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Olena Zarutska

D.Sc. in Economics, Professor, Head of the Department of Finance, Banking, and Insurance, University of Customs and Finance, Dnipro, Ukraine;
 e-mail: helenazarutskaya@gmail.com
 ORCID: [0000-0001-7870-9608](https://orcid.org/0000-0001-7870-9608)
 (Corresponding author)

Roman Pavlov

Candidate of Economy Sciences, Associate Professor of the Department of Economics, Entrepreneurship and Enterprise Management, Oles Honchar Dnipro National University, Dnipro, Ukraine;
 ORCID: [0000-0001-7629-2730](https://orcid.org/0000-0001-7629-2730)

Tetiana Pavlova

D.Sc. in Philosophy, Professor of the Department of Philosophy, Oles Honchar Dnipro National University, Dnipro, Ukraine;
 ORCID: [0000-0001-7178-3573](https://orcid.org/0000-0001-7178-3573)

Tetiana Grynko

D.Sc. in Economics, Professor, Dean of the Faculty of Economics, Oles Honchar Dnipro National University, Dnipro, Ukraine;
 ORCID: [0000-0002-7882-4523](https://orcid.org/0000-0002-7882-4523)

Oksana Levkovich

Candidate of Economy Sciences, Associate Professor, Head of the Department of Finance, Banking and Insurance, Oles Honchar Dnipro National University, Dnipro, Ukraine;
 ORCID: [0000-0002-4570-4963](https://orcid.org/0000-0002-4570-4963)

Tetiana Hviniashvili

Candidate of Economy Sciences, Associate Professor, Head of the Department of Economics, Entrepreneurship and Enterprise Management, Oles Honchar Dnipro National University, Dnipro, Ukraine;
 ORCID: [0000-0002-7961-2549](https://orcid.org/0000-0002-7961-2549)

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TRANSFORMATIONS OF THE RESOURCE MANAGEMENT STRATEGY OF UKRAINIAN BANKS

ABSTRACT

This article examines the peculiarities of the management of assets and liabilities of Ukrainian banks in the conditions of significant structural transformations of the resource base during the period of martial law. The analysis is carried out at the level of homogeneous structural and functional groups of banks (SFGBs), which are formed using published reporting data and the application of Kohonen's self-organizing map (SOM). Accumulation of statistical data has been carried out for 5 years, special attention is paid to structural changes in the resource base and directions of placement of bank assets over the past two years.

Over the past two years, the bank has been under the influence of shock factors affecting assets and liabilities. At the beginning of 2022, there was an outflow of funds from bank accounts, which was gradually compensated by the inflow of current funds from corporations and the population of individuals. In 2023, the National Bank of Ukraine actively stimulated the development of the term resource base, the basis for ensuring the growth of credit operations. Transactions with state securities continue to grow in the structure of bank assets. The priority task of the banking system remains the financial support of business, but in the conditions of a full-scale war, such development of credit operations is limited. It is expedient to study the strategy of banks by combining the structure of assets and liabilities according to similar characteristics and analyzing the dynamics of groups. Observation of homogeneous groups confirms their stable nature, features of strategy, risk profile and development priorities. It has been proven that banks within homogeneous SFGBs demonstrate similar behaviour in the formation of management strategies and reactions to internal and external shocks. At the macro level, the SOM structure allows you to quantitatively assess the main processes taking place in the banking system, conduct comparisons with maps, and identify problems and priorities in the management of bank assets and liabilities. The SFGB method allows you to evaluate the trajectory of individual banks on the map and develop recommendations for improving the strategy of managing assets and liabilities.

Keywords: bank assets, bank liabilities, bank risks, structural and functional groups of banks, business model, market of banking services, banking system, Kohonen maps

JEL Classification: C45, G21, D21

INTRODUCTION

The banking system of Ukraine has been formed for a long time under the permanent influence of economic crises affecting the resource base of banks. Each bank's response to external and internal shocks depends on its financial condition, business model and risk profile. Banks with similar structural and functional characteristics often demonstrate the same strategy and can be combined into homogeneous groups. The study of changes in the composition and characteristics of the SFGB provides useful information about the current state and place of each bank in the market of banking services.

The active development of the banking system in the early 2000s was accompanied by the entry of subsidiary banks of foreign banking corporations and their influence on the development of banking technologies. At that time, intensive consumer lending began, including in foreign currencies, which led to further problems. Before the crisis of 2009-

2011, the system had about 200 banks, and the group of banks with an increased share of loans granted to individuals occupied an important place. The structure of the liabilities of banks with foreign capital has always been supported by the funds of the interbank market, which influenced the management strategy and was manifested in the configuration of the SFGB. After 2011, there was a deterioration in the quality of loan portfolios, an increase in the cost of borrowed funds and liquidity problems for a significant number of banks. At that time, problem banks were grouped into SFGBs with increased interest rates, loan reserves and negative financial results.

During the following period, until 2014, there was an increase in the assets and liabilities of banks. A partial loss of confidence of creditors and depositors was manifested in the structure of funds raised: current resources and funds in foreign currency grew at a faster rate. Lending was restored very slowly. Instead, homogeneous SFGBs with an increased share of assets in securities issued by the NBU grew.

During the 2014-2016 crisis, the banking market shrank significantly. Along with the financial reasons for the liquidation of banks, such factors as the non-transparent ownership structure of banks, increased operational risks, and the practice of conducting dubious operations with increased risks of money laundering and terrorist financing played an important role. The rapid withdrawal of a large number of banks from the market led to a further deterioration in the quality of assets of existing banks and loss of stability of their resource base. The formation of increased reserves for credit risks led to a loss-making financial result of the system, which was observed until 2017.

Since the beginning of the full-scale war, further transformations have been taking place in the conditions of banks' operations and their asset and liability management strategies. In the structure of bank assets, the amount of funds placed in government securities continued to grow, as the development of lending is very limited. The resource base remained quite unstable due to the preference for demand funds. Changes in operating conditions affected the composition and characteristics of homogeneous groups of banks. The group of banks with an increased share of consumer loans continued to shrink. Banks with foreign capital changed their lending strategy to expand operations with securities and placed inter-bank loans. The growth of the share of funds on current card accounts and the flow of resources to high-tech banks that introduce new banking products significantly affect the formation of homogeneous SFGBs.

We conducted a study of the types of financial management strategies within homogeneous SFGBs that have similar structural characteristics and risk profiles. The study of group dynamics provides clear information about the state of the system, volumes, configuration, and structure of the SFGB, allows to assess the current changes in the characteristics of the group and to build the trajectory of each bank to describe its strategy. The method can be useful for describing the structural transformation of the attracted and deployed resources of Ukrainian banks.

LITERATURE REVIEW

Features of asset and liability management of modern banks are studied in many publications by domestic and foreign authors (e.g. : [1; 5; 11; 15; 20; 26]). The priority areas of purposeful changes in the business architecture of the banking sector in the economy of Ukraine are proposed in the work of Kuznyetsova et al. (2020) [14]. The authors describe an approach to reducing systemic risks based on the study of risk appetite in groups of financial institutions with the same business models. Ways of forming a socially responsible banking business are being explored [14].

The management of financial and economic security of banks is considered in the work of G. Karcheva and I. Karcheva (2022) [6]. Proposed approaches to the management system of financial and economic security of banks, taking into account risks in the activities of banks. The integrated model is based on an effective risk management system, which monitors the availability of a certain safety potential (capital, liquidity, profitability, reserves) in banks, the possession of an adaptive (stabilizing) mechanism that would ensure the bank's return to a sustainable development trajectory.

Peculiarities of resource management under martial law conditions are also considered in the work of V. V. Kovalenko (2022) [13]. Approaches to responding to modern requirements in the new Comprehensive Program for Ensuring the Financial Security of Ukrainian Banks are described.

In the works of Onishchenko et al (2020), the structure of bank assets and liabilities is considered the basis of his business model [18]. The works of Kosova et al. (2020) are devoted to the issue of estimating the volume of deposits and loans, related income and expenses, as well as the profitability and efficiency of active and passive operations [12].

The work of Zhurakhovska and Lyashenko (2022) [30] is devoted to the formation of priority areas of the investment strategy of the banking sector in conditions of financial market instability. The study confirms the low investment activity of the banking sector and the predominant investments mostly in government securities.

Methods of anti-crisis management and ensuring the stability of banks are considered in the work of Zhovanetska (2016). Proposed approaches to the assessment of symptoms and factors of the crisis. Parameters of deterioration of assets and liabilities are considered [29].

Systemic analysis of current and future trends in the level of systemic risks and threats generated by the operational environment of the banking system, proposed in the work of Diakonova and Mordan (2015) [3]. The authors proposed to use the method of assessing financial stability, which is based on the complex calculation of a special indicator [3].

AIMS AND OBJECTIVES

Justification of important changes in the management system of involved and deployed resources of Ukrainian banks during a full-scale war, for the period from November 1, 2021, to November 1, 2023. The research is conducted using the SFGB method, which allows to assess the migration of banks between homogeneous groups with their inherent financial characteristics.

METHODS

We substantiated the use of the method of structural and functional groups (SFGB) with the help of SOM for the implementation of differentiated banking supervision in Ukraine and the analysis of the financial condition of banks [27]. The SFGB method is used to study the financial condition of banks and assess risk management at the level of individual banks, homogeneous groups, and the banking system as a whole [27; 28]. The practice of using the SFGB method in recent years demonstrates its effectiveness in assessing banks' strategies for managing assets and liabilities, trends in the development of bank operations, their impact on the risk profile, and current threats to financial stability. The method makes it possible to assess changes in the structure of the resource base of banks and directions of asset placement at a quantitative level. The increase in the number of banks in the respective SFGBs, and the growth of the total volume of their assets indicates the priority directions of development [27; 28].

For the study of multidimensional arrays and the formation of homogeneous groups, the use of neural network methods, namely, Kohonen's self-organizing maps [2; 10; 24]. The SOM method (Kohonen self-organizing maps) belongs to the class of neural network methods with unsupervised learning [7; 8; 9]. Formation of SOM (Kohonen self-organizing maps) is carried out with the help of Viscovery software Software GmbH. We use a system of 31 indicators calculated for all operating banks based on monthly reporting dates for the period from 01.01.2018 to 01.10.2023. The assessment of the structure of bank assets and liabilities and the development of the banks' resource management strategy is based on bank reporting data. Thanks to the monthly systematization and publication of these reports, the NBU can conduct an up-to-date analysis of this issue.

RESULTS

To calculate indicators - indicators of a grouping of banks, published reporting is used [17].

The choice of the indicator system is based on the work [27] and is determined by the reporting format.

The first group consists of 9 indicators that characterize the structure of the largest and most important assets of banks, 10 indicators - the structure of liabilities and 12 indicators that describe important qualitative characteristics that are necessary for the formation of homogeneous groups. The totality of all 31 indicators determines the peculiarities of the business models and risk profile of each bank [27].

Viscovery software Software GmbH, the multidimensional array of initial data is transformed into a two-dimensional SOM map. Figure 1 shows the general view of Kohonen maps at the beginning and at the end of the studied period.

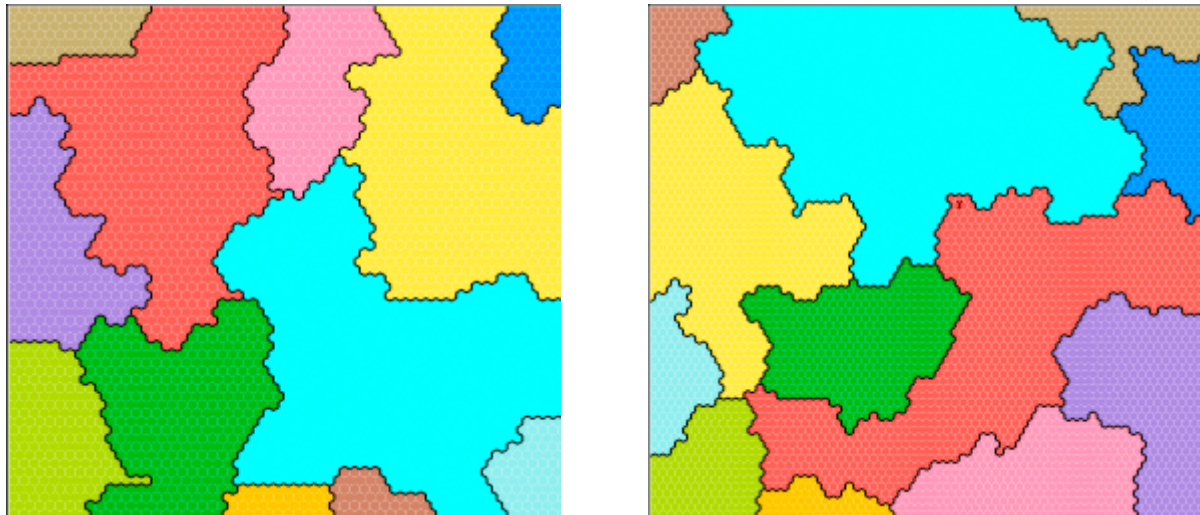


Figure 1. Kohonen cards from 01.10.2021 to 01.10.2023. (Source: built by the authors on the basis of [17])

Homogeneous objects are located next to each other, combined into clusters with their own colour, reminiscent of an ordinary geographical map. A point on the map shows the position of a bank or several banks as elements of the initial array. The geographic location of objects on the map shows the characteristics of the objects: nearby points have many common characteristics, and the far distance on the map shows significant differences between objects [8; 9; 10].

The map construction algorithm takes into account the values of all indicators, which allows to reveal the hidden properties and connections of the structural elements of the system. The analysis of the values of the indicators of the group allows to describe the characteristic properties of each SFGB. For any card, the first three or four groups cover a large number of banks according to reports of different reporting dates. The corresponding banks have characteristics close to the average values of the system. Other groups are smaller in size, located near the borders of the map, and have certain characteristics. Objects with significant differences are located at a diagonal distance.

The choice of the indicator system is determined by the reporting format and is given in Table 1.

Table 1. Description of the system of indicators for calculating SFGB.

No	Name	Content of indicators
<i>Asset structure indicators</i>		
1	SAV	ratio of cash and cash equivalents to net assets
2	SAMI	ratio of funds in other banks in foreign currencies to net assets
3	SAMN	ratio of funds in other banks in national currency to net assets
4	SAUI	ratio of loans of legal entities in foreign currencies to net assets
5	SAUN	the ratio of loans of legal entities in national currency to net assets
6	SAFI	the ratio of personal loans in foreign currencies to net assets
7	SAFN	the ratio of loans of individuals in national currency to net assets
8	SACI	the ratio of the portfolio of securities in foreign currencies to net assets
9	SACN	the ratio of the portfolio of securities in the national currency to net assets
<i>Indicators of the structure of obligations</i>		
10	SPMI	ratio of funds of other banks in foreign currencies to liabilities
11	SPMN	ratio of funds of other banks in national currency to liabilities
12	SPUI	the ratio of funds of economic entities in foreign currencies to liabilities
13	SPUN	the ratio of funds of business entities in national currency to liabilities
14	SPUP	ratio of funds of economic entities on demand to liabilities

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Table 1. Continued

No	Name	Content of indicators
15	SPUS	the ratio of fixed assets of business entities to liabilities
16	SPFI	the ratio of funds of individuals in foreign currencies to liabilities
17	SPFN	the ratio of funds of natural persons in the national currency to liabilities
18	SPFP	the ratio of funds of natural persons on demand to liabilities
19	SPFS	the ratio of term funds of individuals to liabilities.
<i>Other indicators</i>		
20	ROA	profitability of assets
21	RA	the ratio of total reserves for credit risks to net assets
22	CA	ratio of balance sheet capital to net assets
23	VCA	ratio of net assets in foreign currencies to net assets
24	VL	open currency position, which is calculated as the difference between assets and liabilities in foreign currencies, relative to net assets
25	L1	ratio of cash and cash equivalents to liabilities on demand
26	As	the share of net assets of this bank to the total net assets of the system
27	PM	interest margin, the ratio of net interest income to net assets
28	KD	the ratio of net commission income to net assets
29	TD	the ratio of trading results to net assets
30	VA	the ratio of administrative and other operating expenses to net assets
31	VR	the ratio of expenses for the formation of reserves for credit risks to net assets

The first group consists of 9 indicators that characterize the structure of the largest and most important assets of banks, 10 indicators - the structure of liabilities and 12 indicators that describe important qualitative characteristics that are necessary for the formation of homogeneous groups. The totality of all 31 indicators determines the peculiarities of the business models and risk profile of each bank.

Table 2 shows the average values of 31 indicators for 10 groups where banks were located at the beginning of the selected period. The maximum values of the indicators, which highlight the significant differences of each group, are highlighted in colour. Elevated values of indicators are determined by comparison with the average level of indicators given in the last column of Table 1.

Table 2. Average indicators of SFGB as of 01.10.21. (Source: calculated by the authors based on published reports [17])

Indexes		Average values for SFGB with the corresponding number (%)										Total
		1	2	3	4	5	6	7	8	9	10	
1	L1	26.9	15.0	20.7	39.8	7.5	12.9	24.0	13.8	64.3	19.4	22.4
2	SAV	8.5	6.4	6.7	11.2	5.0	8.4	6.8	5.8	4.3	3.8	7.0
3	SAMI	8.5	12.7	9.2	5.3	29.8	19.7	6.7	9.4	24.7	6.1	11.2
4	SAMN	0.8	0.2	0.2	0.8	0.1	0.6	0.4	0.0	0.0	0.6	0.4
5	SAUI	7.8	18.1	16.1	0.8	2.6	8.6	4.6	9.9	26.0	3.0	9.0
6	SAUN	26.3	33.2	27.6	18.2	14.8	23.9	12.8	11.3	5.8	2.1	19.9
7	SAFI	0.1	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1
8	SAFN	12.0	2.1	12.3	1.5	0.0	7.3	1.7	6.2	0.1	66.3	7.1
9	SACI	2.5	3.5	5.4	1.8	1.6	3.1	2.1	6.0	0.0	0.8	2.8
10	SACN	20.2	16.4	10.0	42.6	33.9	23.5	52.8	27.1	21.1	6.4	30.5
11	RA	6.8	4.2	5.3	5.5	0.4	1.9	4.1	23.7	210.6	27.0	11.8

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Table 2. Continued

Indexes		Average values for SFGB with the corresponding number (%)										Total
		1	2	3	4	5	6	7	8	9	10	
12	As	0.4	1.7	2.1	0.1	0.6	1.6	0.2	13.9	1.0	0.4	1.4
13	VCA	22.2	36.0	33.0	12.8	38.7	33.6	17.4	26.4	51.7	11.2	26.0
14	VL	1.7	1.5	1.6	1.4	1.8	1.0	1.1	-7.4	-1.8	0.3	0.9
15	SPMI	0.1	3.5	1.2	0.0	0.1	0.0	1.0	1.2	45.9	0.1	2.3
16	SPMN	4.7	6.8	7.0	1.8	0.1	4.8	36.6	5.0	0.0	0.1	13.4
17	SPUI	8.1	18.1	13.2	12.7	42.4	14.8	8.7	9.2	1.9	3.7	13.4
18	SPUN	36.2	34.5	28.4	52.4	54.9	36.4	28.9	23.5	4.9	10.3	33.3
19	SPUP	28.7	40.3	30.2	61.6	75.7	46.0	29.8	24.6	6.2	9.6	36.8
20	SPUS	15.6	12.3	11.4	3.5	21.6	5.1	7.8	8.1	0.6	4.4	9.9
21	SPFI	17.3	14.4	18.9	4.8	0.4	24.0	8.5	16.0	4.0	8.6	11.9
22	SPFN	28.3	12.4	22.7	5.0	0.8	16.3	10.4	30.2	3.3	71.5	16.5
23	SPFP	15.3	15.0	13.5	7.7	0.6	35.3	7.1	21.9	5.5	13.1	12.4
24	SPFS	30.3	11.7	28.1	2.1	0.5	5.1	11.9	24.3	1.8	67.0	16.0
25	CA	24.0	15.2	13.2	55.2	14.9	17.0	14.4	9.8	40.3	16.9	19.8
26	PM	7.5	5.1	5.1	6.9	3.4	4.8	4.1	5.0	3.9	25.5	5.9
27	KD	3.2	2.0	2.7	4.5	0.7	2.2	2.6	3.0	1.0	2.7	2.5
28	TD	0.9	0.6	0.3	1.8	0.7	0.6	0.9	-1.2	1.0	0.2	0.7
29	VA	9.4	4.8	5.7	12.6	2.7	6.2	7.2	3.8	7.9	14.8	7.2
30	VR	1.2	1.0	0.9	-1.1	-0.1	0.3	0.8	0.5	-6.6	7.8	0.7
31	ROA	2.3	2.0	1.9	1.7	1.8	1.1	0.5	3.1	6.6	5.8	1.8

Table 3 provides information on the number of banks in each SFGB, the total assets of these banks and the largest values of the indicators. The indicators of the maximum values of the asset indicators describe the peculiarities of the structure of the allocation of resources in the corresponding group, in comparison with the average level in the system. Similarly, the priority areas for attracting funds are evaluated using the increased values of the indicators of the structure of obligations. The third group of indicators includes increased values of other indicators that supplement the description of each SFGB.

Table 3. Distribution of banks by SFGB as of 01.10.21. (Source: calculated by the authors based on published reports [17])

Group number	Number of banks	Assets, million hryvnias	Indicators of maximum indicators		
			Assets	obligations	others
1	8	65,057	SAUN (corporate loans)	SPFN, SPUS, SPFS (term resources)	-
2	12	402,767	SAUI, SAUN (corporate loans)	SPUP, SPUI (Current Enterprise Resources)	VCA
3	7	283,633	SAUN (corporate loans)	SPFS, SPFI (retail resources)	VCA
4	6	7,952	SAV, SACN (securities, highly liquid)	SPUN, SPUP (corporate resources)	L1, CA, VA, KD
5	5	60,409	THEMSELVES, SACN (securities, interbank loans)	SPUI, SPUN, SPUP, SPUS (corporate resources)	VCA
6	5	151,589	SAUN (corporate loans)	SPFI, SPUP, SPFP (current resources)	VCA
7	20	95,428	SACN (securities)	SPMN (interbank resources)	-
8	3	804,978	SACI (Balanced Structure)	SPFN, SPFS, SPFP (retail resources)	As, VL, RA
9	2	38,618	SAUI (corporate loans)	SPMI (interbank resources)	L1, RA, VCA, CA, ROA
10	3	21,486	SAFN (retail loans)	SPFN, SPFS (retail resources)	RA, RM, VR, VA, ROA
Sum	71	1,931,916	-	-	-

Let's consider the characteristics of each group of banks as of 01.10.21 to analyze further changes in the characteristics and volumes of SFGBs over the next two years.

The group of banks numbered 1 occupies a large part in the southeast and centre of the map in the first part of Figure 1. As the values of Table 1 and Table 2 show, banks of the first group have increased values of SAUN among the structural indicators of assets, SPUS, SPFN, SPFS – in liabilities. Other indicators of this SFGB are within average values. In comparison with other SFGBs, the majority of the assets of banks of the first group can be defined as corporate loans, and liabilities - as term resources.

The group of banks numbered 2 is located in the centre and northwest of the map in Figure 1. Among the indicators regarding the structure of bank assets, the SAUI/SAUN indicators, which characterize the preference for corporate loans, are of increased importance. SPUP, SPUI indicators, which characterize the advantage of current corporate resources in foreign currencies, have an increased value in the structure of liabilities. The increased value of the ratio of net assets in foreign currencies to VCA net assets requires attention to currency risk management.

Group 3 is in the centre and northeast of the map. The increased value has the same SAUN indicator, which characterizes the direction of corporate loans. SPFS and SPFI indicators, which characterize the direction of retail resources, have an increased value in the structure of liabilities. Also, the VCA indicator has an increased value.

Thus, banks belonging to groups 1, 2 and 3 occupy the central part of the map. The geographical proximity of these SFGBs indicates the presence of common features. The assets of these banks are directed to corporate lending. The resource base of each group has certain features.

Between groups 2 and 3 in the central and northern part of the map is group 6, which is smaller in size and has fewer banks. In the structure of assets of banks of group 6, the SAUN indicator, which corresponds to the direction of corporate loans, has increased importance. In the structure of obligations, SPFI, SPUP, SPFP indicators, which can be classified as current resources, are of increased importance.

Central groups 1, 2, 3 and 6 as of 01.10.21 include 32 out of 71 banks or 45% of the total number. The combined assets of the respective banks make up 47% of the system's assets. Bank assets are focused on corporate lending, as evidenced by the increased SAUN indicator. The liabilities of banks in the central part of the map can be distributed from east to west - from the preference of funds of individuals in group 3 in the eastern part of the map to corporate clients in the western part of the map in group 2. The central part with groups 1 and 6 has a mixed resource base.

From the banks of the central part, we will move to the groups on the borders of the map. In the eastern part of the map, there are banks with the advantage of attracting funds from individuals. Group number 8 occupies the northeast corner of the map, and another group in the southeast corner is number 10. Although the groups are almost identical in size, the banks of these groups have significant differences. It is the difference of the SFGB that leads to the remote location of the groups.

Group 8 in the north-east of the map includes the largest state-owned banks. Throughout the study period, the 2-3 largest banks were combined in a corresponding group on the side of the map where retail resources prevail. For the largest banks, the structure of banking assets is typical and coincides with the average indicators of the system. The exception is only the increased value of the SACI indicator, but the level of the ratio of the portfolio of securities in foreign currencies to net assets is only 6%. Although the increased share of banks' investments in foreign securities in wartime conditions attracts public attention, the indicator is not key in the resource management strategy and is only 3% on average.

As of 01.10.21, the three largest banks (42% of the total assets of the banking system) are located in group 8. It is obvious that the As indicator is the largest in the system. In addition, the level of RA is elevated, which indicates a poor-quality loan portfolio. The VL indicator has the largest negative value by module, which indicates an increased open short currency position, and an excess of liabilities in foreign currencies over assets. The currency risk of these banks needs to be controlled.

Group 10 in the Southeast includes banks that are focused on retail lending with an increased level of loans to individuals SAFN and attracting retail resources, in particular SPFN/SPFS. The values of the corresponding indicators reach the maximum level in the system. The group of retail banks has shrunk significantly over the past decades. Retail banks traditionally have a higher level of RM interest margin and VA administrative costs. High values of RA and VR indicate increased credit risks. At the same time, retail banks have one of the highest levels of ROA.

In the southwestern corner of the map, there are banks of groups numbered 4, 5, and 7, which have many common characteristics and significant differences from other groups, namely, the increased value of the SACN indicator in the structure of assets. These groups include 31 banks, the total assets of which occupy only 8% of the assets of the system.

Group 4 borders Group 1 and is located in the southwest, closer to the centre of the map. In addition to the increased SACN ratio (43% in assets), the level of SAV and L1 is high. Banks have excess highly liquid assets. In the structure of liabilities of banks of this group, corporate resources are of increased importance - SPUN, SPUP indicators, current funds of legal entities and liabilities in national currency. The values of the KD and VA indicators, which characterize the business model of the respective banks, are elevated. The CA indicator has the maximum value in the system. The ratio of balance sheet capital to net assets is high in small banks, which ensures the growth of assets and liabilities at rates adequate to the regulatory minimum capital. Note that the small banks of group 4 are located at a diametrical distance from the largest banks of group 8, which confirms the influence of the features of SFGB on the topology of the map.

Group 7 occupies a corner position in the southwestern part of the map. In the structure of bank assets, the share of SACN securities is as much as 53%. The structure of banks' liabilities shows increased values of SPMN. Banks of this group attract refinancing resources to place most of their assets in government securities. It is this strategy that significantly distinguishes the business model of Group 7 banks as of 01.10.21.

Group 5 is located on the western border of the map, to the north of group 7. The average value of the SACN indicator exceeds a third and is almost equal to the SAMI indicator - the share of assets placed on the interbank market in foreign currency. In the structure of liabilities of the banks of this group, corporate resources of all kinds are of increased importance. The increased value has the ratio of net assets in foreign currencies to net assets of VCA. Group 5 mainly includes banks with foreign capital. With the limited development of lending, the main areas of allocation of funds of these banks are government securities and the interbank market, mainly the parent structures of banks of foreign groups.

The last group at number 9 is in the northwest corner of the map and is quite different from the others. As of October 1, 2021, this group included 2 banks with Russian capital that were on the verge of bankruptcy and therefore showed extreme values of many indicators. Banks were withdrawn from the market in the first days of the full-scale invasion and their influence on the development of the system is insignificant.

Thus, as of October 1, 2021, the system of 69 Ukrainian banks, excluding 2 Russian banks from group 9, was distributed as follows:

- 32 banks of the central group, which accounted for 48% of the system's assets, had the advantage of corporate lending in the structure of assets and mixed types of resources, where the share of individuals and time funds increases from the west to the east of the map;
- 3 largest banks in the north-east of the map with assets amounting to 43% in the system, had diversified assets distributed between corporate loans and government securities and a significant share of retail resources;
- 31 banks in the southwest of the map by assets in the amount of 9% of the system with increased assets in state securities and corporate resources and attracted refinancing funds;
- 3 banks in the southeast of the map by assets, less than 1% with retail assets and liabilities.

Let's consider the changes in the resource management strategy of banks that took place two years later, as of 01.10.23. Qualitative changes in the system can be assessed using the quantitative assessment of the size of SFGBs, their position on the map, and the average values of their indicators. Differences in the characteristics of SFGBs indicate changes in the management of the resources of Ukrainian banks involved and placed.

The location of SFGB on the map as of 01.10.23 is presented in the second part of Figure 1. The topology of this map differs from the previous one, as most banks are concentrated in two central groups numbered 1 and 2, the zone of concentration of banks has moved from the west to the east of the map. Topology changes are partly related to uncontrollable technical reasons for the grouping of homogeneous objects by the values of all indicators at the same time, without taking into account the orientation of the maps of previous periods. However, in the end, the new groups objectively reflect the consequences of the development of bank management strategies. Banks with the same resource management strategies continue to be next to each other in any map orientation. With all the differences in the position of groups of banks, one can observe the synchronous transition of the majority of banks to new groups and interpret their migration on the map. Observation of migration makes it possible to describe the SFGB, find out the reasons for the transition of specific banks, and give an assessment of overall changes in the system.

Let's consider the specific characteristics of SFGB using the values of the selected indicators. Table 4 shows the average values of indicators as of 01.10.23, similarly to Table 2 for the previous period, increased indicators are highlighted in colour.

Table 4. Average indicators of SFGB as of 01.10.23. (Source: calculated by the authors based on published reports [17])

Indexes	Average values for SFGB with the corresponding number (%)											System
	1	2	3	4	5	6	7	8	9	10	12	
L1	20.7	25.9	26.6	39.1	13.1	63.2	36.4	27.8	53.2	21.0	28.9	31.9
SAV	10.6	9.9	8.7	7.5	4.5	4.4	9.4	9.8	8.6	12.5	7.4	9.3
SAMI	15.7	6.5	8.3	3.4	1.9	4.6	6.0	19.3	36.4	10.3	5.1	11.2
SAMN	0.5	1.2	0.4	0.3	0.4	0.7	1.3	0.2	0.1	0.0	0.6	0.7
SAUI	11.3	5.2	25.9	9.0	2.4	0.0	2.5	3.2	0.9	3.9	2.6	6.7
SAUN	16.5	13.9	14.4	33.6	31.1	8.6	1.8	8.9	10.7	10.2	3.5	14.1
SAFI	0.0	0.0	0.4	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
SAFN	3.1	2.6	5.4	0.4	0.7	0.8	47.4	0.6	0.0	6.6	0.1	3.8
SACI	6.1	2.7	2.0	0.0	2.8	0.6	1.0	1.1	1.3	5.2	1.3	3.2
SACN	29.7	44.8	28.2	37.1	50.7	60.4	24.1	47.5	40.7	29.6	68.7	40.5
RA	6.8	6.4	11.6	17.3	6.7	7.3	52.6	3.9	1.6	19.5	5.9	8.6
As	2.2	0.5	1.7	0.0	0.2	0.0	0.5	0.9	1.4	17.5	0.0	1.6
VCA	35.0	17.0	37.6	14.0	8.9	7.3	11.9	27.8	39.0	20.8	11.7	23.4
VL	0.4	-0.2	2.4	0.9	0.0	2.6	-0.6	0.9	0.2	-2.1	2.2	0.5
SPMI	0.7	1.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.3	0.0	0.7
SPMN	0.5	0.8	0.0	0.0	15.4	2.1	0.2	0.6	2.1	0.0	30.2	1.7
SPII	16.3	9.1	10.0	3.0	2.3	6.7	0.7	24.2	39.6	8.6	3.1	12.7
SPUN	38.7	53.8	37.6	30.9	52.9	33.3	20.7	65.2	43.8	19.9	30.9	44.3
SPUP	41.4	42.5	30.5	22.7	37.5	30.3	12.7	41.8	52.8	23.9	30.4	38.4
SPUS	13.6	20.4	17.0	11.3	17.8	9.7	8.8	47.6	30.6	4.7	3.6	18.6
SPFI	19.0	9.3	21.7	20.0	8.3	5.5	13.7	2.9	2.1	15.7	16.7	12.2
SPFN	16.7	19.6	16.0	41.4	19.3	17.3	58.5	2.4	10.6	50.6	13.8	19.3
SPFP	21.0	9.2	9.3	11.4	5.6	10.3	18.4	3.4	1.7	45.1	23.0	13.7
SPFS	14.8	19.7	28.4	50.0	22.0	12.5	53.9	1.9	11.0	21.2	7.5	17.8
CA	13.9	17.8	18.7	44.6	19.6	73.9	19.2	15.6	11.2	12.5	51.7	22.9
PM	6.5	6.8	5.5	12.0	5.5	12.9	22.4	6.9	7.3	7.6	3.6	7.9
KD	1.8	2.0	2.3	2.6	3.5	1.0	1.7	0.4	0.5	3.0	2.3	1.7
TD	0.9	1.2	1.0	0.3	0.2	0.1	1.5	0.4	0.5	1.7	28.6	1.3
VA	5.6	8.7	6.6	11.0	7.6	14.8	11.2	2.6	2.5	4.2	34.3	7.9
VR	1.0	-1.2	-0.5	2.3	0.7	-0.7	5.0	0.0	-0.1	-0.3	4.7	0.2
ROA	2.8	2.3	5.2	1.6	0.7	3.8	8.4	4.7	5.0	7.7	2.1	3.3

Characteristics of the structure of placed and attracted resources, qualitative indicators, number and total assets of banks in groups are presented in Table 5.

Table 5. Distribution of banks by SFGB as of 01.10.23. (Source: calculated by the authors based on published reports [17])

Group number	Number of banks	Assets, UAH million	Indicators of maximum indicators		
			assets	obligations	others
1	19	1,113,267	SAUI, SAUN (corporate loans)	SPUP, SPUI, SPFP (current resources)	VCA
2	19	260,562	SACN (securities)	SPUR, SPUN (corporate resources)	
3	2	90,203	SAUI (corporate loans)	SPFI, SPFS (retail resources)	VCA
4	2	1,432	SAUN (corporate loans)	SPFN, SPFI, SPFS (retail resources)	CA, RA
5	2	9,722	SAUN, SACN (corporate loans, securities)	SPMN, SPUN (interbank, corporate resources)	KD
6	6	1,916	SACN (securities)		L1, CA, VA
7	2	27,780	SAFN (Retail Loans)	SPFN, SPFS, SPFP (retail resources)	RA, RM, VR, ROA
8	6	141,181	SAMI, SACN (securities, interbank loans)	SPUI, SPUS, SPUN, SPUP (corporate resources)	VCA
9	2	72,996	SAMI, SACN (securities, interbank loans)	SPUI, SPUS, SPUP (corporate resources)	L1, VCA
10	2	927,496	SACI (Balanced Structure)	SPFN, SPFP (retail resources)	As, VL, RA, ROA
12	1	1,070	SACN (securities)	SPMN, SPFP (interbank, retail resources)	CA, TD, VA, VR
That's all	63	2,647,624			

Let's consider the peculiarities of the grouping of banks as of 01.10.23 and the differences in their management strategy from the previous period. Group number 1 has the largest size and is located in the centre and north of the map, which is shown in the second part of Figure 1. The vast majority of banks switched to this group from the 2nd group of cards as of 01.10.21. Banks are quite large, and some of them are systemically important. The basis of the group is a number of banks with foreign capital, such as Raiffeisen Bank, Piraeus Bank, and Procredit Bank, as well as banks with Ukrainian capital, Bank Pivdennyi, Bank Vostok, Clearing House, and even the state-owned Ukrgasbank. The structure of the assets of the banks of this group did not change during the research period. An increased share is occupied by corporate loans in national and foreign currencies. As of 01.10.23, the SACI indicator of foreign currency placement in securities has increased, but the value of 6% is not significant, as noted earlier. The liabilities of Group 1 banks also did not change in general. Current resources of individuals have been added to current corporate resources. Banks develop modern innovative products and attract funds to card accounts, among which resources in foreign currency occupy a large share. The issue of currency risk management remains relevant for this group of banks. Group 1 banks can be considered the most balanced and diversified in terms of resource management.

It should be noted that the migration from the 2nd group of banks as of 01.10.21 took place in two directions. Most banks, as noted, have moved to 1 group. At the same time, four banks chose the strategy of increasing the share of assets in securities and moved to groups 8, and 9, which are discussed below. It is the strategy of placing funds in state securities that is an alternative to classic credit operations and is actively used by domestic banks [19].

In turn, migration to group 1 as of October 1, 2023, occurred not only from group 2 but also from other groups of banks with similar characteristics. As noted earlier, the groups in the central part of the map as of 01.10.21, under numbers 1, 2 and 3, have many common features, first of all, an increased share of corporate loans in assets. The differences between the centre groups relate more to the structure of obligations. From group 1 as of 01.10.21 to group 1 as of 01.10.23, two banks, Universal Bank and Bank Grant, which previously migrated from other groups, but for a long time have typical characteristics of the group to which they moved, have moved. Also, 3 banks moved from group 3 to group 1: Kredobank, Lviv, and Kominvestbank, which have also long had characteristics of banks of group 1. Migration of small banks occurs more frequently and may reflect only the temporary nature of customer accounts at the reporting date. The study of the structure of groups and the trajectory of banks in dynamics provides constant information about the strategy of resource management.

Banks of groups 3 and 4 have an increased share of loans in assets as of 01.10.23, which confirms the indicators of Tables 4 and 5. Group 3 is located in the centre and northwest of the map, next to group 1. The resource base of the banks of this group is formed by the funds of individual persons. The share of funds in foreign currencies is high, which requires control over currency risks. As of October 1, 2023, group 3 includes two banks: Sens Bank (formerly Alfabank) and Creditvest Bank. Interestingly, group 3 is located next to group 9, which is in the northwest corner of the map, and is empty, but until February 2022 included two banks with the capital of the aggressor country. The former banks of Russia are located next to each other on the map, which indicates close strategies and operational problems.

Group 4 is in the very centre of the map as of 10/01/23, to the south of groups 1 and 3. Unlike group 3, the assets and liabilities of banks are dominated by funds in national currency. As mentioned earlier, the increased CA indicator is characteristic of small banks, since the size of the assets of these banks lags behind the minimum regulatory capital in terms of growth rates. Small banks of group 4 also have increased credit risks, as evidenced by the RA ratio of reserves to assets. As of October 1, 2023, Group 4 includes Polikombank and Europrombank.

In general, the system of three SFGBs with numbers 1, 3, and 4, located in the northeast and centre of the map, includes 23 banks, the total assets of which make up 46% of the assets of the system. In the resource base of banks, the share of funds of individuals is growing towards the south.

The second large system consists of banks, in the assets of which state securities have an increased share. Such banks are located in groups 2, 5, 6, 8, 9, 12. Groups 8 and 9 are formed, mainly, from banks with foreign capital, located next to each other in the northeastern corner of the map, and have close values of indicators. Group 2 occupies the centre and southeast of the map, while groups 5, 6 and 12 are located on the southeastern borders of the map. Towards the corners and borders of the map, the differences in bank characteristics increase.

As shown in Table 5, groups 2 and 1 include an equal number of 19 banks each, but the total assets of banks in group 2 are 4 times smaller. Group 2 banks have a fairly high level of securities in assets and corporate resources in liabilities. Like all small banks, they change trajectory more often because they depend on large transactions at the reporting date. During the specified period, there was a large migration of 10 banks from group 7 as of 01.10.21 to group 2 as of 01.10.23. As mentioned earlier, Group 7 banks used refinancing loans to place funds in securities. After the increase in the discount rate in June 2022 from 10 to 25%, the corresponding operations stopped bringing profit and the banks changed their management strategy. Most of the banks of group 7 moved to group 2, replacing interbank loans with corporate resources. Among these banks: Industrialbank, Bank Credit Dnipro, Radabank, Kristalbank, SkyBank, Bank Avangard, Yunex Bank, Acordbank, RVS Bank, Bank Ukrainian Capital. At the same time, two banks, MTB and Ukreximbank, moved to group 1, that is, they reduced their investment portfolios. Also, 5 banks from group 7 migrated to groups 5, 6, and 8.

As of 01.10.23, the strategy of attracting interbank resources and placement in securities remained in small groups 12 and 5. In group 12, in the south of the map, there is only one Bank $\frac{3}{4}$, which continues an ineffective strategy, and has an increased level of expenses for the formation of credit reserves, administrative expenses and trading income. In group 5, which is located in the southeast corner of the map, there are 2 banks that combine the old and new strategies. In the assets of Group 5 banks, there is an increased level of corporate loans and securities, in liabilities - interbank loans and funds of legal entities. The group includes MetaBank and Kominbank. Thus, during the two investigated years, the majority of banks abandoned the strategy of using state resources as borrowed and placed funds.

In addition to the main migration from group 7 to group 2, the transition to group 2 of four banks from central group 1 was also observed. The share of securities in the assets of these banks increased somewhat, which caused the following banks to join group 2: Bank Globus, Bank of Investments and Savings, OKSI Bank and Poltava Bank. Also, Taskombank and PUIB moved from central group 3 to group 2. As evidenced by the migration of central groups, the strategy of placing funds in low-risk government securities is very common in periods of increased risks, inhibition of economic development and lending. If as of October 1, 2021, 32 banks had an increased share of corporate loans, and securities prevailed in 31 banks, then in two years, the ratio became 23 against 36 banks.

Banks 8 and 9 groups have many common characteristics and are located in the southeast corner of the map. Group 8 shares a border with groups 2 and 1, and group 9 is located to the north of it. As of 01.10.23, group 8 includes 6 banks, of which 3 were in the composition of group 5, close in terms of indicators, as of 01.10.21. These banks are Deutsche Bank DBU, ING Bank Ukraine, SEB Corporate Bank. In addition to the increased indicator of SACN securities, banks have a high level of the SAMI indicator - assets placed in foreign currency on the interbank market. In conditions of suppressed credit demand, these banks with foreign capital partly invest in government securities, and partly place them in parent structures. The resource base of these banks consists mainly of the funds of legal entities. That is why groups 8 and 9 are

at a diagonal distance from groups 7 and 10, where the largest, and retail banks with an increased share of resources of individuals are located in the southwest of the map.

Two banks with foreign capital joined Group 8 from Central Group 2: Bank Credit Europe and Credit Agricole Bank. Such migration is quite logical and indicates a sustainable strategy for the banks of this group. Finally, the only bank in this group with Ukrainian capital, the International Investment Bank, moved to group 8 from group 7.

Group 9 includes two banks with foreign capital: City Bank and Agroprosperis Bank. The first of them moved from the central group 2, and the second from the closely related group 5. Compared to group 8, the share of securities in assets is somewhat smaller, and in interbank loans - larger. The strategy of banks with foreign capital is stable and the composition of groups 8 and 9 almost does not change.

As can be seen from Table 5, the 23 banks of the north-western part of the map, which have increased indicators of corporate lending, occupy a smaller share in quantitative terms but prevail in the aggregate amount of assets, equal to 46% of the assets of the system. At the same time, 36 banks on the southeast of the map with an increased share of securities in the system have total assets in the amount of 18% of the total. The remaining assets fall into two small groups: the largest banks (group 10) and retail banks (group 7), which are located in the southwest corner of the map.

The group of 10 largest banks includes Privatbank and Oschadbank, which traditionally form a separate group and differ in the values of the same indicators described as of 01.10.21. Only ROA as of 01.10.23 is a new increase. The characteristics of the separate group of retail banks 7, which include A-bank and Idea Bank, have also been preserved for a long time.

Thus, as of 01.10.23, 63 Ukrainian banks were distributed as follows:

- 23 banks of the northwestern part of the map, occupying 46% of the assets of the system, have increased indicators of corporate lending in the structure of assets and mixed types of resources, where the share of individuals and time funds increases from the east to the west of the map;
- 36 banks in the east of the map with assets in the amount of 18% of the system with increased assets in government securities, interbank loans and corporate resources in liabilities;
- 2 largest banks in the southwest of the map with assets amounting to 35% in the system, have diversified assets, distributed between corporate loans and government securities and a significant share of retail resources;
- 2 retail banks in the southwest of the map by assets of 1% in the system with increased assets and liabilities of individuals.

Over the two years of observation, the number of banks with an increased share of corporate loans decreased, although the specific weight of their assets in the system did not decrease significantly. As evidenced by the indicators of these banks, the corresponding SFGBs include high-tech banks with a balanced structure of assets and liabilities. During the same time, the totality of SFGBs with an increased share of securities in assets increased in terms of the number and size of assets. The vast majority of these banks refused to attract refinancing loans and increased the attraction of funds from legal entities. The stable group consists of banks of foreign groups, in whose assets there is an increased share of placed interbank loans in foreign currency. The largest and retail banks are separated by the value of several indicators, including the increased share of resources of individuals. Recently, these banks also have the highest level of profitability in the system.

DISCUSSION

The proposed approach to analyzing the strategy of managing the assets and liabilities of banks has important advantages over existing methods. These advantages are associated with a wide range of indicators used to build clusters and with the use of the neural network method for working with large data sets.

Most of the existing approaches to the construction of clusters do not separate assets and liabilities by types of currencies or terms of placement of funds. To assess the features of business models, it is important to understand the characteristics of the resource base, the quality of the loan portfolio, and the ratio between highly liquid assets and current liabilities of banks. In order to distinguish clusters, it is important to study the sources of income and the main expenditure items of banks. The more data on the financial characteristics of banks used at the input of the model, the more accurate the obtained result. After building a self-organization map, the user has a fairly detailed list of the characteristics of each cluster and can confidently distinguish the business models of the banks of each of them.

At the same time, most researchers are limited to a small number of indicators. Thus, in the article by Rashkovan and Pokidin (2016) [22], only 7 indicators were used and 6 clusters were obtained. The properties of the resulting groups are not detailed enough. We believe that such a number of indicators is not enough to describe business models and asset and liability management strategies. A similar generalized system of clusters is observed in the work of Shkolnyk and Akopyan (2021) [25].

It should be noted that scientific works present various options for using homogeneous groups of banks, which are obtained as a result of cluster analysis. Thus, in the works of Primostka et al. (2017) [21], and Rudevskaya, V. (2020) [23], banks are grouped for the purpose of assessing financial stability. In the work of Mikulyak (2017) [16], groups of banks are formed to evaluate competitive advantages. To evaluate the efficiency and reliability of banks, 7 clusters were formed in the work of Dolinskyi et al. (2017) [4].

The increase in the number of indicators makes the setting of the map more accurate, the description of the differences of each group more detailed, and the conclusions obtained more thorough. When working with dozens of indicators, self-organizing maps reveal hidden properties of objects. The format of monthly bank statements published by the National Bank of Ukraine allows for the calculation of a significant number of important indicators useful for building clusters.

It should be emphasized the importance of step-by-step formation and evaluation of the results of the distribution of banks into clusters and comparison with the data of the previous reporting period. Analysis of clusters for different reporting dates provides important information about changes in the system and migration of banks between groups.

CONCLUSIONS

Analysis of bank strategy changes using the SFGB method demonstrated its adequacy and usefulness for researching the development processes of the banking system, homogeneous groups of banks and each individual bank, from the point of view of its place in the market of banking services.

The structure of the banks' attracted and deployed resources reflects the general state of the economy during the war, the unstable nature of liabilities dominated by current resources, the reduction of credit operations, and ways to protect the solvency of banks using foreign securities and interbank assets. Transactions with government securities play an important role in the management of assets and liabilities of modern banks. The financial result of these operations ensures record profitability of the largest state banks.

The advantage of the SFGB method is also the possibility of modelling the strategy of individual banks, comparing their place on the map with neighbouring banks. Such a study will prevent the movement to those points where the liquidated banks were located and focus on the strategies of the leaders. The possibility of using the method for stress testing, modelling the bank's position in the event of transition to some realistic or negative forecast values of the indicators is proven. The predictive value on the map provides an opportunity to assess the consequences of choosing one or another bank resource management strategy.

Further research is related to the application of the SFGB method for complex economic systems described by a significant number of indicators. Along with banks, it is possible and important to examine the characteristics of non-bank financial institutions that also provide monthly statements. Stock exchanges are an interesting object for clustering, which can be analyzed from the point of view of possible manipulations on the capital market.

As studies have shown, the grouping of financial market subjects by the SFGB method using a large number of indicators provides useful information for identifying areas of increased risks.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

Conceptualization: *Olena Zarutskaya, Roman Pavlov*

Data curation: *Tetiana Grynko, Oksana Levkovich*

Formal Analysis: *Tetiana Pavlova, Tetiana Hviniashvili*

Methodology: *Olena Zarutskaya, Roman Pavlov, Tetiana Pavlova*

Software: *Tetiana Grynko, Oksana Levkovich, Tetiana Hviniashvili*

Resources: *Olena Zarutskaya, Tetiana Grynko, Oksana Levkovich*

Supervision: *Roman Pavlov, Tetiana Pavlova, Tetiana Hviniashvili*

Validation: Tetiana Pavlova, Tetiana Grynko, Oksana Levkovich, Tetiana Hviniashvili

Investigation: Olena Zarutska, Roman Pavlov

Visualization: Oksana Levkovich, Tetiana Hviniashvili

Project administration: Olena Zarutska

Writing – review & editing: Tetiana Pavlova, Tetiana Grynko, Oksana Levkovich, Tetiana Hviniashvili

Writing – original draft: Olena Zarutska, Roman Pavlov

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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Заруцька О., Павлов Р., Павлова Т., Гринько Т., Левкович О., Гвініашвілі Т.

ТРАНСФОРМАЦІЇ СТРАТЕГІЇ УПРАВЛІННЯ РЕСУРСАМИ УКРАЇНСЬКИХ БАНКІВ

Ця стаття досліджує особливості управління активами й пасивами українських банків в умовах значних структурних перетворень ресурсної бази в період воєнного стану. Аналіз проведено на рівні однорідних структурно-функціональних груп банків (СФГБ), які формуються з використанням оприлюднених даних звітності та застосуванням самоорганізаційних карт Кохонена (SOM). Накопичення статистичних даних проведено протягом 5 років, особливу увагу приділено структурним змінам ресурсної бази та напрямів розміщення банківських активів за останні два роки.

Протягом останніх двох років банківська система перебуває під впливом шоків факторів, що відображається на активах і пасивах. На початку 2022 року спостерігався відтік коштів із банківських рахунків, який поступово компенсувався надходженнями поточних коштів від корпорацій і населення. Протягом 2023 року Національний банк України активно стимулював розвиток строкової ресурсної бази, основи для забезпечення зростання кредитних операцій. У структурі банківських активів продовжують зростати операції з цінними паперами держави. Пріоритетним завданням банківської системи залишається фінансова підтримка бізнесу, але в умовах повномасштабної війни такий розвиток кредитних операцій обмежений. Дослідження стратегії банків доцільно проводити шляхом поєднання за близькими характеристиками структури активів і пасивів та аналізу динаміки груп. Спостереження за однорідними групами підтверджує їхню стійку природу, особливості стратегії, профілю ризиків та пріоритетів розвитку. Доведено, що банки в межах однорідних СФГБ демонструють близьку поведінку в формуванні управлінських стратегій і реакції на внутрішні та зовнішні шоки. На макрорівні структура SOM дозволяє кількісно оцінити основні процеси, що відбуваються в банківській системі, проводити порівняння картами, виявляти проблеми та пріоритети управління активами й пасивами банків. Метод СФГБ дозволяє оцінювати траєкторію окремих банків на карті й розробляти рекомендації для вдосконалення стратегії управління активами й пасивами.

Ключові слова: банківські активи, банківські пасиви, банківські ризики, структурно-функціональні групи банків, бізнес-модель, ринок банківських послуг, банківська система, карти Кохонена

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