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ENHANCED EFFICIENCY OF CONSOLIDATED SUPERVISION BASED ON DIAGNOSIS OF BUSINESS MODELS OF BANKING GROUPS

Abstract. An analysis of business models of participant banking groups allows one to further understand the organization of banking business and the risks associated that a financial institution encounters, during its financial transactions/ activities. The study has showed that certain banking groups are implementing similar business models and risk concentration areas, the understanding of which allows the regulator to increase the efficiency of supervision on a consolidated basis and ensure the stability of the financial/banking system.

Based on the clustering method, four types of business models of the banking groups in Ukraine are identified: universal, corporate, corporate with retail financing, retail. Some "small banking groups" are classified as non-typical functional.

Empirically,it is proved that method of mathematical clusterization should be supplemented by the method of grouping by the factor levels,which further allows the probability to allocate by groups , whose average indicators confirm the belonging of the given banking group to be related to a certain typical business model.

For assessing stability of banking groups, the canonical model "Risk-Stability" has been built and studied. Its analysis allows asserting that the banking groups belonging to a corporate business model have relatively high credit and currency risks, and therefore the regulator needs to carefully monitor how the bank increases its requirements to capital and profitability according to the increase in the acceptable risk. Also, in each business model, individual banks have been identified whose activity involves a highest risk. For assessing stability of banking groups, the canonical model "Risk-Stability" has been built and studied. Applying fuzzy logic methods has allowed to substantiate applying enhanced banking supervision over the activities of individual banking groups.

Keywords: banking group, cluster analysis, canonical analysis, fuzzy logic, banking group business model, banking supervision

JEL classification codes: C63, G17, G18, G21, G28, E58

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ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ КОНСОЛІДОВАНОГО НАГЛЯДУ НА ОСНОВІ ДІАГНОСТИКИ БІЗНЕС-МОДЕЛЕЙ БАНКІВСЬКИХ ГРУП

Анотація. Аналіз бізнес-моделей банків / учасників банківських груп дозволяє зрозуміти організацію банківського бізнесу, ризики на які наражається фінансова установа в ході своєї діяльності. Дослідження показало, що певні банківські групи реалізують схожі моделі будови бізнесу та зони зосередження ризиків, розуміння яких дозволяє регулятору

підвищити ефективність нагляду на консолідованій основі та забезпечити стабільність банківської системи.

Базуючись на методі кластеризації ідентифіковано чотири типи бізнес-моделей банківських груп в Україні: універсальна, корпоративна, корпоративна з роздрібним фінансуванням, роздрібна. Частина дрібних банківських груп віднесені до категорії "нетиповий функціонал".

Емпіричним шляхом було доведено, що метод математичної кластеризації повинен доповнюватись методом групування за рівнями чинників, що дозволяє з більшою ймовірністю виділяти групи, середні показники за якими підтверджують приналежність даної банківської групи до певної типової бізнес-моделі, відображають специфіку формування ресурсної бази та спосіб використання активів.

Для оцінювання стабільності банківських груп побудована і досліджена канонічна модель "Ризик-Стабільність", яка доводить, що банківські групи корпоративної бізнес-моделі мають порівняно високі кредитний і валютний ризики, отже регулятору необхідно відслідковувати, наскільки банк зі зростанням прийнятого ризику збільшує вимоги до капіталу та прибутковості. В кожній бізнес-моделі ідентифіковано банки із найбільшим рывнем ризиків.

Застосування методів нечіткої логіки дало можливість обґрунтувати застосування посиленого режиму нагляду за діяльністю окремих банківських груп. Останнє дозволить регулятору передбачати проблеми в банках із критичним значенням нечіткої змінної частоти нагляду *supervision* та вживати превентивних заходів.

Ключові слова: банківська група, кластерний аналіз, канонічний аналіз, нечітка логіка, бізнес-модель банківської групи, режим банківського нагляду

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ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ КОНСОЛИДИРОВАННОГО НАДЗОРА НА ОСНОВЕ ДИАГНОСТИКИ БИЗНЕС-МОДЕЛЕЙ БАНКОВСКИХ ГРУПП

Аннотация. Доказано, что определенные банковские группы реализуют похожие модели бизнеса и зоны сосредоточения рисков, понимание которых позволяет регулятору повысить эффективность надзора на консолидированной основе и обеспечить стабильность банковской системы. Методом кластеризации идентифицировано четыре типа бизнес-моделей банковских групп в Украине: универсальная, корпоративная, корпоративная с розничным финансированием, розничная. Построена и исследована каноническая модель "Риск-Стабильность". Методі нечеткой логики дают обоснование усиленного режима надзора за деятельностью отдельных банковских групп.

Ключевые слова: банковская группа, кластерный анализ, канонический анализ, нечеткая логика, бизнес-модель банковской группы, режим банковского надзора

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Introduction. According to the world practice and expectations of the domestic regulator, enhancement of supervision efficiency on a consolidated basis is connected with analysis of business models of the banks and their banking groups.

The extension of the SREP methodology ("Guidelines on common procedures and

methodologies for the supervisory review and evaluation process") [1] to the field of the consolidated supervision requires a supervisory body to carry out a four-stage evaluation procedure: 1. BM - Analysis and assessment of business model. 2. CG - Assessment of internal governance and institution-wdie controls. 3 CAP - Assessment of risks to capital (credit, market, interest and operating). 4. LIQ - Assessment of risks to liquidity and financing.

According to the laws of Ukraine on regulation of activities of banking groups, the above-mentioned stages 3 and 4 have been formalized [2, 3] and are being implemented towards 34 consolidated financial market participants, which are recognized by National Bank of Ukraine (NBU) as of October 01, 2018; stage 2 is being implemented satisfactorily; stage 1 - Analysis and assessment of business model - is being carried out partially under the internal procedure of the NBU, however, it is not supported methodologically either by the procedure of identification and recognition of banking groups in Ukraine or by the procedure of regulating their activities. Identification of the ownership structure of the banking group may be considered an expedient analytical procedure with certain restrictions. Firstly, this procedure does not ensure the comparability of subjects of assessment (banking groups). Secondly, it does not allow the use of mathematical tools for assessing viability of the business model and determining sustainability of the development strategy.

We proceed from the fact that some banking groups implement similar business models and risk concentration areas (threats to the stability of the banking system) that can be objectively detectable by statistical means.

Analysis of research and problem statement. The concept of a business model was first mentioned in scientific works in the 1950s; this concept received further development in the context of the description of the digital economy in the 2000s and it became actual with regard to the activities of offline companies in the 2010s. Despite the widespread use of the term "business model" in economic research, up to this day the interpretation of the concept for scientific pruposes and applications is quite broad. For instance, the article "Methodology of system analysis of the concept of business model" [4] otlines six approaches to the interpretation of the essence of the concept of "business model", namely as the logic and economic model of business functioning (economic approach); in the context of internal business processes and operations (operational or procedural approach); as an option of a marketing strategy; as a set of interconnected elements from the spheres of strategy; as a closed system or structure (desing); as a dynamic system.

Our conducted analysis of the scientific studies on business models as an economic phenomenon allows to talk about (1) the lack of a single academic definition of a company's “business model” at present and (2) shift of the emphasis in this field from the conceptual understanding of a business model as a specific way of "earning money" to the economic mechanism of its functioning, and further, to finding the factors that ensure the development (innovation) and the long-term stability of business models.

The first systematic study of 26 business models of European banking institutions was carried out by Ayadi (2010) [5]. Since then, the banking business model of some scientists tend to an economic model for obtaining (structure) profits, while others tend mainly to the methods of forming financial resources and management thereof, the third ones tend to the balance of active and passive operations and the preservation of liquidity; the fourth ones focus on the client component of banking intermediation. Based on their "vision" of the banking business model, researchers perform their structuring.

Research on banking business models conducted by Llewellyn D. [6], Straw R. [7], Angus W.H. Yip, Nancy M.P. Bocken [8] also have their own specifics: (1) it is mainly descriptive and (2) it has similar defects in the decomposition of the structure as a company’s business model being presented as a more general concept.

The methods of researching banking business models by different scientists also vary. In the works of Roengpitya R., Tarashev N., Tsatsaronis Kostas [9], Farn. M., Vouldis A. [10], Ayadi R., De Groen WP, Sassi I., Mathlouthi W., Rey H., Aubry O. [11] the traditional method of studying business models is a cluster analysis based on a variety of indicators and, at the same time, the

number banking business models varies from 3 to 8, typically their number is 4-5. Most often the authors identify 3 business models: a commercial bank funded by the retail business; commercial bank financed by wholesale trade; a markets capital-oriented bank. Also, in the banking business model research methodology, qualitative methods such as semi-structured interviews or expert evaluations followed by statistical processing of a large amount of data are often used (such as Angus W.H. Yip, Nancy M.P. Bocken [8]).

The cluster analysis of the Ukrainian banking sector on the basis of the Kohonen self-organizing map (SOM) was carried out by Rashkovan V., Pokidin D. [12]. The authors identified six business models, which are typical of the Ukrainian banking system (Households-corporations, Retail, Universal, Corporate, Investment, Frozen/Undefined banks), investigated the crisis transformation of the banking sector; built the authors' risk map of the Ukrainian financial market, which allows to evaluate specific business model and predict a possible default of a particular bank.

Following the most indicative methodological studies of banking business models, we see that the focus of scientists is on explaining specific behavior of representatives of different groups of financial institutions (so-called clusters and/or models), and the most applied stratification tool is applying the cluster analysis methods. At present, the article authors are unaware of applying cluster analysis towards the activities of banking groups.

The main objective of the research is to identify business clusters (banking models) typical of the banking system of Ukraine, to evaluate specific risk-stability combinations for each cluster, and to develop recommendations for enhanced consolidated supervision over problematic banking groups.

The source of statistical data was the data sample from the arrays of the National Bank of Ukraine [14], statistical reporting of the banks [15] and consolidated reporting of banking groups for the period January 01, 2014- July 01, 2018. As arguments for functional modeling, the indicators calculated by the authors on the basis of the above-mentioned statistical data were used, and, if required by the method, they were normalized. The analysis of the economic indicators of business models of banking groups is largely based on the statistics of banks-centers of banking groups, since the share of assets of such banks in the assets of the group is 94.2 - 100.0% for the overwhelming majority of the data sample [13].

Data clustering methods [16, 17] were used to define business models of banking groups; canonical correlation analysis was used for assessment of sustainability risks of banking groups; Fuzzy Logic methods were used to determine banking supervision over the participants in the banking group. The calculations werre made in the software environments STATISTICA 10 and MATLAB R2017a.

Research results. The obtained results (1-3) correspond to the declared objective of the research, i.e. increase of efficiency of the consolidated banking supervision and they provide for the following stages:

1. Defining specifics of business models of banking groups in Ukraine. At the descriptive stage of the study of banking groups by using the data clustering method, their clustering - breakdown of the set of recognized banking groups into non-intersecting subsets (clusters) - has been performed, so that each cluster contains similar objects, and objects of different clusters differ. The object of clustering is the banking group, which is described by the vector (indicators) of the general type (1):

$$X = \{x_1, x_2, \dots, x_p\}, \quad (1)$$

where $x_1, x_2, \dots$ are specific indicators that characterize a bank; p is a number of characteristics that defines dimensionality of characteristics space.

We have a hypothesis regarding the number of clusters: there should be no more than 4 clusters (observations numbers and p=8 variables). Thus, as of January 01, 2014 we have 29 banks out of 30, which are centers of banking groups.

In order to group the banks according to the models of their behavior, **by using the k-means method** we select the banks that have systemic significance (the market share is more than 5% and is

constantly growing), namely PJSC CB "PRIVATBANK", JSC "OSCHADBANK", JSC "Raiffeisen Bank Aval" in a separate cluster. Accordingly, the banking groups, where these banks are the centers, must be classified into a separate cluster.

Other clusters will be formed on the basis of indicators descyвribing the business model of the banks' behavior. Taking into account the experience of scientists Roengpitya R., Tarashev N., Tsatsaronis Kostas [9], Farn M., Vouldis A. [10], Kasatkina T., Plahotha A. [18] and the specifics of the funding of domestic banks, we form the list of indicators that describe the business model to the fullest extent possible: share of gross loans in gross assets,%; share of loans of legal entities in the amount of loans (on a gross basis),%;share of funds of individuals in liabilities, %; share of legal entities' funds in liabilities, %; characteristics of the bank on the interbank market (the difference between active and passive transactions on the interbank market to the amount of liabilities, in %); share of subordinated debt,%; share of domestic government loan bonds,%; ROA,%.

Comparison of the results of clustering by k-means method on different statistical data gives unstable clusters (a pendulum change in the positions of individual banking groups) and can not be attributed only to the change in the business model of bank, which is a participant of the banking group. In addition, the revealed disadvantage of the clustering method was that one cluster (cluster 4) hit the banks with different approaches to financing and placement of funds, in particular PJSC "MEGABANK" and PJSC "BANK FORWARD". The first bank mainly grants loans to corporate clients, and the second bank is an example of exclusively retail lending. Thus, the method of mathematical clustering built on minimizing the Euclidean distance does not allow to achieve the objective of the research, since it is difficult to explain the obtained results from an economic point of view.

As an alternative clustering method, we will use **the grouping by using standard statistical methods** (taking into account factor levels $x_1 - x_8$) with the following logic of building a banking business model:

− cluster 1 – a universal model – should unite banks, which are characterized by: approximately equal shares of loans to individuals and corporate clients - 40-50% each, the same proportions are characteristic of the resource base, but at the same time, in its funding the bank relies little on sub-debt or other liabilities than the liabilities of individuals and legal entities;

− cluster 2 – a corporate model – is inherent to the banks, where the share of loans granted to legal entities in the loan portfolio (gross) is more than 85%, but at the same time, the share of funds of individuals in liabilities is less than 30-35%;

− cluster 3 – a corporate model with retail financing – is typical for banks, where the share of corporate loans in assets exceeds 40%, but, at the same time, the share of funds of legal entities in liabilities is less than 50%;

− cluster 4 – a retail model - the share of funds of individuals in liabilities is more 50%, and, at the same time, the share of loans to corporate clients is less 5%.

− cluster 5 – a non-typical functional - unites the banks, for which the share of gross loans in assets is less than 50%, but, at the same time, the assets, which are non-typical for banking business, prevail in the structure of assets (a significant amount of fixed assets, investment property, more than one third of assets is in securities, etc.).

Table 1 contains the results of calculations in the software STATISTICA 10.

There are grounds to consider that the latest clustering of banking groups (according to business models) is clustering that describes the type of economic behavior of their participants more successfully, reflects the specifics of formation of the resource base and the way the assets are used and a potential model of financial risks - Table. 2.

Thus, in comparison with other models, in general the best indicators of profitability (in terms of ROA) are common for the universal model of banks in Ukraine. This model is characterized by almost equal share of funds of individuals (46.33%) and legal entities (43.08%) in liabilities. At the same time, the banks of this business model rely on domestic government loan bonds by almost 10% in assets.

Table 1.

Statistical grouping of the banks pursuant to the factors, as of July 01, 2018

Name of the business model and the amount of the banks therein	Names of the banks – responsible entities of banking groups
Universal (8)	PJSC CB "PRIVATBANK", JSC "Raiffeisen Bank Aval", JSC "UkrSibbank", OTP BANK JSC, JSC "ALFABANK",PJSC "FUIB", TASCOMBANK JSC, JSC "Kredobank"
Corporate (7)	JSC "VTB BANK", PJSC "ING Bank Ukraine", Pivdennyi Bank,UKRCONSTINVESTBANK JSC, PJSC BANK ALLIANCE, JSC "CRYSTALBANK ", PJSC "BANK VOSTOK"
Corporate with retail financing (9)	JSC "OSCHADBANK" , PJSC "MEGABANK", PJSC "BANK SICH", PJSC "BANK "UKRAINIAN CAPITAL", JSC "BANK "GRANT", PJSC "INDUSTRIALBANK", JSC "ASVIO BANK", JSC "CIB", JSC "COMINVESTBANK"
Retail (1)	(earlier - RUSSIAN STANDARD), PJSC "BANK FORWARD"
Non-typical functional (5)	PJSC "BANK ¾", JSC "MOTOR-BANK", JSC "UNEX BANK", PJSC "BANK AVANGARD", PJSC "Commercial bank "Trust-capital"
Total (30 banks)	X

The source: calculated by the authors

Table 2

The average values of factor indicators pursuant to the business models (July 01, 2018)

Model type	Share of gross loans in gross assets,%	Share of loans of legal entities in the amount of loans,%	Share of funds of individuals in liabilities, %	Share of legal entities' funds in liabilities,%	Characteristics of the bank on the interbank market	Share of subordinated debt,%	Share of domestic gvernment loan bonds in balance-sheet total, %	ROA, %
Universal model	62,49	74,25	46,33	43,08	11,99	1,76	9,68	5,54
Corporate model	64,69	94,99	30,38	52,53	-0,25	0,21	1,82	-2,13
Corporate with retail financing model	60,07	95,48	51,42	38,36	6,29	0,68	7,92	2,63
Retail model	72,81	2,47	77,28	1,00	-13,77	0,00	0,00	-8,22
Non-typical functional	32,88	82,20	28,85	57,30	15,45	0,00	17,53	1,72

The source: calculated by the authors on the basis of the NBU data

The banks of corporate and corporate with retail financing models place the majority of their assets in corporate loans. On the interbank market they have less relative activity compared to other models. The corporate with retail financing model is profitable (ROA is 2.63% on average), the corporate model is loss-making (ROA is minus 2.13% on average).

Non-typical functional model is the least banking model, but it is a profitable business (ROA is 1.72% on average). The banks of this group are ther most active on the interbank market, they have the largest share of domestic goverrnment loan bonds in a balance-sheet total (17.5%) among other business models and they largerly do not acquire the subordinated debt.

2. Necessity to assess stability of banking groups arise from the legislative definition of consolidated supervision in the Law of Ukraine "On Banks and Banking Activity" [19] being a supervision performed by the NBU over a banking group, in order to ensure stability of the banking system and limit the risks, to which the bank is exposed as a result of participation in the banking

group, by regulating, monitoring and controlling the risks of a banking group in the manner defined by the NBU.

In order to assess stability of the banking groups, we will apply canonical correlation analysis to a pair of sets of variables "RISK-STABILITY". Such a task of identifying the equation of interconnection between two complex concepts can be solved either by canonical analysis or using structural modeling equations. Due to greater ease of use and perception, we will use the canonical analysis method.

The guidelines [16] recommend the number of observations 20 times greater than the number of variables. We propose to include 7 variables, i.e. 160 observations are minimum required and this is achieved by the statistics available at our disposal (for the entire data array: 19 quarters * 30 banks = 570 observations> 140 observations). For the smallest group (non-typical functional): 19 quarters * 5 banks = 95 observations. That is, this sample is not small, but the results can not be considered absolutely reliable, since: 95 observations <140 observations. The group representing the retail model is excluded, since it contains 1 bank PJSC "BANK FORWARD". But the statistics of the bank was included in the indicators of the entire data array.

In the canonical analysis the left and right sets are represented by "canonical scales" for "RISK" and "STAB". In particular, the following indicators are included in the “RISK” set: the ratio N4 (quick ratio), the ratio N7 (ration of maximum amount of credit risk per counterparty), the analogue of the limit L13 (net foreign exchange position limit), Prov/As indicator (share of reserves in the total assets ,% "). The set of "STAB" is formed out of indicators: the ratio N2 (regulatory capital adequacy ratio), ROA (return on assets in %), Share (market share indicator).

The described canonical dependence is as follows (2-3):

$$STAB = f(RISK), \tag{2}$$

$$a_0 + a_1 \cdot Z_{H2} + a_2 \cdot Z_{ROA} + \cdot a_3 \cdot Z_{Share} = \\ = f(b_0 + b_1 \cdot Z_{H4} + b_2 \cdot Z_{H7} + \cdot b_3 \cdot Z_{Prov/As} + \cdot b_4 \cdot Z_{,713-\alpha}), \tag{3}$$

where a_i is parameters under the indicators of the left set of the canonical equation; b_i is parameters under the indicators of the right set of the canonical equation.

Before calculations, all variables were normalized. The presence of outliers has a significant impact on the results of the canonical analysis, so they were excluded from the calculations. The result is obtaining of canonical equations (table 3), the basis of which are so-called "canonical scales", which is the contribution of a certain variable in its value of canonical variable.

The calculations show that the canonical variable RISK for the entire data array and for most groups is most affected by the Prov/As variable (except for the Group of Non-typical functional, where the quick ratio N4 comes first, and the influence of Prov/As is the smallest). In the canonical variable STAB, the most impact is made by the return on assets (ROA) for the majority of the groups with the exception of the last two groups: Corporate with retail financing model and Non-typical functional.

The maximum number of canonical roots corresponds to the smallest number of variables in two sets, in our case these are three. We check the significance of the criteria χ^2 and the level of significance (*p*-level) in the tab "Canonical factors: Statistics χ-square for canonical roots." For all business models, *p*-level is within 0.001-0.032, which is lower than the adopted threshold for economic research α = 0.05. This conclusion about the significance of the results obtained can also be given by the criterion χ^2, which did not acquire a value of less than 22.5 (and even much higher) for any business model, which with a critical/tabular, with 12 degrees of freedom, χ^2 of the table (0.05; 12) = 21.0 actually confirms the proper quality of the calculations (Table 4).

Table 3

"Canonical scales" for RISK and STAB (right and left sets)

	RISK (right set)				STAB (left set)		
	root 1	**root 2**	**root 3**		**root 1**	**root 2**	**root 3**
Entire array							
N4	-0,1128	-0,9450	0,0917	**N2**	-0,1100	-1,0064	0,2998
N7	0,0129	0,1916	-0,5671	**ROA**	0,8809	0,2499	0,4535
Prov/As	0,9568	-0,0408	-0,3506	**Share**	-0,4777	0,0519	0,9169
L13-a	-0,2372	-0,2088	-0,7404				
Universal model							
N4	-0,1049	0,4833	-0,1502	**N2**	-0,5194	-0,5702	-0,7367
H7	0,2073	0,8738	0,3286	**ROA**	0,7326	-0,6061	0,4826
Prov/As	0,8124	0,1145	-0,6117	**Share**	-0,6663	-0,3377	0,6685
L13-a	0,3964	-0,3877	0,7472				
Corporate model							
N4	-0,1236	-1,0281	-0,0282	**N2**	-0,0446	-1,0190	-0,3036
N7	0,2803	0,3132	-0,8972	**ROA**	-0,9525	0,2756	-0,3752
Prov/As	-0,5714	0,4040	-0,0042	**Share**	0,1008	-0,0022	-1,0937
L13-a	0,3670	-0,1268	1,0162				
Corporate with retail financing model							
N4	0,0534	-0,6105	-0,8005	**N2**	0,0917	-0,7405	-0,8298
N7	0,1240	0,3851	-0,2676	**ROA**	0,0066	-0,5272	1,0437
Prov/As	0,9922	0,0971	0,1505	**Share**	-0,9683	-0,4940	0,1513
L13-a	-0,0960	-0,7475	0,5982				
Non-typical functional							
N4	0,6760	-0,1534	-0,7585	**N2**	0,9465	-0,5280	-0,3286
N7	-0,4698	0,1725	0,1209	**ROA**	0,0646	0,1024	1,0374
Prov/As	0,0862	-0,8918	0,5090	**Share**	-0,0871	-1,0968	-0,0784
L13-a	0,3240	0,3331	0,9604				

The source: calculated by the authors

Table 4

Quality indicators of the obtained canonical models

Set	Canonical R	χ^2	*p*-level	Obtained variances (right set), %	Obtained variances (left set), %
Entire array	**0,7369**	**208,12**	**0,0000**	**78,6**	**100**
Universal model	0,7097	38,7	0,0001	76,8	100
Corporate model	0,9578	118,6	0,0000	85,6	100
Corporate with retail financing model	0,8295	73,3	0,0000	72,5	100
Non-typical functional	0,6911	22,5	0,0322	77,1	100

The source: calculated by the authors

Check of the normal type of the amplitudes of oscillations of the canonical model's indicators was confirmed by the "Chart of Amplitude" in the "Canonical Analysis" package (figure 1).

In the context of banks, the following baks (for the general trend) have the worse "risk-stability" ratio for their business model: for the universal model - PJSC "FUIB", JSC "ALFABANK", for the corporate model - JSC "VTB BANK"; for corporate with retail financing model - JSC "OSCHADBANK", sich; for non-typical functional - PJSC "BANK ¾".

As we can see, the share of the explained variance of one set at the expense of another is from 50% in all business models. For a large number of observations (n> 200), the result is considered acceptable when the canonical correlation is R = 0.30 (R^2= 0.09), that is, in fact, only the tenth part of the oscillations of the canonical variable is explained.

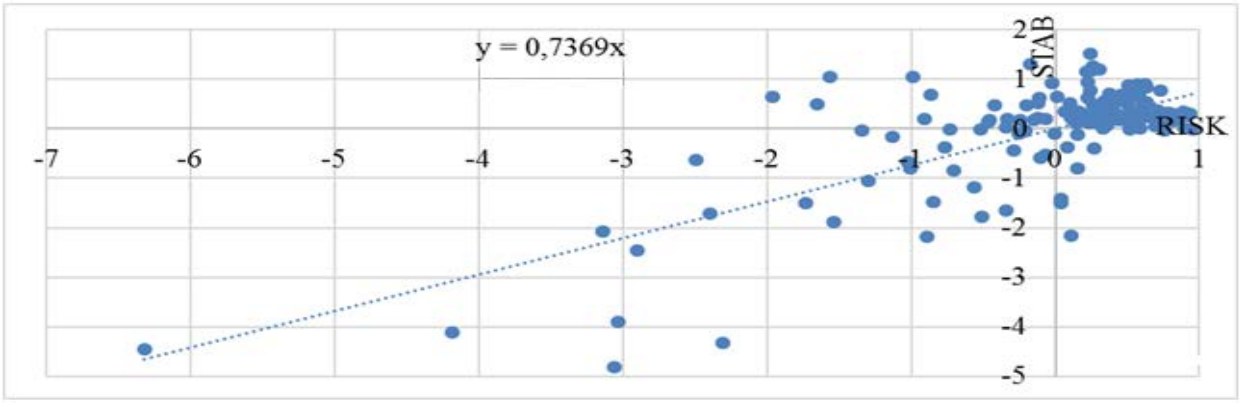

Fig. 1. Canonical correlation of RISK and STAB for the entire data array

3. Defining banking supervision under participants of the banking group. The grounded above necessity of the primary control over the risks of individual banks-centers of the banking groups requires a systematic approach to determining the depth and frequency of supervision. According to the established practice, NBU carries out inspections and off-site supervision. The frequency of inspections depends on the size of the bank-participant of the banking group (its value for the system) and the risks in the activities (but not more than once a year). Off-site supervision is an analysis of the bank's performance according to the statistical reporting (daily, monthly, quarterly), trend analysis and comparison with the peer group, and from 2018 it is conducted on an annual basis under the SREP system (the effectiveness of the last system for prudential supervision in Ukrainian practice is still unknown) .

Following the principle of proportionality with respect to the volume, frequency and intensity of banking supervision [1, p. 2.4] / (clause 2.4 SREP, 2014)/ within a homogeneous cluster, we formalize the decision-making process with the fuzzy logic approach implemented in the MATLAB R2017a package of numerical analysis application programs.

The statistical base of this part of the research will be formed according to the following criteria: (1) the size of the bank (large, medium and small); (2) change in the size of regulatory capital; (3) change in the amount of attraction of deposits from the population. The first indicator is determined by the SREP method as a criterion for determining the categories of banks, the other two are the most indicative for the system of rapid response to the deterioration of the financial condition of the banking institution. For a long time, there is a well-established practice of the National Bank of Ukraine for off-site supervision, namely the immediate intervention of the regulator in the bank's activities in case of a sharp (≥10%) decline in regulatory capital within a month. Simultaneous rapid (≥10%) increase of attraction of deposits from individuals (at higher interest rates) shows the attempts of the bank to "fill gaps" in liquidity. The latter is also a signal to the NBU's early reaction.

As input indicators, we will consider three fuzzy linguistic variables: for the first variable "size", we use the set of terms T_1 = *{«large», «medium», and «small»}* with the corresponding interval values of the bank's share in the banking group *{more than 5% »; "from 1% to 5%"; "less than 1%"}*; for the second variable "*change in % of the regulatory capital"/capital* we use the set T_2 = *{"catastr_decrease", "decrease", "growth capital"}*, subject to the corresponding change in regulatory capital *{"falling more than 10%"; "drop from 0 to -10%"; "growth"}*; for the third variable "change in % of the amount of attraction of deposits from individuals"/*deposits* we use the set T_3 = *{"decrease_deposits", "medium_growth_deposits", "fast_growth_deposits"}* under the condition of {"decrease"; "growth from 0 to 10%"; "growth of more than 10%"}.

Output variable *supervision* will have the following terms: "enhanced supervision" - or "*frequent*"; supervision under the usual procedure "*normal*"; monitoring of control indicators is "*less_often_than_usual*".

For description of distribution, *gauss2mf*, two-sided Gaussian membership function (4) with

two output arguments is used:

$$y = gauss2mf(x, params), \quad (4)$$

where x is the vector,for which coordinates it is necessary to calcuate the degree of membership; $params$ is the vector of parameters of membership function. The order of parameter input assignments is [a1 c1 a2 c2].

The statistical data array is formed on a monthly basis from 2017 to 2018), which is 13 dates and 12 periods for comparison. Data on the balances of term funds of individuals (acc. 2630) were received from the balance lists of the banks [14]; data on regulatory capital from [20]; the bank's share in banking sector assets is calculated according to [14]. The results obtained are illustrated in Table 5.

Table 5

Calculated frequency of supervision (fragment of maximum values)

Names of the banks – responsible entities of banking groups	Bank' share in the assets of sector, %	Bank size	Growth rates of regulatory capital, %	Growth rates of depostis of individuals, %	Calculated frequency of supervision
PJSC BANK ALLIANCE	0,12	small	-2,6	12,89	**0,845**
JSC "ASVIO BANK"	0,06	small	1,0	6,86	0,500
JSC "COMINVESTBANK"	0,10	small	-4,7	1,99	0,500
PJSC "BANK "UKRAINIAN CAPITAL"	0,06	small	0,3	3,52	0,500
JSC "UNEX BANK"	0,06	small	-1,2	1,27	0,500
JSC "CIB"	0,06	small	0,1	11,05	0,500
PJSC "BANK VOSTOK"	0,61	small	1,8	21,69	**0,840**
UKRCONSTINVESTBANK JSC	0,07	small	0,0	16,44	0,535
PJSC "BANK ¾"	0,08	small	2,4	1,02	0,500
JSC "CRYSTALBANK "	0,09	small	13,9	0,99	0,500

The source: calculated by the authors according to the data of internal statistics of the banks

Thus, two banks have the highest indicator of *supervision*: PJSC BANK ALLIANCE (0.845) and PJSC "BANK VOSTOK" (0.840). They require a comprehensive risk analysis. At the same time, at the latest date (September 01, 2018), none of the banks -centers of the banking groups has the value of fuzzy variable *supervision* near 1.0, and this indicates their stability and viability of business models.

Statistical In the future, it is proposed to revise the supervisory regime of the bank with high values of the fuzzy variable of supervision frequency "*supervision*" (0.75-1.0) from ordinary to enhanced, i.e. to make appropriate changes to supervisory actions, in particular, to establish requirements for the bank's activities, to provide recommendations for improvement of activities, initiation of inspection checks, appointment of a supervisor, etc. The proposed measures will allow to respond quickly to problems in banks with high value *supervision*.

Література

1. Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP). EBA/GL/2014/13. — 2014. — December 19. — P. 1—218.
2. Про затвердження Положення про порядок ідентифікації та визнання банківських груп : Постанова від 09.04.2012 № 134 [Електронний ресурс] / Національний банк України. — Режим доступу : http://zakon.rada.gov.ua/laws/show/z0708-12/print.
3. Про затвердження Положення про порядок регулювання діяльності банківських груп : Постанова від 20.06.2012 № 254 [Електронний ресурс] / Національний банк України. — Режим доступу : http://zakon.rada.gov.ua/laws/show/z1178-12/print.
4. Стрекалова Н. Д. Концепция бизнес-модели: методология системного анализа / Н. Д. Стрекалова // Известия Российского государственного педагогического университета имени А. И. Герцена. — 2009. — № 92.
5. Ayadi, R., E. Arbak and W. P. de Groen. Business Models in European Banking: A pre-and post-crisis screening

[Electronic resource] / R. Ayadi, E. Arbak, W. P. de Groen. — Brussels : Centre for European Policy Studies (CEPS), 2011. — Available at : http://rymayadi.com/wp-content/uploads/2014/11/Business-Models-in-European-Banking.pdf.

6. Llewellyn D. The Evolution of Bank Business Models: Pre and Post-crisis [Electronic resource] / D. Llewellyn ; Loughborough University. — 2012. — Available at : https://www.researchgate.net/publication/254411125.

7. Straw R. Sustainable Banking. Fokus Financial Services. Audit Committee News [Electronic resource] / R. Straw // KPMG. — 2013. — Available at : http://www.kpmg.com/CH/Documents/ACNews/pub-20121220-06-sustainable-banking-de.pdf.

8. Yip A. W.H. Sustainable business model archetypes for the banking industry [Electronic resource] / Angus W.H. Yip, Nancy M.P. Bocken // Journal of Cleaner Production. — 2018. — Vol. 174. — February, 10. — P. 150—169. — Available at : https://doi.org/10.1016/j.jclepro.2017.10.190.

9. Roengpitya R. Bank business models [Electronic resource] / Roengpitya R., Tarashev N., Tsatsaronis K. // BIS Quarterly Review. — 2014. — December. — Available at : https://www.bis.org/publ/qtrpdf/r_qt1412g.pdf https://www.bis.org/publ/qtrpdf/r_qt1412g.pdf.

10. Farn M. Business models of the banks in the euro area / Farn M., Vouldis A. // European Central Bank. Working Paper Series No 2070. — 2017. — May. — P. 1—47.

11. Ayadi R. Banking Business Models Monitor 2014—2015 EUROPE [Electronic resource] / Ayadi R., De Groen W. P. — 2016. — Available at : http://institutcoop.hec.ca/wp-content/uploads/2017/10/Banking-Business-Models-Monitor-Europe-2015.pdf.

12. Рашкован В. Кластеризація бізнес-моделей українських банків: застосування нейронних мереж Кохонена / В. Рашкован, Д.Покідін // Вісник Національного банку України. — 2016. — № 238. — С. 13—38.

13. Миненко Л. М. Моделювання ефективності банківських груп у контексті консолідованого нагляду / Л.М. Миненко // Бізнес Інформ: Науковий журнал. — 2018. — № 5. — С. 334—342.

14. Показники банківської системи [Електронний ресурс] / Національний банк України. — 2018. — Режим доступу : https://bank.gov.ua/control/uk/publish/article?art_id=34661442&cat_id=34798593.

15. Інформація про визнані банківські групи [Електронний ресурс] / Національний банк України. — 2018. — Режим доступу : https://bank.gov.ua/control/uk/publish/article?art id=81452&cat id=57513.

16. StatSoft, Inc. Electronic textbook on statistics [Electronic resource]. — Moscow: StatSoft, 2012. — Available at : http://www.statsoft.ru/home/textbook/default.htm.

17. Romesburg C. Cluster Analysis for Researchers [Electronic resource] / C. Romesburg. — Morrisville, North Carolina: Lulu Press, 2004. — Available at : https://digitalcommons.usu.edu/envs_facpub/42.

18. Касаткіна Т. Аналіз бізнес-моделей банків у рамках процесу нагляду та оцінки (SREP) [Електронний ресурс] / Т. Касаткіна, А. Плахота ; НБУ (Семінар 18 травня 2018). – Режим доступу : https://bank.gov.ua/doccatalog/document?id=69900832.

19. Про банки і банківську діяльність : Закон України від 07.12.2000 № 2121-III [Електронний ресурс] / Верховна Рада України. — Режим доступу : http://zakon.rada.gov.ua/laws/show/2121-14/print.

20. Нормативи та складові розрахунку регулятивного капіталу станом на 01.09.2018 [Електронний ресурс] / Національний банк України. — 2018. — Режим доступу : https://bank.gov.ua/doccatalog/document?id=66304206/

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References

1. Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP). (2014, 19 December). 1–218.

2. National bank of Ukraine. (2012). Pro zatverdzhennia Polozhennia pro poriadok identyfikatsii ta vyznannia bankivskykh hrup : Postanova vid 09.04.2012 № 134 [On Approval of the Regulation on the Procedure for the Identification and Recognition of Bank Groups : Resolution, 09.04.2012 № 134]. Retrieved from http://zakon.rada.gov.ua/laws/show/z0708-12/print [in Ukrainian].

3. National bank of Ukraine. (2012). Pro zatverdzhennia Polozhennia pro poriadok rehuliuvannia diialnosti bankivskykh hrup : Postanova vid 20.06.2012 № 254 [. On Approval of the Regulation on the Procedure for Regulating the Activities of Bank Groups : Resolution, 20.06.2012 № 254]. Retrieved from http://zakon.rada.gov.ua/laws/show/z1178-12/print [in Ukrainian].

4. Strekalova N. (2009). Koncepciya biznes-modeli: metodologiya sistemnogo analiza [Business Model Concept: Methodology Of System Analysis]. Izvestiya Rossijskogo gosudarstvennogo pedagogicheskogo universiteta imeni A. I. Gercena — Proceedings of the Russian State Pedagogical University named after A. I. Herzen, 92. Retrieved from https://cyberleninka.ru/article/n/kontseptsiya-biznes-modeli-metodologiya-sistemnogo-analiza [in Russian].

5. Ayadi, R., Arbak, E. & De Groen, W. P. (2011). Business Models in European Banking: A pre-and post-crisis screening. Brussels: Centre for European Policy Studies (CEPS). Retrieved from http://rymayadi.com/wp-content/uploads/2014/11/Business-Models-in-European-Banking.pdf.

6. Llewellyn D. (2012). The Evolution of Bank Business Models: Pre and Post-crisis. Retrieved from https://www.researchgate.net/publication/254411125.

7. Straw, R. (2013). Sustainable Banking. Fokus Financial Services. Audit Committee News. KPMG. Retrieved from http://www.kpmg.com/CH/Documents/ACNews/pub-20121220-06-sustainable-banking-de.pdf.

8. Yip, Angus W.H., & Bocken, Nancy M.P. (2018). Sustainable business model archetypes for the banking industry. Journal of Cleaner Production, 174, 150—169. Retrieved from https://doi.org/10.1016/j.jclepro.2017.10.190

9. Roengpitya, R., Tarashev, N., &Tsatsaronis, K. (2014, December). Bank business models. BIS Quarterly Review. Retrieved from https://www.bis.org/publ/qtrpdf/r_qt1412g.pdf https://www.bis.org/publ/qtrpdf/r_qt1412g.pdf.

10. Farn, M., & Vouldis, A. (2017, May). Business models of the banks in the euro area. European Central Bank. Working Paper Series No 2070, 1—47.

11. Ayadi, R., & De Groen, W. P. (2016). Banking Business Models Monitor 2014—2015 EUROPE. Retrieved from http://institutcoop.hec.ca/wp-content/uploads/2017/10/Banking-Business-Models-Monitor-Europe-2015.pdf.

12. Rashkovan, V., &Pokidin, D. (2016). Klasteryzatsiia biznes-modelei ukrainskykh bankiv: zastosuvannia neironnykh merezh Kokhonena [Ukrainian Banks' Business Models Clustering: Application Of Kohonen Neural Networks]. Visnyk Natsionalnoho banku Ukrainy —Bulletin of the National Bank of Ukraine, 238, 13—38. Retrieved from https://bank.gov.ua/doccatalog/document?id=41706633 [in Ukrainian].

13. Minenko, L.M. (2018). Modeliuvannia efektyvnosti bankivskykh hrup u konteksti konsolidovanoho nahliadu [Banking

groups efficiency modeling in the context of a consolidated supervision]. Biznes Inform: Naukovyi zhurnal — Business Inform: Science Journal, 5, 334—342. Retrieved from http://business-inform.net/export_pdf/business-inform-2018-5_0-pages-334_342.pdf [in Ukrainian].

14. National Bank of Ukraine. (2018). Pokaznyky bankivskoi systemy [Indicators of the banking system]. Retrieved from https://bank.gov.ua/control/uk/publish/article?art_id=34661442&cat_id=34798593 [in Ukrainian].

15. National Bank of Ukraine. (2018). Informatsiia pro vyznani bankivski hrupy [Information about recognized banking groups]. Retrieved from https://bank.gov.ua/control/uk/publish/article?art_id=81452&cat_id=57513 [in Ukrainian].

16. StatSoft, Inc. (2012). Electronic textbook on statistics. Moscow: StatSoft. Retrieved from http://www.statsoft.ru/home/textbook/default.htm.

17. Romesburg, C. (2004). Cluster Analysis for Researchers. Morrisville, North Carolina: Lulu Press. Retrieved from https://digitalcommons.usu.edu/envs_facpub/42.

18. Kasatkina, T., & Plahotha, A. (2018). Analiz biznes-modelei bankiv u ramkakh protsesu nahliadu ta otsinky (SREP) [Analysis of business models of banks in the framework of the Supervisory review and evaluation process (SREP)]. Retrieved from https://bank.gov.ua/doccatalog/document?id=69900832 [in Ukrainian].

19. Verhovna Rada Ukrainy. (2000). Pro banky i bankivsku diialnist : Zakon Ukrainy vid 07.12.2000 № 2121-II [Law of Ukraine. On banks and banking activity, NO. 2121-III December 7, 2000]. Retrieved from http://zakon.rada.gov.ua/laws/show/2121-14/print [in Ukrainian].

20. National Bank of Ukraine. (2018). Normatyvy ta skladovi rozrakhunku rehuliatyvnoho kapitalu stanom na 01.09.2018 [Norms and components of the calculation of regulatory capital as of 01.09.2018]. Retrieved from https://bank.gov.ua/doccatalog/document?id=66304206 [in Ukrainian]

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