonical Analysis Summary (data CCA) Canonical R: ,99772 Chi?(84)=404,84 p=0,0000 Left Set	Right Set
No. of variables	12	7
Variance extracted	90,2278%	100,000%
Total redundancy	83,1932%	86,6132%
Variables: 1	Y1	X1
2	Y2	X2
3	Y3	X3
4	Y4	X4
5	Y5	X5
6	Y6	X6
7	Y7	X7
8	Y8	
9	Y9	
10	Y10	
11	Y11	
12	Y12	

Figure 2. Canonical Analysis Summary for factor and resulting variables in the banking system of Ukraine

**Source: own calculations depicted in Statistica 12.*

Analysis of the results in Fig. 2 has showed that as a result of the canonical analysis, the total redundancy for the variables of the first set (Y1-Y12) is 83.1932%, and the total redundancy for the variables of the second set (X1 - X7) is 86.6132%. This means that 83.1932% of the variations in the main performance indicators of the banking system are determined by the change in factors (X1 - X7). At the same time, the main performance indicators of the banking system describe 86.6132% of the variation of their main factors.

We obtained seven roots with a canonical value of the correlation coefficient R = 0.9977. This coefficient is significant (because p <0.001) and shows the closeness between the canonical variables in the first and second sets. These roots describe 90.2278% of the variance of the set of indicators of the banking system and 100% of the variance of the set of factors. These results indicate a fairly strong relationship between the variables of the two sets.

The significance of the canonical roots is checked using the Chi-Square test (Fig. 3).

Root Removed	Chi-Square Tests with Successive Roots Removed (data Canonical Correlation Analysis) Canonicl R	Canonicl R-sqr.	Chi-sqr.	df	p	Lambda Prime
0	0,997717	0,995439	404,8448	84	0,000000	0,000001
1	0,990742	0,981570	243,1358	66	0,000000	0,000302
2	0,907970	0,824409	123,3223	50	0,000000	0,016396
3	0,829307	0,687751	71,1344	36	0,000436	0,093374
4	0,733996	0,538751	36,2157	24	0,052392	0,299036
5	0,461434	0,212921	13,0013	14	0,526441	0,648317
6	0,419880	0,176299	5,8184	6	0,443852	0,823701

Figure 3. Significance of canonical roots (Chi-Square Tests) performance indicators of the banking system

**Source: Compiled by the authors using the Statistica 12 toolkit.*

The value of the canonical correlation coefficient R=0.997717 for the first canonical root is greater than the value for other canonical roots (see Fig. 2). Further

consistent application of the criterion gives reason to consider only the first canonical root with R = 0.997717.

We will describe the correlation between the variables of each set, taking into account their factor structures according to the first canonical root. The structure of the factors of the left set shows (Fig. 4) that the variables of the left set are highly correlated with the canonical factor Y10 (Funds of economic entities, value: 0.946921), Y1 (Number of banks, value: -0.937803). Similarly, the factor structure of the right set (Fig. 5) allows us to identify factors with higher loadings relative to the first canonical root. These are X1 (GDP in actual prices), X2 (Average monthly wage per employee), X5 (Population).

Root	Factor Structure, left set (data Canonical Correlation Analysis)						
Variable	**Root 1**	Root 2	Root 3	Root 4	Root 5	Root 6	Root 7
Y1	-0,937803	0,283130	-0,058960	0,071035	0,063087	0,097832	-0,052224
Y2	-0,914028	0,331547	-0,106714	0,051419	0,084029	0,007461	0,032753
Y3	0,332890	0,709661	-0,396623	0,117315	0,225373	0,089558	0,224244
Y4	0,802545	0,014205	0,373416	0,135675	0,224630	0,170431	-0,186395
Y5	0,760019	-0,395001	0,039064	0,278340	0,243574	0,058618	-0,119533
Y6	0,748659	-0,524334	0,039149	0,193506	0,147785	0,058531	-0,059464
Y7	0,304241	0,483663	-0,280141	-0,447700	0,514550	-0,088752	-0,061094
Y8	0,370867	0,785401	0,284649	0,214830	0,069801	-0,111149	-0,037062
Y9	0,798028	-0,095474	0,395712	0,101643	0,234548	0,205359	-0,149519
Y10	0,946921	-0,034125	0,253926	-0,068362	0,042893	0,022609	-0,029527
Y11	0,898909	0,112639	0,271207	0,150196	0,129826	0,157800	-0,142191
Y12	0,426670	0,633622	-0,085919	0,037297	0,082507	0,049537	-0,080560

Figure 4. Factor Structure, left set

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Root	Factor Structure, right set (data Canonical Correlation Analysis)						
Variable	**Root 1**	Root 2	Root 3	Root 4	Root 5	Root 6	Root 7
X1	0,950981	-0,028527	0,043031	0,036881	0,051796	-0,205628	0,215971
X2	0,988292	0,107919	0,052018	-0,002249	0,094317	0,004817	0,001333
X3	-0,100879	-0,512505	0,397777	0,061239	0,601788	0,261745	0,366779
X4	0,251650	-0,853295	-0,436323	0,114327	0,058125	0,002628	-0,041543
X5	-0,826679	0,474980	-0,171072	-0,070004	-0,156604	0,108061	0,143622
X6	0,104691	-0,236124	-0,121624	-0,904124	0,247873	-0,185405	-0,072364
X7	0,019202	0,952243	0,040389	0,087983	0,277392	-0,073934	0,032858

Figure 5 . Factor Structure, right set

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Based on the **Canonical Weights** of the left (Fig. 4) and right (Fig. 5) sets, respectively, we will construct the equations of the canonical models for the variables and for the first canonical root (R = 0.997717):

	Canonical Weights, left set (data Canonical Correlation Analysis)						
Variable	**Root 1**	Root 2	Root 3	Root 4	Root 5	Root 6	Root 7
Y1	-0,559874	0,44310	-0,19474	-2,20228	-0,60486	4,82988	2,53499
Y2	-0,267365	0,25844	1,06632	1,02340	0,89582	-2,55963	-1,25587
Y3	0,166297	-0,01438	-0,85527	0,66027	0,56907	0,44747	1,68580
Y4	0,324147	-1,70139	-6,20103	4,26367	4,56024	-8,23448	-7,75006
Y5	0,111637	0,10766	0,69345	0,95880	-3,45276	-2,27003	-2,19529
Y6	-0,206232	-0,56911	-0,97991	-0,57829	4,93667	2,52664	3,72989
Y7	0,003970	0,16783	-0,10944	-0,89098	0,91426	-0,13243	-0,50722
Y8	-0,115512	0,34781	1,20996	0,28273	0,94808	-0,62763	2,01064
Y9	-0,444590	0,05025	5,91571	-2,36968	-0,06295	6,18260	7,94280
Y10	-0,044340	0,41755	0,93084	-2,49744	-1,74854	0,73574	2,91570
Y11	0,427787	1,93719	0,41205	-0,56123	-3,85656	3,07672	-4,13693
Y12	0,090214	0,02187	-0,30060	-0,32949	-0,29649	0,84362	-0,48776

Figure 6. Canonical Weights, left set

**Source: Compiled by the authors using the Statistica 12 toolkit.*

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Variable	Canonical Weights, right set (data Canonical Correlation Analysis)						
	Root 1	Root 2	Root 3	Root 4	Root 5	Root 6	Root 7
X1	0,067224	-0,132826	0,06146	0,196389	-0,494732	-2,30792	2,192175
X2	1,006036	0,504876	-0,61481	-0,804570	-0,389408	3,86139	-0,333417
X3	-0,061062	-0,160161	0,29216	-0,027101	0,617493	0,66897	0,682977
X4	0,030408	-0,207701	-1,62907	0,483690	0,824132	0,10142	-0,020430
X5	0,080493	0,415353	-1,23015	-0,687538	-0,779497	1,84932	2,010642
X6	-0,022171	-0,027021	-0,15064	-0,922143	0,340285	-0,29102	-0,077151
X7	-0,163265	0,502757	-0,65478	0,630194	1,573340	-1,05043	-0,569308

Figure 7 . Canonical Weights, right set

**Source: Compiled by the authors using the Statistica 12 toolkit.*

$$U = -0,559874Y_1 - 0,267365Y_2 + 0,166297Y_3 +$$
$$+ 0,324147Y_4 + 0,111637Y_5 - 0,206232Y_6 +$$
$$+ 0,003970Y_7 - 0,115512Y_8 - 0,444590Y_9 -$$
$$- 0,044340Y_{10} + 0,427787Y_{11} + 0,090214Y_{12}$$
$$V = 0,067224X_1 + 1,006036X_2 - 0,061062X_3 + 0,030408X_4 +$$
$$+ 0,080493X_5 - 0,022171X_6 - 0,163265X_7$$

On the basis of the constructed equations, it is possible to analyze the influence of each variable. The canonical correlation method also allows you to link a set of factor indicators not with one indicator of the banking system's performance, but with several, which increases the objectivity of analytical conclusions as a basis for making management decisions.

The relationship between the values of canonical variables from the right and left sets is shown in fig. 8.

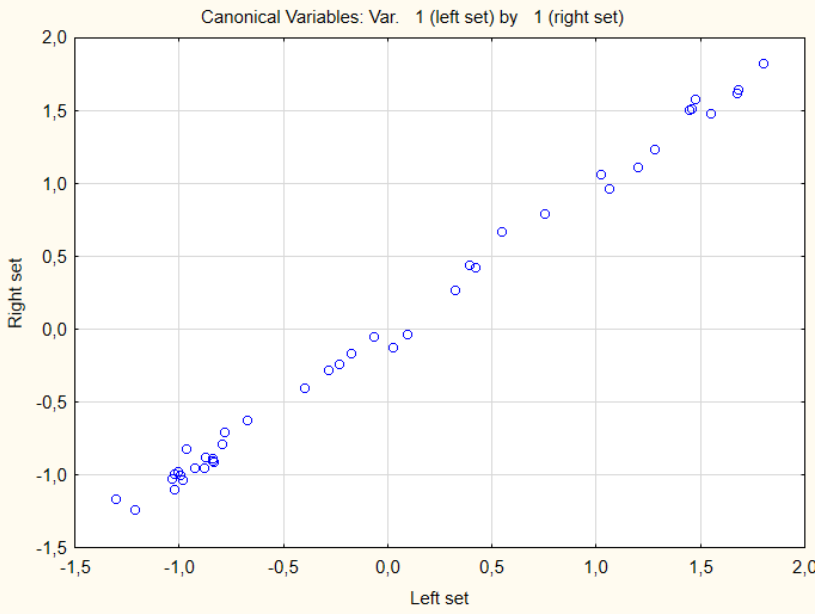

Figure 8. Scatterplot of canonical correlations for the first canonical root

**Source: Compiled by the authors using the Statistica 12 toolkit.*

There are no sharp outliers on the obtained graph. In addition, the deviations from the regression line do not form any characteristic bends (for example, being located in the form of U or S curves around the regression line). Therefore, it can be

concluded that there are no noticeable violations of the main assumptions of the canonical analysis.

Correlations within and between sets make it possible to analyze correlation matrices characterizing the relationship between variables. The matrix of the relationship between the variables of bank efficiency (Y) and factors (X) is presented (Fig. 9).

Variable	Correlations, left set with right set (data Canonical Correlation Analysis)						
	X1	X2	X3	X4	X5	X6	X7
Y1	-0,909550	-0,892797	-0,035421	-0,441001	0,906239	-0,206246	0,260954
Y2	-0,873749	-0,865099	-0,069220	-0,459603	0,916182	-0,186148	0,312424
Y3	0,304290	0,401094	-0,386232	-0,342299	0,106268	-0,148880	0,715831
Y4	0,755267	0,826066	0,144869	0,067460	-0,749689	-0,030510	0,089720
Y5	0,735176	0,725425	0,248576	0,548217	-0,867249	0,001712	-0,290409
Y6	0,727275	0,693959	0,278041	0,641490	-0,899200	0,075134	-0,437501
Y7	0,272802	0,374700	-0,192967	-0,241053	-0,021082	0,388317	0,526140
Y8	0,357216	0,467271	-0,310706	-0,659769	-0,008778	-0,314176	0,791680
Y9	0,754319	0,811787	0,221617	0,146811	-0,796239	0,015427	-0,014171
Y10	0,904050	0,945173	0,027389	0,161891	-0,838128	0,136874	-0,002175
Y11	0,841969	0,920188	0,012418	0,045476	-0,754882	-0,060583	0,163481
Y12	0,375836	0,490108	-0,363788	-0,385975	-0,054433	-0,108918	0,619518

Figure 9. Correlations within and between sets*

**Source: own calculations depicted in Statistica 12.*
Marked correlations are significant at p < ,05000.
N=41 (Casewise deletion of missing data).

Analysis of the matrix shows that factor X1 (GDP at actual prices) affects such performance indicators of the banking system as Y1 (number of banks), Y2 (number of banks with foreign capital), Y4 (bank assets), Y5 (loans to customers), Y6 (loans to economic entities), Y9 (liabilities of banks), Y10 (funds of economic entities), and Y11 (funds of individuals);

X2 (average monthly salary per employee) - Y1 (number of banks), Y2 (number of banks with foreign capital), Y4 (bank assets), Y5 (loans to customers), Y6 (loans to businesses), Y9 (liabilities of banks), Y10 (funds of economic entities), and Y11 (funds of individuals);

X4 (NBU discount rate) - Y5 (loans to customers), and Y6 (loans to businesses);

X5 (Population) - Y1 (number of banks), Y2 (number of banks with foreign capital), Y4 (bank assets), Y5 (loans to customers), Y6 (loans to businesses), Y9 (liabilities of banks), Y10 (funds of economic entities), Y11 (funds of individuals);

X7 (number of legal entities) - Y3 (Number of banks with 100% foreign capital); Y8 (capital of banks); Y12 (net profit / loss);

Also, the analysis of the matrix (Fig. 9) shows that factors X3 (consumer price index as a percentage of the previous month) and X6 (number of business entities) do not have a significant impact on the performance of the banking system of Ukraine.

The results of the canonical analysis confirmed that the relationship between the selected performance indicators and selected determinants should be studied in terms of individual indicators of the banking system of Ukraine to form a system of scenarios for the development of these indicators depending on selected factors. Therefore, we turn to the correlation-regression analysis and investigate the dependencies of performance indicators on selected factors.

Let us construct linear models of multiple regression of the dependence of the performance indicators of the banking system of Ukraine on the main macroeconomic factors that affect them:

$$Y = \alpha + \sum_{j=1}^{m} \beta_j X_j + \varepsilon ,$$

where Y is the corresponding performance indicator of the banking system of Ukraine, X is the appropriate selected factor that hypothetically should affect the development and dynamics of the banking system of Ukraine, α, β_j, ($j = \overline{1,m}$, m is the number of independent factors) are unknown

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theoretical regression parameters, and ε is random theoretical deviation.

Using the least squares method, the theoretical parameters of regressions are estimated and the sample equations of linear multiple regression of the dependence of the performance of the banking system on the selected set of factors are constructed. Models of linear multiple regression in standardized form are also constructed, as standardized regression parameters b_j^* ($j=\overline{1,m}$) are dimensionless quantities and in contrast to the usual parameters of multiple regression b_j, $j=\overline{1,m}$, they can be compared with each other. The larger the value of the parameter b_j^*, the greater the influence on the dependent variable Y has X_j factor. This content of standardized regression parameters allows to use them when eliminating insignificant factors, namely, the factors with the lowest value will be excluded from the model. b_j^* (Grygorkiv, V., 2009).

Analyzing the dependence of the performance of the banking system of Ukraine on the selected factors, it can be argued that the selected set of factors to some extent affect the resulting indicators. All constructed regression equations are significant at a significance level of 0.05, the corresponding coefficients of determination are more than 0.61.

The insignificance of some regression parameters is explained by the presence of a relationship between the included explanatory factors, i.e. the existence of the phenomenon of multicollinearity (Table 1). In this case, the regression parameter estimates found using the method of least squares become shifted (the property of the Gauss-Markov theorem is violated), the variances of the parameter estimates (respectively, and standard parameter errors) increase (leading to widening confidence intervals and deteriorating accuracy), and decrease *t*-statistics of regression parameters (which in turn generates incorrect conclusions about the existence of the influence of the corresponding explanatory variable on the dependent variable).

Table 1. Correlation matrix between selected factors

	GDP in actual prices, separately by quarter (UAH million)	Average monthly wage per employee, UAH	Consumer price index, in % of the previous month	Accounting Rate of the NBU, or refinancing rate,, %	Population	Number of business entities, units	Number of legal entities
GDP in actual prices, separately by quarter (UAH million) X1	1						
Average monthly wage per employee, UAH	0,94	1					
Consumer price index, in % of the previous month	-0,01	-0,08	1				
Accounting Rate of the NBU, or refinancing rate,, %	0,24	0,14	0,27	1			
Population	-0,81	-0,79	-0,25	-0,56	1		
Number of business entities, units	0,10	0,10	0,08	0,19	-0,18	1	
Number of legal entities	0,03	0,15	-0,31	-0,80	0,38	-0,23	1

**Source: Compiled by the authors in MS Excel.*

Therefore, the values of correlation coefficients in Table 1 indicate the presence of direct relationships between such factors as "GDP in actual prices" and "Average monthly wage per employee"; as well as inverse relations between such pairs of factors as "GDP in actual prices" and "Population"; "Population" and "Average monthly wage per employee"; "Accounting Rate of the NBU" and "Number of legal entities". Let's consider the connections of each pair of factors in more detail.

"GDP in actual prices" and "Average monthly wage per employee". These factors characterize direct relationships that are easy to explain in theory: an increase in the average monthly salary per employee leads to an increase in the purchasing power of the population in general, and therefore to an increase in demand for goods, work, and services, which, in turn, stimulates the production of goods inland. At the same time, the development of production leads to an increase in the wages of workers, as a tool of the competitive struggle for workers in conditions of total personnel shortage in Ukraine and an element of universal motivation of workers.

The inverse nature of the relationship between the factors "Population" and "Average monthly wage per employee" is also explained by the general shortage of personnel and increased competition for an individual employee. After all, the population of Ukraine is rapidly decreasing during the entire period of independence [], while the need for workers in the conditions of the development of the market economy is constantly increasing.

The pair of factors "Accounting Rate of the NBU" and "Number of legal entities" are also characterized by inverse relationships, which is related to the nature of the accounting rate as an instrument of the monetary policy of the NBU. Thus, its reduction leads to an increase in the amount of money supply, which creates additional opportunities for attracting financial resources (in particular, credit) for the creation and development of legal entities of all forms of ownership.

We believe that there is no real relationship between the pair of factors "GDP in actual prices" and "Population", the revealed mathematical relationship is explained by the existence of two parallel processes, and not by regularity.

We will carry out correlation and regression analyzes of the dependence of performance indicators on a selected set of macroeconomic factors. The results are presented in Table 2.

Table 2. Correlation coefficients between the resulting indicators and factors influencing the results of the banking system in Ukraine

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
X1	-0,91	-0,87	0,30	0,76	0,74	0,73	0,27	0,36	0,75	0,90	0,84	0,38
X2	-0,89	-0,87	0,40	0,83	0,73	0,69	0,37	0,47	0,81	0,95	0,92	0,49
X3	-0,04	-0,07	-0,39	0,14	0,25	0,28	-0,19	-0,31	0,22	0,03	0,01	-0,36
X4	-0,44	-0,46	-0,34	0,07	0,55	0,64	-0,24	-0,66	0,15	0,16	0,05	-0,39
X5	0,91	0,92	0,11	-0,75	-0,87	-0,90	-0,02	-0,01	-0,80	-0,84	-0,75	-0,05
X6	-0,21	-0,19	-0,15	-0,03	0,00	0,08	0,39	-0,31	0,02	0,14	-0,06	-0,11
X7	0,26	0,31	0,72	0,09	-0,29	-0,44	0,53	0,79	-0,01	0,00	0,16	0,62

**Source: Compiled by the authors using the Statistica 12 toolkit.*

The analysis of the results of the correlation and regression analysis of the relationships between the resulting indicators of the banking system of Ukraine and selected macroeconomic factors (constructed regressions and standardized parameters, correlation coefficients) allows to exclude individual macroeconomic factors from the study. Table 3 contains data on the initial inclusion of factors in the model and on the inclusion of factors in new models.

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Table 3. Factors included in the studied model before and after exclusion

	Initial inclusion of factors in the model	New model after exclusion
Y1 Number of banks, units	X1, X2, X3, X4, X5, X6, X7	X1, X2, X4, X5, X7
Y4 Assets of banks, UAH million	X1, X2, X4, X5, X6, X7	X2, X4, X5, X7
Y5 Loans provided to clients, UAH million	X1, X2, X4, X5, X6, X7	X4, X5, X6
Y8 Capital of banks, UAH million	X1, X2, X4, X5, X6, X7	X4, X7
Y9 Liabilities of banks, UAH million	X1, X2, X4, X5, X6, X7	X4, X5, X7
Y 12 Net profit/loss, UAH million	X1, X2, X3, X4, X5, X6, X7, Y1, Y4, Y8	X1, Y1, Y2, Y3

**Source: Compiled by the authors.*

So, after the transformation, the models became significantly simpler. At the same time, it is worth noting that some factors showing weak relationships with the corresponding Y were left in the model, because the theory indicates that there should be real relationships between them, which, however, the analysis did not show, probably due to the existence of phenomena of multicollinearity.

Also, we consider it inappropriate to continue the analysis for such performance indicators as Y2 (Number of banks with foreign capital) and Y3 (Number of banks with 100% foreign capital), since they are part of such a performance variable as Y1 (Number of banks) .

A similar situation with regard to performance indicators Y6 (Loans provided to business entities), Y7 (Loans provided to individuals), which are components of the performance variable Y5 (Loans provided to clients), as well as Y10 (Funds of business entities) and Y11 (Funds of individuals), which are components of the resulting variable Y9 (Liabilities of banks).

We will construct the relationship equation between the performance indicators and the selected factors of the new models (Table 3), the results will be placed in Tables 4-9.

Table 4. Equation of the relationship between Y1 (Number of banks) and selected macroeconomic factors

Y1 (R=0,9815, R^2=0,9634, F(5,35)=184,18, p<0,0000)						
Y1	b*	sb*	b	sb	t	p-value
			-88,7658	107,3714	-0,8267	0,4140
X1	-0,2548	0,1041	0,0000	0,0000	-2,4483	0,0195
X2	-0,7098	0,1253	-0,0103	0,0018	-5,6650	0,0000
X4	0,0708	0,0615	0,5452	0,4731	1,1524	0,2570
X5	0,0203	0,0923	0,0000	0,0000	0,2205	0,8268
X7	0,4245	0,0706	0,0002	0,0000	6,0132	0,0000
The model is adequate, the parameters at X1, X2, and X7 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 5. Equation of the relationship between Y4 (Assets of banks) and selected macroeconomic factors

Y4 (R=0,8775, R^2=0,7699, F(4,36)=30,118, p<0,00000)						
Y4	b*	sb*	b	sb	t	p-value
			4748591,5624	1027537,6046	4,6213	0,0000
X2	0,2902	0,2093	16,3877	11,8187	1,3866	0,1741
X4	-0,3528	0,1511	-10580,9611	4530,3292	-2,3356	0,0252
X5	-0,7341	0,2275	-0,0815	0,0253	-3,2275	0,0027
X7	0,0403	0,1743	0,0768	0,3321	0,2313	0,8184
The model is adequate, the parameters at X4 and X5 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 6. Equation of the relationship between Y5 (Loans provided to clients) and selected macroeconomic factors

Y5 (R=0,8868, R^2=0,77868, F(3,37)=45,42, p<0,00000)						
Y5	b*	sb*	b	Sb	t	p-value
			3542470,2930	300292,3307	11,7967	0,0000
X4	0,1127	0,0924	2012,5771	1650,5885	1,2193	0,2304
X5	-0,8360	0,0922	-0,0553	0,0061	-9,0669	0,0000
X6	-0,1739	0,0778	-0,1149	0,0514	-2,2356	0,0315
The model is adequate, the parameters at X5 and X6 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 7. Equation of the relationship between Y8 (Capital of banks) and selected macroeconomic factors

Y8 (R=0,929, R^2=0,6286, F(2,38)=32,161, p<,00000)						
Y8	b*	sb*	b	sb	t	p-value
			-133495,2897	74894,0688	-1,7825	0,0827
X4	-0,0721	0,1650	-355,0923	813,1273	-0,4367	0,6648
X7	0,7340	0,1650	0,2297	0,0516	4,4476	0,0001
The model is adequate, the parameters at X7 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 8. Equation of the relationship between Y9 (Liabilities of banks) and selected macroeconomic factors

Y9 (R=0,8762, R^2=0,7678, F(3,37)=40,78, p<0,00000)						
Y9	b*	sb*	b	sb	t	p-value
			5711400,0686	609347,8712	9,3730	0,0000
X4	-0,3715	0,1497	-10385,9788	4184,7575	-2,4819	0,0177
X5	-1,0341	0,0968	-0,1071	0,0100	-10,6845	0,0000
X7	0,0779	0,1337	0,1383	0,2374	0,5826	0,5637
The model is adequate, the parameters at X4 and X5 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

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Table 9. Equation of relationships between Y12 (net profit / loss) and selected macroeconomic factors

Y12 (R=0,8200, R^2=0,6725, F(4,36)=40,78, p<0,00000)						
Y12	b*	sb*	b	sb	t	p-value
			-107486,8426	49000,8056	-2,1936	0,0348
X2	1,0737	0,3907	13,1703	4,7926	2,7480	0,0093
Y1	0,4765	0,3149	403,3107	266,5721	1,5130	0,1390
Y4	-0,4962	0,1728	-0,1078	0,0375	-2,8714	0,0068
Y8	0,5386	0,1596	0,7123	0,2110	3,3749	0,0018
The model is adequate, the parameters at X2, Y4, and Y8 are significant						

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Tables 4-9 demonstrate that at a significance level of 0.05, all constructed regression equations are significant, so let's construct point and interval forecasts of individual values of the dependent variable. Construction of interval estimates was performed at a significance level of 0.05.

Taking into account the significance of the constructed regression equations, using the scenario method, we will analyze the possibility of achieving positive changes in the banking system of Ukraine by influencing the resulting indicators of each of the significant equations through the management of significant factor variables (Tables 10-14).

Table 10 shows an idealistic version of the events, according to which we simultaneously manage all significant factors, changing them by 5% in the direction that ensures the achievement of a positive effect on the resulting indicator. Accordingly, a simultaneous decrease by 5% of factor indicators X1 (GDP) and X2 (Average monthly wage) and an increase of factor indicator X7 (number of legal entities) by 5% (the direction of change is determined by the direction of the relationship between factor and resulting indicators) can lead to growth of the resulting indicator Y1 (Number of banks) to the indicator of 85 units. (16.5%) in the confidence interval [75:95] units.

Table 10. Point and interval estimates of the values of the performance indicator Y_1 (Number of banks, units) with a simultaneous decrease by 5% of factors X1 and X2 and an increase of factor X7 by 5%

X_1 GDP	X_2 Average monthly wage	X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entities	Y_1 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
-5%	-5%	6	41588354	+5%	85	75	95
952937,516	11455,19142			1465220	+16,5%	+3%	+30%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 11 shows an idealistic version of the events, according to which we simultaneously manage all significant factors, changing them by 5% in the direction that ensures the achievement of a positive effect on the resulting indicator. Accordingly, a simultaneous decrease by 5% of factor indicators X4 (Accounting Rate of the NBU) and X5 (Population) (the direction of change is determined by the direction of the relationship between factor and resulting indicators) may lead to a decrease in the resulting indicator Y4 (Assets of banks, UAH million) to the figure of UAH 1,771,344.51 million. (-0.6%) in the confidence interval [1631145.5:1911543.6] UAH million.

Table 11. Point and interval estimates of the values of the performance indicator Y4 (Assets of banks, UAH million) with a simultaneous decrease of 5% of factors X4 and X5

X_2 Average monthly wage	X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entities	Y_4 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
12058,1	-5%	-5%	1395448	1771344,51	1631145,5	1911543,6
	5,7	39508936,3		-0,6%	-8,4%	+7,3%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 12 shows an idealistic version of the events, according to which we simultaneously manage all significant factors, changing them by 5% in the direction that ensures the achievement of a positive effect on the resulting indicator. Accordingly, a simultaneous decrease by 5% of factor indicators X5 (Population) and X6 (Number of business entities) (the direction of change is determined by the direction of the relationship between factor and resulting indicators) may lead to an increase in the resulting indicator Y5 (Loans provided to clients, UAH million) to the figure of UAH 1157212.8 million. (+22.9%) in the confidence interval [1091484.7:1222940.8] UAH million.

Table 12. Point and interval estimates of the values of the performance indicator Y5 (Loans provided to clients, UAH million) with a simultaneous decrease of 5% of factors X5 and X6

X_4 Accounting Rate of the NBU	X_5 Population	X_6 Number of business entities	Y_5 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
6	-5% 39508936,3	-5% 1844615,95	1157212,8	1091484,7	1222940,8
			+22,9%	+15,9%	+29,8%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 13 shows an idealistic version of the events, according to which we simultaneously manage all significant factors, changing them by 5% in the direction that ensures the achievement of a positive effect on the resulting indicator. Accordingly, a simultaneous decrease by 5% of factor indicators X4 (Accounting Rate of the NBU) and X5 (Population) (the direction of change is determined by the direction of the relationship between factor and resulting indicators) may lead to an increase in the resulting indicator Y9 (Liabilities of banks, UAH million) to the figure of UAH 1,614,165.5 million. (+2.44%) in the confidence interval [1505753.4:1722577.5] UAH million.

Table 13. Point and interval estimates of the values of the performance indicator Y9 (Liabilities of banks, UAH million) with a simultaneous decrease of 5% of factors X4 and X5

X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entities	Y_9 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
-5%	-5%	1395448	1614165,5	1505753,4	1722577,5
5,7	39508936, 3		+2,44%	-4,44%	+9,32%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

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Table 14 shows an idealistic version of events, according to which we simultaneously manage all significant factors, changing them by 5% in the direction that ensures the achievement of a positive effect on the resulting indicator. Accordingly, a simultaneous increase by 5% of factor indicators X2 (Average monthly wage) Y8 (Capital of banks) and a decrease of factor indicator Y4 (Assets of banks) by 5% (the direction of change is determined by the direction of the relationship between factor and resulting indicators) can lead to to the increase of the resulting indicator Y12 (Net profit/loss, UAH million) to the indicator of UAH 60,227.2 million. (+49.22%) in the confidence interval [37058:83397.4] UAH million.

Table 14. Point and interval estimates of the values of the performance indicator Y12 (Net profit/loss, UAH million) with a simultaneous 5% increase in the X2 and Y8 factors and a 5% decrease in the Y4 factor

X_2 Average monthly wage	Y_1 Number of banks	Y_4 Assets of banks	Y_8 Capital of banks	Y_{12} Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
+5%	73	-5%	+5%	60227,2	37058	83397,4
12661,0		1692525,2	216171,9	+49,22%	-8,19%	+106,62%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

However, such a variant of the scenario analysis presented in Tables 10-14 is not only idealistic, but also impossible, since the state-wide conjuncture forms certain internal relationships between factor indicators, and, therefore, achieving "pure" simultaneous changes in all significant factor indicators in practice is impossible.

Therefore, scenario analysis is more realistic and useful from a practical point of view under the condition of managing specific values of significant factor variables (with other factors unchanged) (increase and decrease by 5% from the last sample observation). Let's consider in detail the results of constructed estimates (tables 15-20).

Table 15 contains information about the expected value of the resulting indicator "Number of banks" under the condition of alternate management of significant factors with other factors unchanged. Accordingly, we can see that changes in such factors as X1 "GDP" and X2 "Average monthly wage" do not lead to an increase in the number of banks in the banking system (the last value of the indicator of the number of banks as of January 1, 2021 was 73 in total). At the same time, an increase in factor variable X7 "Number of legal entities" by 5% leads to a significant increase in the indicator of the number of banks in the banking system (+5.17%). Such growth is quite logical and indicates that the increase in business activity within the state, the consequence of which is the increase in the number of legal entities that are necessarily bank clients, leads to an increase in the number of banks in the banking system, i.e. the load on the banking system remains unchanged.

Table 15. Point and interval estimates of the values of the performance indicator Y_1 (Number of banks, units)

X_1 GDP	X_2 Average monthly wage	X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entities	Y_1 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
-5% *952937,516*	12058,1	6	41588354	1395448	64	55	74
					-11,8%	-24,74%	+1,14%
+5% *1053246,728*	12058,1	6	41588354	1395448	60	52	68
					-17,53%	-28,84%	-6,22%
1003092,124	*-5%* *11455,19*	6	41588354	1395448	69	60	77
					-6,17%	-17,17%	+4,84%
1003092,124	*+5%* *12661,00*	6	41588354	1395448	56	46	66
					-23,16%	-36,63%	-9,69%
1003092,124	12058,1	6	41588354	*-5%* *1325675,6*	48	37	58
					-34,5%	-48,85%	-20,15%
1003092,124	12058,1	6	41588354	*+5%* *1325675,6*	77	67	86
					+5,17%	-7,79%	+18,13%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 16 contains information about the expected value of the resulting indicator "Assets of banks" under the condition of managing a significant factor with other factors unchanged. Accordingly, we can see that the management of factor X4 "Accounting Rate of the NBU" in any direction leads to a decrease in bank assets (the last value of the indicator of the amount of bank assets as of January 1, 2021 was UAH 1,781,605.47 million). Such results indicate that for the normal development of the banking system of Ukraine, other parameters remaining unchanged, stability is important, and a change in the discount rate is stressful for it and in any case leads to a reduction in bank assets (at least in the short term).

Table 16. Point and interval estimates of the values of the performance indicator Y4 (Assets of banks, UAH million)

X_2 Average monthly wage	X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entities	Y_4 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
12058,1	-5% 5,7	41588354	1395448	1601778,94	1522039,2	1681518,68
				-10,09%	-14,57%	-5,62%
12058,1	+5% 6,3	41588354	1395448	1595430,36	1518237,35	1672623,37
				-10,45%	-14,78%	-6,12%
12058,1	6	-5% 39508936,3	1395448	1768170,28	1629109,45	1907231,11
				-0,75%	-8,56%	+7,05%
12058,1	6	+5% 43667771,7	1395448	1429039,01	1303854,54	1554223,48
				-19,79%	-26,82%	-12,76%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 17 contains information on the expected value of the resulting indicator "Loans provided to clients" under the condition of alternate management of significant factors, with other factors unchanged. Accordingly, we can see that an increase in factor X5 "Population" by 5% leads to a reduction of the resulting indicator by 2.75%, and a decrease in the factor indicator by 5% leads to a significant increase in the resulting indicator by 21.68%. Such a result can be explained by the fact that, since the reduction of the population means at the same time a decrease in the number of bank customers (which means a decrease in the ability to dispose of their resources), banks choose the easiest option for them to increase earnings - providing loans.

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As a result of the management of factor indicator X6 “Number of economic entities” there is an increase in the volume of loans provided. Thus, an increase in the number of business entities leads to additional demand from them for the credit product of banks, that is, to an increase in the volume of loans granted, and a reduction in the number of business entities by 5% leads to an increase in the volume of Loans provided to clients by 10.65%, as and in the case of a decrease in the “Population’ indicator, it means a decrease in the client base of banks, and therefore forces them to use the issuance of a credit product as a means of generating income.

Table 17. Point and interval estimates of the values of the performance indicator Y5 (Loans provided to clients, UAH million)

X_4 Accounting Rate of the NBU	X_5 Population	X_6 Number of legal entities	Y_5 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
6	-5% 39508936,3	1941701	1146058,69	1080091,72	1212025,67
			21,68%	+14,67%	+28,68%
6	+5% 43667771,7	1941701	916016,06	887645,04	944387,07
			-2,75%	-5,76%	+0,27%
6	41588354	-5% 1844615,95	916016,06	887645,04	944387,07
			+10,65%	+6,1%	+15,2%
6	41588354	+5% 2038786,05	1019883,27	972965,85	1066800,69
			+8,28%	+3,3%	+13,26%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 18 contains information about the expected value of the resulting indicator of “Capital or banks” under the condition of controlling a significant factor with other factors unchanged. Accordingly, we can see that the change in factor X7 “Number of legal entities” without changes in another significant factor “Accounting rate of the National Bank of Ukraine” does not give the desired result - the growth of banks' capital. A reduction in the factor indicator by 5% leads to a reduction in banks' capital by as much as 17.98%. However, the growth of the factor indicator is accompanied by a decrease in the capital of banks - by 2.41%. Thus, it can be assumed that the capital formation of banks is affected by other indicators, which, however, were not taken as a basis for our research. However, based on the calculations, it is obvious that under the conditions of management of the selected macroeconomic indicators and unchanged all other indicators, it is possible to direct the state policy to increase the number of legal entities, because the right interval limit of the confidence interval still shows an increase in the capital of banks by 4.04%.

Table 18. Point and interval estimates of the values of the performance indicator Y8 (Capital of banks, UAH million)

X_4 Accounting Rate of the NBU	X_7 Number of legal entities	Y_8 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
6	-5% 1325675,6	168868,38	159140,73	178596,04
		-17,98%	-22,7%	-13,25%
6	+5% 1465220,4	200920,41	187642,79	214198,02
		-2,41%	-8,86%	+4,04%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 19 contains information on the expected value of the resulting indicator "Liabilities of banks" under the condition of alternate management of significant factors, with other factors unchanged. When factor X5 "Population" is changed while the other significant factor "Number of legal entities" remains unchanged, there is no desired result — an increase in bank liabilities. A reduction of the factor indicator by 5% leads to an increase in the liabilities of banks by 2.24%. However, the growth of the factor indicator is accompanied by a reduction in the liabilities of banks — by 26.02%. As we noted above, we discovered the inverse nature of the relationship between the factors "Population" and "Average monthly wage per employee", therefore, even with a decrease in the population of Ukraine, the amount of income received by Ukrainians increased, which became an impetus for increasing citizens' investments in banks. which are an important component of banks' liabilities. As the population grows, current consumption and household expenses will increase, which may lead to a decrease in savings, which are transformed into bank deposits and their liabilities. Important characteristics of the current state of development of the Ukrainian economy are its high level of shadowing and labor migration of the population, which can also significantly distort statistical indicators and the results of their economic and mathematical analysis. In order to reduce the probability of exposing income obtained illegally, the population tries to bypass the services of banks (in particular, opening deposits with them), since banks are one of the most important subjects of primary financial monitoring. It can also be assumed that the formation of banks' liabilities is influenced by other indicators, which, however, were not taken as a basis for this study.

Table 19. Point and interval estimates of the values of the performance indicator Y9 (Liabilities of banks, UAH million)

X_4 Accounting Rate of the NBU	X_5 Population	X_7 Number of legal entries	Y_9 Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
-5% 5,7	41588354	1395448	1391478,05	1320160,84	1462795,25
			-11,69%	-16,22%	-7,17%
+5% 6,3	41588354	1395448	1385246,46	1316338,02	1454154,9
			-12,09%	-16,46%	-7,72%
6	-5% 39508936	1395448	1611049,66	1503917,99	1718181,33
			+2,24%	-4,56%	+9,04%
6	+5% 43667772	1395448	1165674,85	1121958,43	1209391,27
			-26,02%	-28,80%	-23,25%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Table 20 contains information about the expected value of the resulting indicator "Net profit/loss" under the condition of alternate management of significant factors with other factors unchanged. So we can see that an increase in the factor X2 "Average monthly wage" by 5% leads to an increase in net profit by 7.26%. Management of bank assets does not give a positive result, because the reduction of assets leads to an increase in profit, and their growth leads to a significant reduction in the net profit of banks. There is a direct and close relationship between the factor indicator "Bank capital" and the effective indicator "Net profit": a decrease in the capital of banks by 5% results in a decrease in profit by 30.58%, while an increase in the capital of banks by 5% leads to an increase and banks' profits by 5.75%. Thus, it can be concluded that the reduction of the total capital of banks is a significant stress for the banking system.

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Table 20. Point and interval estimates of the values of the performance indicator Y12 (Net profit/loss, UAH million)

X_2 Average monthly wage	Y_1 Number of banks	Y_4 Bank assets	Y_8 Bank capital	Y_{12} Predicted	The left boundary of the interval estimate -95,0%CL	The right boundary of the interval estimate +95,0%CL
-5% 11455,19	73	1781605,47	205878,04	27411,98	2822,41	52001,56
				-32,09%	-93,01%	+28,84%
+5% 12661,00	73	1781605,47	205878,04	43292,87	16866,01	69719,72
				+7,26%	-58,21%	+72,73%
12058,10	73	-5% 1692525	205878,04	44954,89	23469,19	66440,58
				+11,38%	-41,85%	+64,61%
12058,10	73	+5% 1870685,74	205878,04	25749,98	-3655,94	55155,92
				-36,20%	-109,06%	+36,65%
12058,10	73	1781605,47	-5% 195584,14	28020,55	2277,13	53763,96
				-30,58%	-94,36%	+33,20%
12058,10	73	1781605,47	+5% 216171,94	42684,30	17977,13	67391,47
				+5,75%	-55,46%	+66,97%

**Source: Compiled by the authors using the Statistica 12 toolkit.*

Conclusions

As a result of the conducted research, the main macroeconomic factors affecting the results of the banking system of Ukraine were determined, which is crucial for the formation of a methodology for researching the banking system in general, identifying obstacles to its development and developing effective mechanisms for improving its functioning.

A multifactorial model of the influence of factors on the performance indicators of the banking system has been developed, and the method of canonical correlations has been used to find the maximum correlations between groups of variables. As a result, we found a close correlation between the change in the macroeconomic indicators of Ukraine's development and the performance indicators of the banking system of Ukraine. The results of the canonical analysis have confirmed that the relationship between the selected performance indicators of the banking system of Ukraine and macroeconomic indicators should be investigated in terms of individual indicators of the banking system of Ukraine in order to form a system of scenarios that will make it possible to predict their change depending on the selected factors.

Correlation and regression analysis and research on the dependence of the performance indicators on the selected factors demonstrated that the selected set of factors affects the resulting indicators to one degree or another, as all constructed regression equations are significant. The presence of direct relationships between such factors as “GDP in actual prices” and “Average monthly wage per employee” has been revealed (since the increase in the average monthly wage per employee leads to an increase in the purchasing power of the population in general); as well as inverse relationships between such pairs of factors as “Population” and “Average monthly wage per employee” (which is explained by the general staffing deficit and increased competition for an individual employee); “Accounting rate of the National Bank of Ukraine” and “Number of legal entities” (since the reduction of the accounting rate of the National Bank of Ukraine leads to an increase in the volume of the money supply, which creates additional opportunities for attracting financial resources for the creation and development of legal entities of all forms of ownership); “GDP in actual prices” and “Population” (which can be explained by the existence of two parallel processes, and not by real connections between these factors).

Using the scenario method, the possibility of achieving positive changes in the banking system of Ukraine by influencing the resulting indicators of each of the significant equations through the management of specific significant factor variables has been analyzed.

A change in such factors as “GDP” and “Average monthly salary” does not lead to an increase in the number of banks, at the same time, an increase in the “Number of legal entities” by 5% leads to a significant increase in the indicator of the number of banks (+5.17%), since the increase in business activity within the state, an increase in the number of legal entities that are necessarily bank clients leads to an increase in the number of banks.

A change in the “Accounting Rate of the NBU” in any direction leads to a decrease in “Bank Assets” (at least in the short term), since the stability of the regulator's policy is important for the activity of banks.

An increase in the factor “Population” by 5% leads to a reduction of the resulting indicator "Loans provided to clients" by 2.75%, and a decrease in the factor indicator by 5% leads to a significant increase in the resulting indicator by 21.68%. When the population decreases, the number of bank clients also decreases (which means a decrease in the ability to dispose of their resources), so banks choose the easiest option for them to increase earnings, that is providing loans. As a result of the management of the factor indicator “Number of business entities” there was an increase in the indicator “Loans provided to clients”.

The resulting indicator “Bank capital” under the condition of managing the significant factor “Number of legal entities” does not provide the desired result - the growth of the capital of banks. The capital formation of banks is influenced by other indicators that we have not taken as a basis for this study. However, under the conditions of management of the selected macroeconomic indicators and the invariance of all other indicators, it is possible to direct the state policy to the growth of the number of legal entities, because the right interval limit of the confidence interval still shows an increase in the capital of banks by 4.04%.

Changes in the “Population” factor, with the other significant factor “Number of legal entities” unchanged, have no desired result — an increase in the resulting “Liabilities of banks” indicator. Important characteristics of the current state of development of the Ukrainian economy are its high level of shadowing and labor migration of the population, which can also significantly distort statistical indicators and the results of their economic and mathematical analysis.

The resulting indicator “Net profit/loss” under the condition of increasing the factor “Average monthly salary” by 5% leads to an increase in net profit by 7.26%. Management of bank assets does not give a positive result, because the reduction of assets leads to an increase in profit, and their growth leads to a significant reduction in the net profit of banks. Not all assets of banks bring them profit, as they can be “non-working”, but expenses for them arise constantly (the need to pay interest on borrowed deposits, interbank loans, etc.), and also carry a certain level of risk, which affects the amount of profit received by banks. A direct and close connection was found between the factor indicator “Capital of banks” and the effective indicator “Net profit”, therefore, the reduction of the aggregate capital of banks is a significant stress for the banking system, and it is necessary to direct the regulatory policy to a stable and gradual growth of the capital of banking institutions.

The carried out correlation-regression and scenario analysis of the impact of macroeconomic indicators on the performance of banks makes it possible to state that it is worth conducting a state policy to manage these factors in order to achieve the desired result in the country's banking system. It is necessary to manage a given set of factors that have been found to have a positive effect on the performance of banks, to promote the growth of banks' capital, the number of legal entities, the average monthly salary, the stability of the NBU discount rate, etc.

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It is also worth noting that this analysis has been carried out on the basis of official statistics, which may not take into account many significant factors influencing the functioning of Ukrainian banks. In particular, the high level of shadowing of the Ukrainian economy and the reluctance to cooperate with banks that are subjects of primary financial monitoring, that is, they are obliged to be the first to expose suspicious transactions (based on the sources of origin of funds and their volumes). As well as significant volumes of labor migration of the population, in which the actual number of the population may decrease, but the incomes received by them entering Ukraine pass through the banking system.

The results of this study will serve as a basis for further studies devoted to the development of the banking system of Ukraine, in order to find opportunities to improve the conditions of functioning of Ukrainian banks, which are a powerful source of development of the entire economy.

References

Grygorkiv, V. S. (2009). Ekonometrika: Liniini modeli parnoyi ta mnozhynnoyi regresiyi [Econometrics: Linear models and multiple regression pair], Chernivtsi, Ukraine, 224p.

Hotelling, H. (1936), Relations between two sets of variates. *Biometrika*, Vol. 28, no. 3/4, pp. 321–377. https://doi.org/10.2307/2333955

Nguyen Phu Ha (2021). Impact of macroeconomic factors and interaction with institutional performance on Vietnamese bank share prices. *Banks and Bank Systems*, 16 (1), 127-137. doi:10.21511/bbs.16(1).2021.12

Setyo Tri Wahyudi, Rihana Sofie Nabella and Kartika Sari (2021). Measuring the competition and banking efficiency level: a study at four commercial banks in Indonesia. *Banks and Bank Systems*, 16 (1), 17-26. doi:10.21511/bbs.16(1).2021.02

State Statistics Service of Ukraine. Statistic materials. Retrieved from: http://www.lv.ukrstat.gov.ua/dem/piramid/all.php

Tkachuk I. (2017). Asset operations of Ukrainian banks on the current stage of banking system development. *Banks and Bank Systems*, 12(1-1), 119-127. doi:10.21511/bbs.12(1-1).2017.04

Wasfi Al Salamat, Mohammad Q. M. Momani and Khaled Batayneh (2021). Firm-specific, macroeconomic factors and stock price risk for Jordanian banks. *Banks and Bank Systems*, 16(3), 166-172. doi:10.21511/bbs.16(3).2021.15

Yarovy A., Strakhov E. (2015). Multidimensional statistical analysis: an initial manual for students of mathematics and economics. Odessa. Astroprint. 132 p.