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MAIN CHARACTERISTICS OF BUSINESS MODELS
AND RISK PROFILE OF UKRAINIAN BANKS

Abstract. The article investigates the main characteristics of the financial stability of Ukrainian banks, their risk profile, structure of assets, liabilities, income, expenses based on the monthly reporting data for 2004—2020 (number of observations — 3 813). The Kohonen self-organizing map (SOM) toolkit is used to form homogeneous groups of banks based on a large number of financial indicators. The selected toolkit provides a convenient visualization of the results. Each bank occupies a specific place on the SOM. The close location of banks on the map indicates that these banks have many common characteristics. This study is called the method of structural and functional groups of banks. The study formed stable groups of banks with the same characteristics of business models and risk profile. The formation of consecutive maps for each reporting period allows to obtain the characteristics of each bank separately and the banking system as a whole. The trajectory of an individual bank's activity during the observation period characterizes the development of its business strategy. The migration of a large number of banks between groups reflects the objective changes in the conditions of banking. Increasing groups of high-risk banks indicate systemic problems. The results show that after a significant reduction in the banking system of Ukraine in 2014—2016, the business models of banks have changed significantly. The resource base relies on unstable sources of current funds with no set term of use. In the assets of banks, a significant portion is invested in government securities — government bonds. Bank loan portfolios have declined and have a higher proportion of non-performing assets (NPL). Many banks have increased currency risk. Concerns are raised about the state of large state-owned banks that hold a separate high-risk group. Thus, the conducted research allows to distinguish groups of banks with specific characteristics of business models and to observe changes of risk profile inherent to these groups. For each structural-functional group, changes in the values of financial indicators are investigated and migration between groups is studied. The proposed methodology is useful for studying both macro and macro levels.

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ОСНОВНІ ХАРАКТЕРИСТИКИ БІЗНЕС-МОДЕЛЕЙ І ПРОФІЛЮ РИЗИКІВ УКРАЇНСЬКИХ БАНКІВ

Анотація. Проведено дослідження ключових характеристик фінансової стійкості банків України, їх профілю ризиків, структури активів, пасивів, доходів, витрат на основі щомісячних даних звітності за 2004—2020 рр. (кількість спостережень — 3 813). Використано інструментарій самоорганізаційних карт Кохонена (Self-organizing map — SOM), який дозволяє формувати однорідні групи банків на підставі значної кількості фінансових показників. Обраний інструментарій забезпечує зручну візуалізацію результатів. Кожний банк займає конкретне місце на SOM. Близьке положення банків свідчить про наявність значних спільних характеристик. Це дослідження отримало назву «метод структурно-функціональних груп банків». Установлено наявність стійких груп банків із близькими характеристиками бізнес-моделей і профілю ризиків. Формування послідовних карт на кожний звітний період дозволяє отримати характеристику кожного банку окремо і банківської системи загалом. Траєкторія окремого банку за період спостережень характеризує розвиток його бізнес-стратегії. Міграція значної кількості банків між групами відображає об'єктивні зміни умов діяльності банків. Збільшення груп банків із високими ризиками свідчить про наявність системних проблем. Отримані результати свідчать, що після значного скорочення банківської системи України у 2014—2016 роках бізнес-моделі банків суттєво змінилися. Ресурсна база спирається на нестійкі джерела поточних коштів без установленого строку використання. В активах банків значну частину займають інвестиції в цінні папери держави — ОВДП. Кредитні портфелі банків скоротилися і мають підвищену частку непрацюючих активів (NPL). Багато банків має підвищений валютний ризик. Занепокоєння викликає стан великих державних банків, які займають окрему групу із

підвищеними ризиками. Таким чином, проведене дослідження дозволяє виокремити групи банків із конкретними характеристиками бізнес-моделей і спостерігати зміни профілю ризиків, притаманних саме цим групам. Для кожної структурно-функціональної групи досліджується зміна значень фінансових показників і вивчається міграція між групами. Запропонована методика корисна для дослідження як не макрорівні, так і на макрорівні.

Ключові слова: бізнес-моделі банків, профіль ризиків банків, самоорганізаційні карти, структурно-функціональні групи банків.

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ОСНОВНЫЕ ХАРАКТЕРИСТИКИ БИЗНЕС-МОДЕЛЕЙ И ПРОФИЛЯ РИСКОВ УКРАИНСКИХ БАНКОВ

Аннотация. Проведено исследование ключевых характеристик финансовой устойчивости банков Украины, их профиля рисков, структуры активов, пассивов, доходов, расходов на основе ежемесячных данных отчетности за 2004—2020 гг. Использован инструментарий саморганизацийных карт Кохонена. Исследование получило название «метод структурно-функциональных групп банков». Установлено наличие устойчивых групп банков с близкими характеристиками бизнес-моделей и профиля рисков. После значительного сокращения банковской системы Украины в 2014—2016 ресурсная база опирается на неустойчивые источники текущих средств. В активах банков значительную часть занимают инвестиции в ценные бумаги государства. Кредитные портфели банков сократились и имеют повышенную долю неработающих активов. Беспокойство вызывает состояние крупных государственных банков. Предложенная методика полезна для исследования как макроуровне, так и на макроуровне.

Ключевые слова: бизнес-модели банков, профиль рисков банков, самоорганизационные карты, структурно-функциональные группы банков.

Формул: 2; рис. 1; табл.: 1; библ.: 16.

Introduction. The financial stability of banks depends on the effectiveness of their business model and the quality of risk management. A clear definition of the bank's business model must meet the specific conditions of the country's banking system [1—4]. The study of business models of banks requires the identification of key characteristics of the structure of assets, liabilities, income and expenses of modern banks. The business model reflects the bank's city in the financial market. Banks with the same characteristics have the same business models [5; 6]. To build a system of business models, it is necessary to take into account a large number of financial indicators. To process arrays of information, it is important to choose an adequate mathematical model.

Literature review and the problem statement. The study of the economic content of business models and their role in the implementation of strategies of companies and banks is actively developing in recent years. In the works of A. Osterwalder, J. Euchner [7] it is determined that the business model makes it possible to understand the basics of activity and the basic principles of organization of companies, which ensures the creation and fixation of the value they create. Researchers use the concept of «Business model canvas», which is formed of nine segments: customers, value proposition, delivery and communication channels, customer relations, revenue streams, core resources, key activities, partner network and cost structure. R. Lueg, C. Schmaltz and M. Tomkus [8] defines the business model as the bank's priorities for its financing, set of business products and services and risk acceptance. Banking business in this model develops around three main processes: obtaining funds for operations, providing services and products as a means of generating income, and risk. F. Mergaerts, R.V. Vennet [9] conducted a study of banks' business models using the factors of asset management, financing, capitalization and income diversification. The proposed model of the asset structure is characterized by the lending ratio, the quality of loans, and the size of the bank, the structure of liabilities is characterized by the volume of deposits and risk of financing.

The National Bank of Ukraine identifies five types of banks' business models. These models have the following conventional names: universal, retail, corporate, corporate model with retail financing, limited credit intermediation model. This banks division is based on individual indicators values. The process of bank allocation is not sufficiently formalized and subjective. Model definitions also cannot be considered transparent and straightforward.

We have proved that Ukrainian banks can be divided into clear structural-functional groups (SFGB), which have retained their characteristics over the past decades. Each group combines banks with the same business models. Groups of banks are formed using Kohonen's self-organization maps (SOM) [10—12]. The method allows to take into account the peculiarities of the banking system in a particular period and to objectively divide banks into groups.

Research results. The SFGB method is based on the construction of homogeneous clusters of banks based on a large number of indicators that are calculated from bank reports. The SOM mathematical apparatus allows you to process multidimensional arrays and display the result on a two-dimensional plane. Self-organizing map is like a geographical map. Each point corresponds to the bank. Nearby points have many similar characteristics. The place of the bank is determined on the basis of the values of indicators — structural indicators (SI). Each SI reflects the structural-functional characteristics of banks. The use of the values of many indicators allows you to assess various aspects of banks and find areas of increased risk. 31 SIs were used to describe the bank's business model and risk profile. They are calculated on the basis of bank reporting for the period from 2003 to 2020 [13]. The distribution of banks by SFGB persists for a long time. The scorecard is shown in *Table*. The choice of SI is an important factor in building a model. It is necessary to determine the largest components of assets and liabilities, income and expenses and other indicators that affect banking risk. All 31 structural indicators simultaneously affect the bank's position on the SOM. Each SI is important for the formation of SFGB in 31-dimensional space.

Table

Selection of structural indicators for the formation of Kohonen self-organizing map

№	SI	Content
1	A-s	Share of bank assets in total assets of the system
2	VCA	Share of foreign currency assets in total assets
3	VL	The ratio of the gap between assets and liabilities in foreign currency to total assets
4	ROA	Return on assets
5	RA	The ratio of credit risk provisions to assets
6	CA	Balance capital to assets ratio
7	L1	The ratio of highly liquid assets to current liabilities
8	L2	The ratio of the loan portfolio to the deposit portfolio
9	SAC	Share of securities in assets
10	SAUN	Share of national currency corporate loans in assets
11	SAUI	Share of foreign currency corporate loans in assets
12	SAFN	Share of consumer loans of national currency in assets
13	SAFI	Share of consumer loans of foreign currency in assets
14	SAMN	The share of interbank loans in national currency in assets
15	SAMI	The share of interbank loans in foreign currency in assets
16	SAV	Share of highly liquid assets in assets
17	SPUS	Share of fixed funds of legal entities in liabilities
18	SPUP	Share of current funds of legal entities in liabilities
19	SPUN	Share of legal entities funds in national currency in liabilities
20	SPUI	Share of legal entities funds in foreign currency in liabilities
21	SPFS	Share of individual time funds of in liabilities
22	SPFP	Share of individual current funds in liabilities
23	SPFN	Share of individual funds in national currency in liabilities
24	SPFI	Share of individual funds in foreign currency in liabilities
25	SPMN	The share of interbank loans of national currency in liabilities
26	SPMI	The share of interbank loans of foreign currency in liabilities
27	VR	The ratio of expenses for the credit risk provisions formation for assets
28	PM	Net interest margin
29	KD	The ratio of commission income to assets
30	TD	The ratio of trade income to assets
31	VA	The ratio of administrative expenses for assets

Source: Compiled by the authors.

During the study period, the volumes of different SFGB changed. During the recent crises, large groups of troubled banks were formed at the SOM border, which had losses (ROA) and increased reserves for credit risks (RA). During the crisis of 2009—2010, troubled banks had higher interest rates on borrowed and placed resources (PD, PV). Such characteristics reflected liquidity problems. During the crisis of 2015—2017, a significant number of liquidated banks had significant trade losses (TD) due to the sharp change in the exchange rate.

The distribution of banks on SFGB and placement of groups on the map as of 01.04.2020 is presented in *Fig*.

Placement of SFGB on the map has constant general patterns. Banks in the western part of the SOM have a larger share of foreign currency than in the eastern part. Banks in the southern part of the map invest more assets in the retail loan market than others. Banks in the northeast of the map invest more resources in holding securities. There are troubled banks in the north-western part of the SOM.

The largest banks in Ukraine are always united in a separate group, as they differ from other banks. The largest banks JSC CB «PrivatBank», JSC «Oschadbank», JSC «Ukreximbank» have 47.2% of the total assets of the whole system. The formation of this group depends on the value of the indicator A-s. Banks are located almost inside the map close to its northwestern part. The share of foreign currency assets is higher than average. Credit risks of the largest banks are increased, the RA indicator exceeds the average value. The risks of the largest banks characterize the greatest risks of the system, as their share in the assets of the system is the largest [14; 15]. At the beginning of 2020, credit and currency risks of the banking system of Ukraine are of great importance (*Fig*).
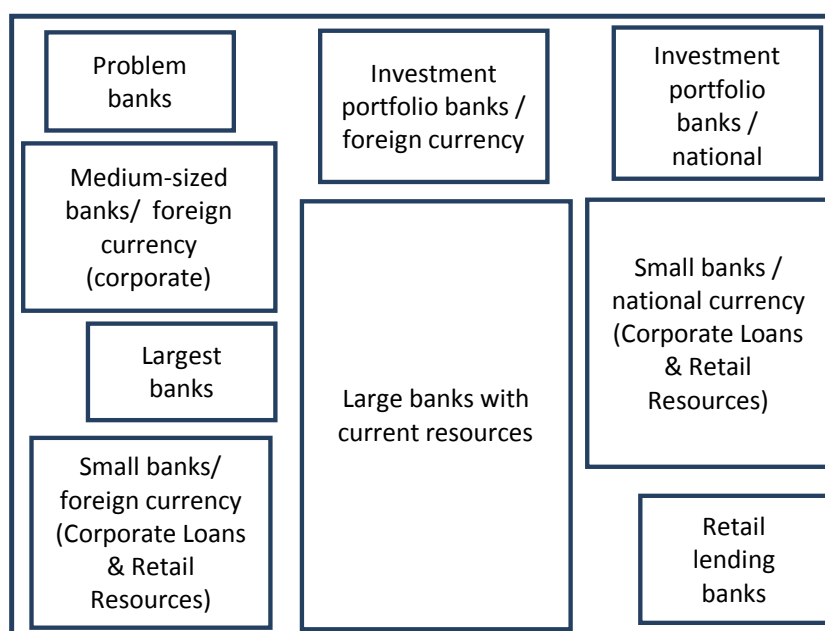
Fig. **Placement of Ukrainian banks on SFGB as of 01.04.2020**

Source: Compiled by the authors.

The largest number of banks is in the group «Large banks with current resources». This group occupies the central part of the SOM. The number of banks in this group is gradually growing. By 2020, this group included 13 banks. In 2020, 10 more banks joined the SFGB. The total assets of this group are equal to 27.8% of total assets. The values of SPFI and SPFP indicators are high. Banks have a high share of current resources. Many clients from bankrupt banks have moved to the banks of this group. After the crisis of 2015, customers place fewer term resources in banks than before. In the assets of banks in this group, interbank loans and government securities have an increased share. SAMI, SAC indicators take a high value. This group includes Raiffeisen Bank Aval JSC, JSC «ALFA-BANK», JSC «UKRSIBBANK», OTP BANK JSC, JSC «FUIB». The resources of banks in this group are short-term and the assets are longer-term.

The south-eastern part of the map is occupied by banks with an increased share of government securities in assets. The concentration of assets in securities has been growing in recent years. The group «Investment portfolio banks / foreign currency» has an increased share of assets in foreign currency. This group includes four banks JSB «UKRGASBANK», JSC «CREDIT AGRICOLE BANK», JSC «ING Bank Ukraine», JSC Deutsche Bank DBU. The total assets of this group are 11.4% of the total assets of the system. The resource base of banks has a high share of funds of legal entities. The «Investment portfolio banks / national currency» group has much in common with the previous group. The share of foreign currency assets is smaller. The size of the banks is small. This group includes 13 banks. The total assets of banks are equal to 2.8% of the total assets of the system. The profit of banks in this group is the largest. Although government securities are considered highly liquid assets in the world, large groups of banks with a high concentration of such assets indicate increased credit risks [16].

The group «Small banks / foreign currency (Corporate Loans & Retail Resources)» includes eight banks. The total assets of these banks are 2.2% of the total system. This group is located in the southwest of the SOM. The business model of these banks has a common characteristic: corporate lending and retail financing. The largest banks in this group are JSC «PROCREDIT BANK», JSCB «LVIV». The banks of the group «Small banks / national currency (Corporate Loans & Retail Resources)» have a similar model. These banks are located on the eastern part of the map. Funds in foreign currency have a smaller share than in the previous group. This group includes twelve banks.

The largest banks in this group are JSC «UNIVERSAL BANK», JSC «CB "GLOBUS"», JSC «BANK ALLIANCE». The total assets of these banks are 2.6% of the total system. Banks of these groups are developing traditional business models of Ukrainian banks.

In the south-eastern part of the SOM there are banks that work with household funds. Banks have the highest value indicators SPFN, SAFN, PM, KD, VA. Retail business allows banks to receive the highest commission income and interest margin. The administrative costs of these banks are the largest in the system. The amount of profit is negatively affected by large reserves for credit risks. The group includes five banks with total assets of 1.1% of the total assets of the system. The largest banks of the group are JSC «A-BANK», JSC «IDEA BANK». The group of banks with retail loans was larger until the last crises. The loan portfolio of these banks has deteriorated significantly in recent years.

Finally, the north-western part of SOM is occupied by troubled banks, which have received a negative financial result over the past year. The quality of the loan portfolio is the worst in the system. The group consists of banks with Russian capital «SBERBANK» JSC and PSC Prominvestbank.

The group «Medium-sized banks/ foreign currency (corporate)» is located between the troubled and the largest banks. This group includes five banks JSC «CREDITWEST BANK», TASCOMBANK JSC, MEGABANK JSC, JSC «BANK FOR INVESTMENTS AND SAVINGS», JSC IIB. The total assets of the group are 2.5%. The high value of the VCA indicator testifies to the increased currency risk of this SFGB.

It is important for Ukrainian banks to control the share of the foreign currency balance sheet and the size of the currency position. Increased currency risks may occur under adverse external conditions. In contrast to the approach of the National Bank of Ukraine, the SFGB method examines the type of currency on the operations of certain groups of banks.

A large number of different SI allows us to assess various aspects of banks' risks in specific conditions of the banking system development. These groups characterize the business models of Ukrainian banks in early 2020. During the study period, the number of SFGB varied. Significant migration between the SFGB indicated major changes in the system. Using the SFGB method allows you to get an objective distribution without user intervention.

Conclusion. The method of SFGB allows to study the financial condition of the entire banking system and each bank. A bank's location on the map is characterized by its business model and risks. The trajectory of each bank indicates the strategy of its development. It is advisable to analyze the changes of neighboring banks when changing the trajectory on the map. The experience of troubled banks in past periods, which are close to each other on the map, should be taken into account in management.

The use of this method allowed to assess the financial condition of the modern banking system. The risks of the largest banks characterize the greatest risks of the system. At the beginning of 2020, credit and currency risks of the banking system of Ukraine are of great importance. The largest number of banks is in the group «Large banks with current resources». The number of banks in this group is gradually growing. The resources of banks in this group are short-term and the assets are longer-term. The concentration of assets in securities has been growing in recent years. Although government securities are considered highly liquid assets in the world, large groups of banks with a high concentration of such assets indicate increased credit risks.

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