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THE COGNITIVE MODELING OF THE DEVELOPMENT OF THE UKRAINIAN BANKING SYSTEM

Abstract. The aim of the study is the analysis of the development of the banking system of Ukraine in the current economic and political conditions and identifying the opportunities of using the cognitive technologies for predicting its development. Methodical research tools include the cognitive modeling, which allows establishing a qualitative relationship between quantitative indicators. Testing of methodological tools was conducted on the example of the Ukrainian banks. It was analyzed the current financial position of the banking system of Ukraine with the help of the indicators of profitability, equity, liquidity, business activity. As a result the substantial worsening of indicators of basic performance of Ukrainian banks was discovered. It was investigated the possibilities of using cognitive models in bank's management for prediction the development of the banking system of Ukraine. It was proposed to use integrated assessment of financial stability of the Ukrainian banking system as a factor that reflects the level of its development. By using cognitive modeling intercommunication of indexes that characterize financial sustainability of Ukrainian banking system was investigated. It was founded that among the indicators of financial sustainability of Ukrainian banking system the most important is an index of correlation of clean open position in foreign currency to the capital. It was proposed to use the results of cognitive analysis in constructing scenarios of development of the banking system of Ukraine.

Keywords: banking system, equity, business activity, cognitive map, liquidity, profitability, liabilities.

JEL classification: C53, G21

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КОГНІТИВНЕ МОДЕЛЮВАННЯ РОЗВИТКУ БАНКІВСЬКОЇ СИСТЕМИ УКРАЇНИ

Анотація. Метою дослідження є аналіз розвитку банківської системи України в нинішніх економічних і політичних умовах і виявлення можливості використання когнітивних технологій для прогнозування її розвитку. Проаналізовано поточний фінансовий стан банківської системи України, в результаті чого виявлено значне погіршення показників діяльності українських банків. Запропоновано використовувати інтегральний показник фінансової стійкості української банківської системи як фактор, який відображає рівень її розвитку. За допомогою когнітивного моделювання досліджено взаємозв'язок показників, що характеризують фінансову стійкість банківської системи України. Виявлено, що серед цих показників найбільш впливовим є показник співвідношення чистої відкритої позиції в іноземній валюті до капіталу. Запропоновано використовувати результати когнітивного аналізу при побудові сценаріїв розвитку банківської системи.

Ключові слова: банківська система, капітал, ділова активність, когнітивна карта, ліквідність, прибутковність, зобов'язання.

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КОГНИТИВНОЕ МОДЕЛИРОВАНИЕ РАЗВИТИЯ БАНКОВСКОЙ СИСТЕМЫ УКРАИНЫ

Аннотация. Целью исследования является анализ развития банковской системы Украины в нынешних экономических и политических условиях и выявление возможности использования когнитивных технологий для прогнозирования её развития. Проанализировано текущее финансовое состояние банковской системы Украины, в результате чего выявлено значительное ухудшение показателей деятельности украинских банков. Предложено использовать интегральный показатель финансовой устойчивости украинской банковской системы как фактор, который отражает уровень ее развития. С помощью когнитивного моделирования исследована взаимосвязь показателей, характеризующих финансовую устойчивость банковской системы Украины. Выведено, что среди этих показателей наиболее влиятельным является показатель соотношения чистой открытой позиции в иностранной валюте к капиталу. Предложено использовать результаты когнитивного анализа при построении сценариев развития банковской системы.

Ключевые слова: банковская система, капитал, деловая активность, когнитивная карта, ликвидность, прибыльность, обязательства.

JEL classification: C53, G17, G21.

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Introduction. The acceleration of economic growth of the country and increase in investment in its economy largely depends on the efficiency of the banking system. However, the main indicators of Ukrainian banks in Ukraine remain low. So, for seven months of 2016 the total loss of Ukrainian banks reduced in 3.3 times compared to the same period last year and at 01.08.2016 it was 9.3 bln UAH (01.08.2015 the loss of Ukrainian banks was 30.2 bln UAH). At 01.08.2016 33 operating banks had losses in the amount of 16.6 bln UAH. 68 banks had earnings in the amount 7.4 bln UAH, including in July 75 banks had earnings in the amount of 1 bln UAH [1]. The main factors that determined the negative economic trends in the banking system of Ukraine in recent years were decline in purchasing power due to the reduction in real incomes; decline of foreign investments.

Literature review and the problem statement. Investigation of the problems of the banking system in Ukrainian scientific literature is given significant attention. The scientific works of I. Blahun [2], I. Dyakonova [3], A. Epifanov [4], V. Kolobov [5] O. Kolodiziev [6; 7] are dedicated to this issue. In the work of I. Blahun [2] it is grounded the necessity of development of mechanism of forming of strategies of the banking system in connection with the problem of practical providing of efficiency of development of banks both on macro- and at microeconomic level. The work of I. Dyakonova [3] is dedicated to the exposure of weak points and foreground tasks for further development of the banking system of Ukraine. The methodological components of an effective bank's sector development and its co-operating with the real sector of national economy are investigated in the work of A. Epifanov [4]. The modern problems of development of the banking system of Ukraine are investigated in the work of V. Kolobov [5]. In the work of O. Kolodiziev [6] it was proposed the system of indexes of estimation of the bank's financial planning that can be used as a base of formation of financial plans. In the work [7] the multilevel system of indexes of financing of innovative activity was formed that will assist to development of the bank's sector.

Due to the complexity and dynamism of current economic and political processes it is insufficiently illuminated the issues of application of advanced modeling techniques for predicting trends in the banking system of Ukraine. This determines the choice of the topic and confirms its relevance.

The aim of the article is to identify the opportunities of using the cognitive technologies for predicting the development of the banking system of Ukraine.

Research results. One of the main factors ensuring the proper development of the country's financial system is an effective functioning of banking institutions. The banking system influences on regional development, creates conditions for active investment activity, ensuring the proper financing of enterprises and increasing the standard of living of the population.

In order to justify the need of forecasting of the development of the banking system of Ukraine it was considered its current financial condition by using the indicators of profitability, equity, liquidity, business activity.

During 2007-2016 the return on assets of Ukrainian banks didn't exceed 10%, at 01.01.2016 p. it reached its minimum value (-1.91%), which indicates inefficient use of assets of domestic banks. The return on equity was also low during the studied, and since the beginning of 2014 it began to decline rapidly to -51.91% at 01.01.2016.

To analyze the equity of Ukrainian banks it was compared its pace of growth with the pace of growth of Ukraine's GDP during 2007-2015 [8]. During 2007-2009 the pace of growth of the own capital of Ukrainian banks ahead the pace of growth of Ukraine's GDP, during 2010-2011 the situation is reversed, and during 2012-2013 the pace of growth of these indicators differed slightly. However, in 2014 the pace of growth of the own capital of Ukrainian banks amounted 76.88%, i.e. the amount the own bank's capital in Ukraine has decreased by 23.12%, due to which the pace of growth of GDP exceeded the pace of growth of the own capital of Ukrainian banks. A similar situation was observed in the following year.

The distribution of Ukrainian banks in the share of equity in liabilities is unequal: in the considerable number of Ukrainian banks (40 of 108) the share of equity in liabilities is from 0 to 20%, in one bank (PJSC CB "Financial initiative") this index is negative, while in 20 banks the equity exceeds liabilities. Exponential distribution of Ukrainian banks in magnitude of the equity and unequal distribution of Ukrainian banks in the share of equity in liabilities confirms the conclusion about substantial bank's differentiation in the analyzed indicators.

To analyze the liquidity of Ukrainian banks the dynamics of banks' liquidity norms was reviewed [9]. During 2007-2016 the attained values of the index of the instant liquidity, which characterizes ability of bank to provide timely implementation of the bills of debt due to its highly liquid assets, exceeded a

norm more, than twice. Analogical tendencies are traced in relation to the values of indexes of current and short term liquidity that testifies to surplus of liquidity of banks, their inability to place resources effectively.

For the analysis of the business activity of Ukrainian banks the distribution of domestic banks by the indicator of the share of the credit portfolio in assets was considered. As of 01.07.2016 10 banks of Ukraine had maximum large share of the credit portfolio in assets, and 20 banks had maximum small value of this index by comparison to a middle level in the banking system (60%). Analysis of the values of the share of the credit portfolio in assets suggests the need to improve the business activity of domestic banks.

Thus, the analysis of the financial state of domestic banks enabled to find out the substantial worsening of basic indicators of their performance, in fact the domestic banking system tested considerable shocks as a result of soldiery events on east of country. The marked testifies that for gradual renewal of the banking system it is necessary not only to perfect the bank's anticrisis management but also apply the modern methods of prognostication of its development.

In the conditions of non-stationary external environment the mobility of economic systems grows. For this reason for prognostication of development of the Ukrainian banking system the application both adaptive methods prognostication and modern technologies of cognitive modeling is appropriate, which foresee realization not so much quantitative analysis of the proper indexes, but also quality analysis.

The method of construction of cognitive maps [10] involves the construction of the oriented count the ribs of which are represented by links between the elements of the system (concepts, i.e. indexes that have the greatest impact on the system) and can acquire one of three values [11, p. 14]: +1 (positive influence of one concept on the second); -1 (negative influence); 0 (absence of cause and effect connections between concepts). As model factors the indicators of financial sustainability were selected. There are indexes of current financial status and sustainability of financial institutions of country and their counterparties from to the sector of non-financial corporations and sector of house keepings [12].

In the process of construction of the cognitive model it follows to select the followings factors: base factors, which describe financial sustainability of the banking system, i.e. the indicators of financial sustainability; factor-indicator, which represents the level of development of the banking system of Ukraine. It is proposed to choose the integral estimation of financial sustainability as a factor-indicator. The results of calculation of the integral index of the financial sustainability of the Ukrainian banking system are shown in Table 1.

Table 1

The integral index of financial sustainability of the banking system of Ukraine

Code	The indicator	The standardized value of the indicator											
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	The first half of 2016
11	The ratio of the regulatory capital to the risk-weighted assets	-0,39	-0,17	1,57	1,67	0,97	0,88	-0,91	0,77	-0,25	-1,02	-0,73	-0,36
12	The ratio of the regulatory capital of the 1 level to the risk-weighted	-0,67	-0,49	1,77	1,76	1,10	1,03	-0,17	-0,41	-0,68	-1,11	-0,53	-0,08
13	The ratio of non-performing loans excluding capital reserves to the	-0,77	-0,82	1,47	1,14	1,03	0,98	-0,06	-0,23	-0,98	-1,03	-0,47	-0,51
14	The ratio of non-performing loans excluding capital reserves to the total gross loans	-0,74	-0,35	-0,84	-1,22	0,86	0,81	-0,57	-1,72	-1,24	-1,29	-0,04	0,11
16	The rate of return on assets	0,76	1,03	-0,67	-0,69	-1,33	-1,00	1,29	-0,16	-1,00	-1,18	-0,14	0,22
17	The rate of return on capital	1,78	1,43	-0,69	-0,61	-0,22	-0,07	1,20	-0,01	-0,16	0,83	-0,29	0,95

Continuation of Table 1

I18	The ratio of the interest margin to the gross income	1,07	0,93	-0,72	-0,64	0,08	0,16	0,85	1,21	-0,18	0,96	-0,58	1,02
I19	The ratio of non-interest expenses to the gross income	0,76	0,83	-0,64	-0,54	0,50	0,46	0,98	-0,09	0,22	0,80	-0,71	1,15
I10	The ratio of the liquid assets to the total assets	0,83	0,88	-0,68	-0,74	0,42	0,40	0,31	0,76	0,05	0,76	-0,61	1,16
I11	The ratio of the liquid assets to the short term liabilities	-0,15	-0,32	-0,45	-0,41	-1,26	-0,93	-0,90	-0,40	0,70	0,65	-0,07	-0,68
I12	The ratio of the net open position in foreign exchange to the capital	-1,37	-1,62	0,07	0,07	-1,74	-2,26	-2,03	-1,44	1,45	0,89	2,22	-2,22
I13	The ratio of capital to the assets	-1,10	-1,33	-0,20	0,20	-0,41	-0,46	0,00	1,71	2,07	0,74	1,93	-0,76
I14	The ratio of the big net open position in foreign exchange to the capital	-0,39	-0,17	1,57	1,67	0,97	0,88	-0,91	0,77	-0,25	-1,02	-0,73	-0,36
I18	The ratio of the trading income to the gross income	-0,67	-0,49	1,77	1,76	1,10	1,03	-0,17	-0,41	-0,68	-1,11	-0,53	-0,08
I19	The ratio of the staff costs to the non-interest expenses	-0,77	-0,82	1,47	1,14	1,03	0,98	-0,06	-0,23	-0,98	-1,03	-0,47	-0,51
I20	The spread between rates on loans and deposits (basis points)	-0,74	-0,35	-0,84	-1,22	0,86	0,81	-0,57	-1,72	-1,24	-1,29	-0,04	0,11
I21	The spread between the highest and the lowest interbank rates (basis points)	0,76	1,03	-0,67	-0,69	-1,33	-1,00	1,29	-0,16	-1,00	-1,18	-0,14	0,22
I22	The ratio of the customer deposits to the total gross loans (excluding interbank)	1,78	1,43	-0,69	-0,61	-0,22	-0,07	1,20	-0,01	-0,16	0,83	-0,29	0,95
I23	The ratio of the foreign currency loans to the total gross loans	1,07	0,93	-0,72	-0,64	0,08	0,16	0,85	1,21	-0,18	0,96	-0,58	1,02
I24	The ratio of the foreign currency liabilities to the	0,76	0,83	-0,64	-0,54	0,50	0,46	0,98	-0,09	0,22	0,80	-0,71	1,15
I39	The ratio of the real estate loans to the total gross	0,83	0,88	-0,68	-0,74	0,42	0,40	0,31	0,76	0,05	0,76	-0,61	1,16
I40	The ratio of the commercial estate loans to the total	-0,15	-0,32	-0,45	-0,41	-1,26	-0,93	-0,90	-0,40	0,70	0,65	-0,07	-0,68
	Euclid's distance to the standard point	9,80	8,50	9,09	9,39	9,45	8,52	8,76	8,90	9,53	9,03	10,10	8,76
	The integral index I	0,04	0,16	0,11	0,08	0,07	0,16	0,14	0,13	0,06	0,11	0,01	0,14

Source: calculated by the authors on the base of [12]

The matrix of causality and directions of influence of concepts in the system of the indexes used for determination the financial sustainability of the banking system of Ukraine is shown in Table 2.

Table 2

The matrix of causality and directions of influence of concepts in the system of the indexes used for determination the financial sustainability of the banking system of Ukraine as of 01.07.2016

	I1	I2	I3	I4	I6	I7	I8	I9	I10	I11	I12	I13	I14	I18	I19	I20	I21	I22	I23	I24	I39	I40	I
I1		← +	0	0	0	0	← +	0	0	0	→ -	← +	← -	0	0	0	0	0	← -	0	0	0	0
I2	→ +		0	0	0	0	← +	0	0	0	→ -	→ +	← -	0	0	0	0	0	← -	0	0	0	0
I3	0	0		→ +	0	0	0	0	0	0	0	0	0	0	0	0	← -	← +	0	0	0	0	0
I4	0	0	← +		0	0	0	0	0	0	0	0	0	0	0	0	← -	← +	0	0	0	0	0
I6	0	0	0	0		← +	0	0	0	0	← -	← +	0	0	← +	0	0	0	0	0	0	0	0
I7	0	0	0	0	→ +		← +	0	0	0	← -	← +	← -	0	← +	0	0	0	0	0	0	0	0
I8	→ +	→ +	0	0	0	→ +		0	0	0	0	← +	← -	0	0	0	0	0	0	0	0	0	→ -
I9	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I10	0	0	0	0	0	0	0	0		← +	0	0	→ +	0	← -	0	0	→ +	0	0	0	0	0
I11	0	0	0	0	0	0	0	0	→ +		0	0	0	0	← -	0	0	0	0	0	0	0	0
I12	→ -	→ -	0	0	→ -	→ -	0	0	0	0		→ -	→ +	0	→ -	0	0	0	← +	0	0	0	0
I13	← +	← +	0	0	→ +	→ +	→ +	0	0	0	← -		← -	0	0	0	0	0	0	0	0	0	0
I14	← -	← -	0	0	0	→ -	→ -	0	← +	0	← +	→ -		0	← -	0	0	0	0	0	0	0	0
I18	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
I19	0	0	0	0	→ +	→ +	0	0	→ -	→ -	← -	0	→ -	0		0	0	0	0	0	0	0	0
I20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		← -	0	1	0	0	0	0
I21	0	0	→ -	→ -	0	0	0	0	0	0	0	0	0	0	0	0	→ +		→ -	→ -	0	0	0
I22	0	0	→ +	→ +	0	0	0	0	← +	0	0	0	0	0	0	0	0		0	→ -	→ -	0	0
I23	→ -	→ -	0	0	0	0	0	0	0	0	→ +	0	0	0	0	← +	← -	0		← +	0	0	0
I24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	← +	→ -		→ +	→ +	0
I39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	← +	0	← +		← +	0
I40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	← +	→ +		0
I	0	0	0	0	0	0	← -	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Source: elaborated by the authors

As shown in Table 2, in the matrix of causality it was established relationships between concepts. Yes, connection of $I_i \rightarrow I_j$ is positive (sign "+"), if the increases of I_i lead to the increase (strengthening) of I_j , and vice versa. The sign of "-" means that connection is negative, i.e. under equal conditions the increase of I_i leads to the reduction of I_j , and the reduction of I_i leads to the increase of I_j .

For the exposure of presence or absence of cause and effect connection between concepts the closeness of correlation between them are estimated using the scale of Cheddok [13]. For finding the direction of cause and effect connection the test of Granger is conducted [14] between every pair of concepts. The construction of the matrix of causality allowed presenting the causal relationships between the investigated indicators in the form of cognitive map (Fig. 1).

As shown on Fig. 1, in the analyzed system of indexes the most significant is the ratio of the net open position in foreign exchange to the capital.

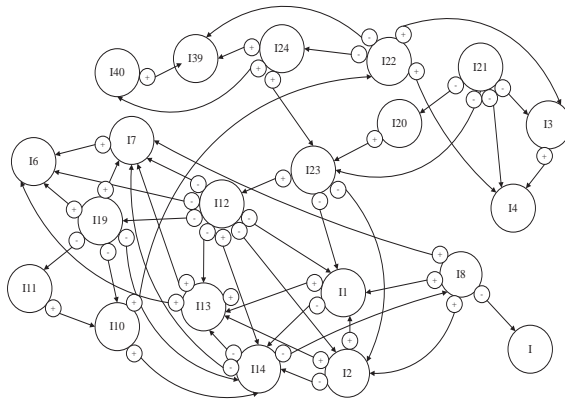


Fig. 1. The cognitive map of interrelations of indicators of financial sustainability of the banking system of Ukraine
Source: elaborated by the authors

For the analysis of descriptions of the cognitive model the cognitive consonance of the model was calculated. A consonance in a cognitive modeling is a function of positive and negative influence of concept on the whole system [15, c. 63].

The results of calculation of the consonance in the program FC Mapper shown, that the most influential concepts in the formed system of indexes are: the ratio of the net open position in foreign exchange to the capital I12, the ratio of the large open positions to the capital I14, the ratio of the capital to the assets I13, the ratio of the regulative capital to the risk-weighted assets I1, the ratio of the regulative capital of the 1 level to the risk-weighted assets I2, the ratio of the percent margin to the gross income I8.

Conclusions. Thus, by using of cognitive modeling the most influential variables are distinguished among the indicators of financial sustainability of the banking system of Ukraine, the results of analysis it is suggested to take into account at the construction of scenarios of the development of the banking system of Ukraine.

For providing the stable functioning and development both on regional and on country's level banks must constantly raise the level of capitalization, reduce the level of riskiness of operations, form the necessary volume of reserves for risk on active operations, improve the quality of assets and passives, optimize charges and profits and increase their efficiency. Thus, it is possible to affirm that on the modern stage the main task of bank institutions must be maintenance of the country's financial stability and also restoring of public confidence to the banking system in a post-crisis period.

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