MONEY, FINANCE AND CREDIT

RATING OF BANKS UNDER SYSTEMIC INSTABILITY

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Introduction. Banking crisis in Ukraine and a record series of defaults in 2014–2015 opened a unique opportunity to assess the predictive accuracy of bank solvency rating estimates for a very short period of time in historical terms. In addition to the traditional theoretical and expert methods of rating argumentation, a new empirical method has been added, which allows us to improve the methodology based on real historical data instead of not always objective conclusions [5]. According to the results of this study, the accuracy of our rating turned out to be quite high, and an additional analysis of the dynamics of individual rating indicators allows us to make it even more effective as regtech solution for automated assessment of banks.

Resent researches and publications review. Methodology for calculating the bank credit ratings of international and national rating agencies (RA), numerous normative and legislative acts and internal bank documents on the risks management problems require calculation of the key financial stability indicators, which completely or partly coincide with the components of the CAMELS system. Spreading of the Unified Financial Institutions Rating System (UFIRS, officially named CAMELS) resulted in the appearance of numerous scientific publications, which are not only using certain elements of CAMELS, but are also making attempts to verify the validity of the relevant indices in terms of predicting defaults and crises.

In the articles by foreign scientists J. Babecký [1], A. Evans [4], A. Demirguc-Kunt [3], A. Rose [7] attempts were made to choose the most significant early warning indicators of banking crises among the standard indicators of CAMELS. But they do not create integral rating indicator of bank solvency. Methodologies and results of these studies differ, but their key difference from our research is based on the early warning of the system-wide instability, which allows authors to abstract from individual aspects and to aggregate the studied indices at the level of national banking systems. Among the analogous national works on financial soundness indicators, publications of the following scholars are worth noting: O.I. Baranovskyi, I.V. Belova, O.V. Dziubliuk, S.V. Mishchenko, S.V. Naumenkova, V.I. Ohiienko, being characterized by theoretical and methodological orientation or based on the aggregate system-wide indices analysis. Instead, in present research we conducted a more detailed empirical analysis at the bank-specific level.

The second field of the early warning indicators research, made by such authors as R. Barro [2], G. Kaminsky, P. Manasse [6] is also characterized by an emphasis on studying the macroeconomic disasters and crises signals. However, researchers do not pay attention to parameters specific to the banking system, because they are using stock and macroeconomic indicators. Meanwhile, the indicators of banking institutions' internal stress resistance, which is the main subject of the present study, remains beyond the above works.

The closest, as to their methodology and objectives, to our study are the research studies of such scholars as M. Arena (Arena, 2008), F. Betz (Betz et al., 2013), R. Cole (Cole and Gunther, 1998), A. Cullen (Cullen, 2010), W. Francis (Francis, 2014), who take into account the distribution of the indicative values of

individual reliability indicators among problematic and stable banks. However, they relate to Latin America, Asia, the US and the EU, while with respect to Ukrainian empirical data, this problem remains understudied.

Formulation of the problem. The purpose of this article is to study the early-warning ability of proposed bank rating methodology based on public information under the crisis conditions. We obtain empirical results of the best solvency predictive indicators after the research of bank rating retrospective dynamics and decomposition of its factors.

Methodology and data. The selection of banks for presented rating includes banks that actively work in retail deposits market with the volume of deposits over 1 billion UAH. The rating sample excludes insolvent banks, which became under DGF temporary administration. The rating had been calculated quarterly. The rating takes into account the most important indicators from open sources of information that influence the depositors' choice of the bank. The overall rating of banks, quarterly published in Minfin.com.ua financial web-portal [5], is defined as the average arithmetic mean of three groups of indicators, received by each bank: 1) stress tolerance factors; 2) loyalty of depositor factors; 3) expert assessment factors.

The boundaries of the ranges for assigning rating scores from 1 (weak) to 5 (strong) for each indicator are calculated, depending on the distribution of the values of the banks indicators in the sample.

Thus, the dynamics of statistical distribution of indicators is automatically taken into account and the influence of the subjective factor on the rating results is minimized. In the case of strong abnormal deviations of a number of indicators from the normal distribution, expert methods for determining the ranges for assigning primary scores are allowed, with the statistical parameters of the "non-standard" distribution (arithmetic mean, median, standard deviation, maximum and minimum values, etc.).

Banks that have lost their solvency due to current massive non-payment of deposits are excluded from the rating.

The expert component of the overall assessment of the bank's stability is intended to eliminate the deviations caused by the intentional manipulation with the financial statements or the lack of only official figures for the final report. For example, official reporting does not reflect the strength of the positions of the bank's owner, which experts can judge by analysing both official and unofficial information. Engaged experts present their own assessment of the Bank's stability on a 5-point scale (from 1 to 5), based on their own forecasts and calculations on the bank. The overall assessment of analysts is calculated as an arithmetic mean of all ex-perts' assessments.

The intermediate score for the group of factors (stress tolerance or loyalty) is the sum of the pre-scores weighed on the importance of each indicator. The factor "estimation of analysts", an intermediate score is the arithmetic average. The overall rating score is the arithmetic average of the three intermediate points for all factors. The overall rating point is converted into an integral score by rounding. Bank rating = from 1 to 5 scores.

Quantitative variables used in presented rating methodology are divided by two groups of factors: stress tolerance factors and loyalty factors.

Stress tolerance factors: 1) *dependence on retail deposits*: the share of deposits of individuals in liabilities. Higher values of the coefficient indicate a higher inclination of the bank to panic among depositors. Empirical results of defaults of 2014-2015 testify that in banks with temporary administration the average share of retail deposits was relatively higher; 2) *quality of funding* – reflects type of owners (domestic or foreign); 3) *profitability* – return on assets; 4) *liquidity* – cash-to-bank resources ratio; 5) *capital adequacy* – capital to net assets ratio; 6) *scale of activity* – determined by the bank's place in the ranking of net assets.

Loyalty factors: 1) *bank's share* in the retail deposit market; 2) *absolute growth* of the retail deposit portfolio for the quarter – in conditions of high volatility of the exchange rate, the intermediate ball is calculated as the arithmetic mean of the foreign currency (denominated in dollars) and hryvnia (denominated in national currency) deposit portfolio; 3) *relative growth* of the retail investment portfolio for the quarter; 4) *market experience* – the number of years of bank existence and the number of financial crises that have passed; 5) *bank's payment reputation* – non-payment of deposits, mass protests of depositors in the range of the last 3 years, implemented default on non-deposit liabilities, implemented default on non-deposit obligations, technical default or the absence of such cases.

Main results. Before becoming bankrupt, problem banks lost their positions in our integral rating on average for several months – until the default. The average rating was about 3.5 points. However, the rating of problem banks that subsequently went bankrupt was, on average, 2.3 points. A year before bankruptcy, it was slightly higher, but still much lower than the median score (fig.1).
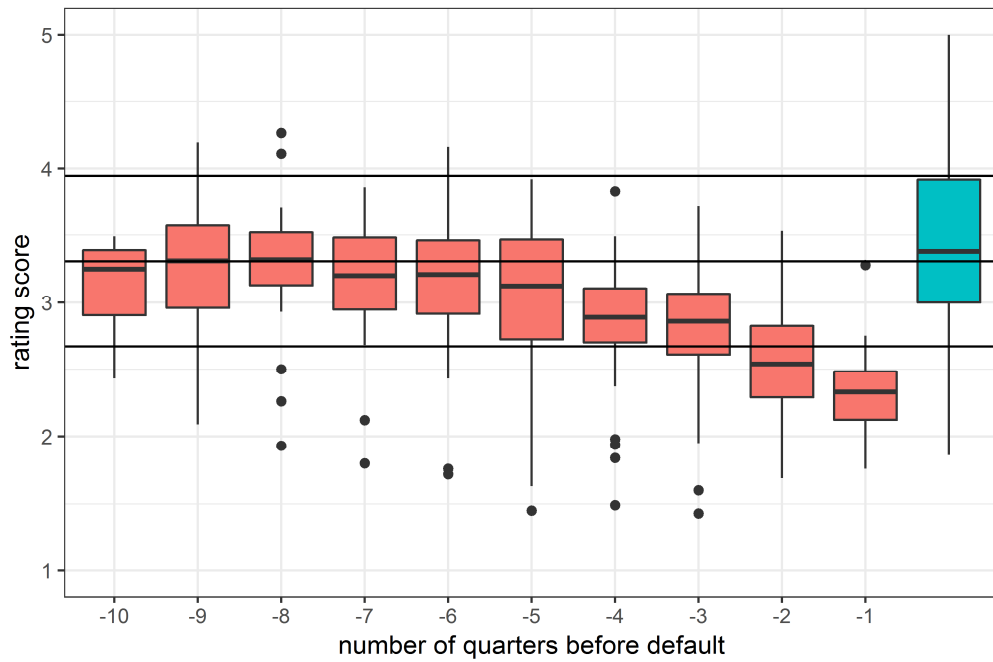
Fig.1. Rating scores distribution of defaulted banks by quarters before default in comparison with distribution of healthy banks ratings, calculated during 2012–2018 [5]

Before default average scores of insolvent banks were much lower than system median score (fig. 2). While the distribution of system rating points in time changed slightly.
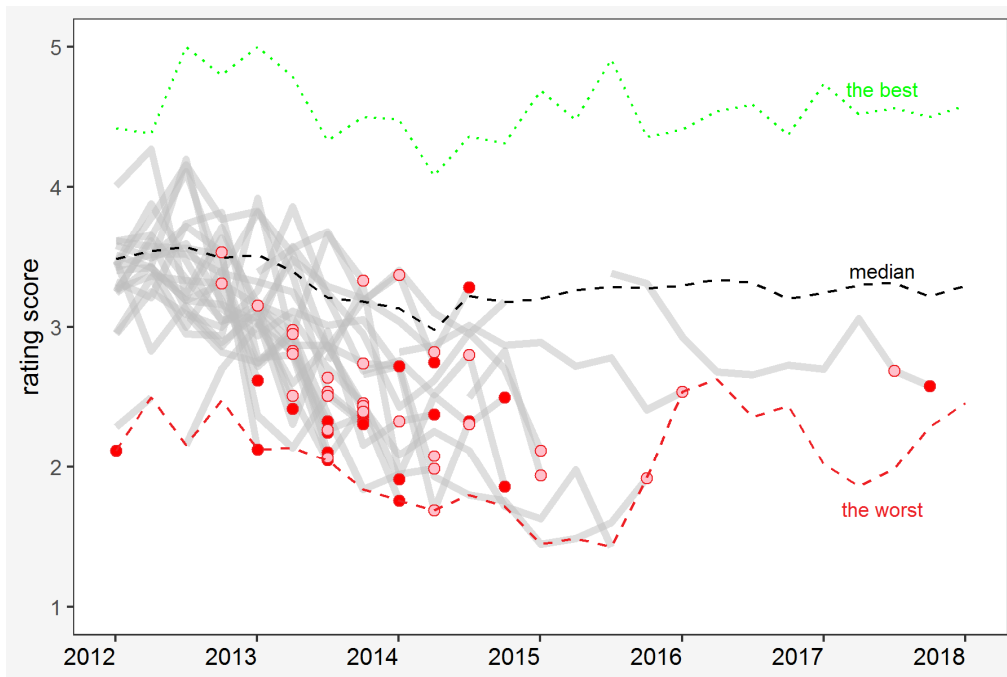
Fig.2. Rating scores trajectories of defaulted banks in comparison with system-wide distribution of bank ratings, calculated during 2012–2018 [5]

The rating efficiency is confirmed by the visualization of the distribution of ratings for the subgroup of problem banks, which turned out to be shifted to the left, towards lower scores compared to the overall distribution (see fig. 3-4).
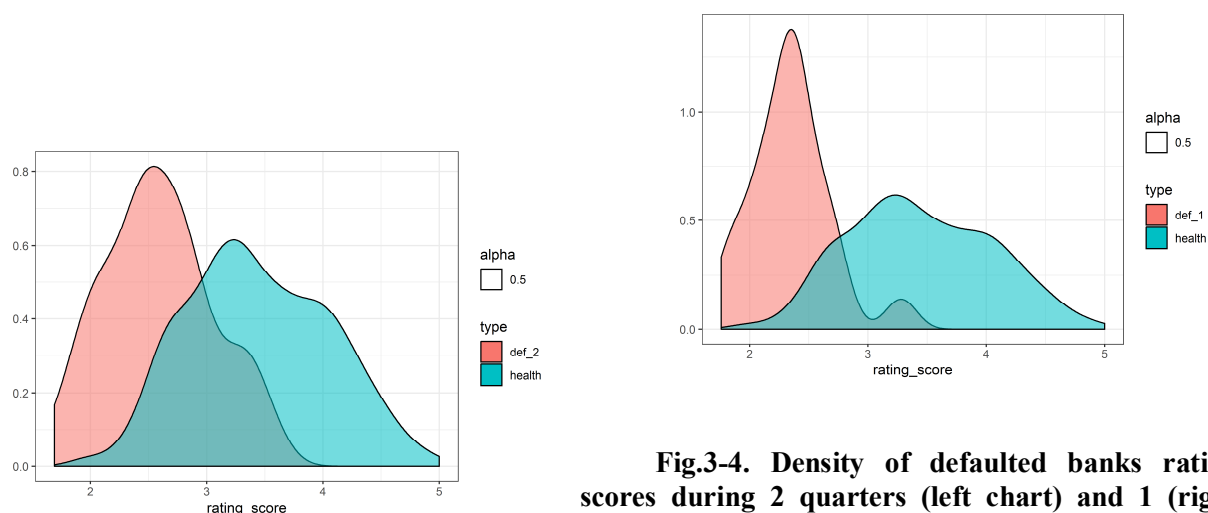
Fig.3-4. Density of defaulted banks rating scores during 2 quarters (left chart) and 1 (right chart) quarter before DGF temporary administration in comparison with bank ratings density of healthy banks, calculated during 2012–2018.

Average rating of troubled banks. All solvent banks received an average score more than 3.5 points. But compared to other banks, overall ratings turned out to be overvalued for bank "National Investments" and UPB which on average received more than 3 points. It should be noted that the average rating values were considered for the entire history of the rating, and in most cases they dropped a few quarters before the default.

Ratings for 4 quarters before default in the context of individual banks were below average, especially low ratings were in UBB, Kyivan Rus and Demark (2.5 points). VAB was significantly overvalued (4 points), Forum, Brokbusiness and Aktiv received 3.5 points.

Ratings for 2 quarters before the default have decreased significantly. Rating was particularly able to reveal problems in following banks: Nadra, Delta, City Commerce Bank, Terra Bank, Ukrainian Business Bank, Kyivan Rus, Cambio, Zlatobank, VAB (1.5-2.5 points).

At the same time, it was not possible to clearly fix the problems of Imexbank, the Forum and Brokbusinessbank (3.5 points). Possible causes of errors were: a) the suddenness of the crisis of the beginning of 2014. And a sharp change in the political situation, which analysts did not expect, making corrections; b) a large role of the owners, who have sharply lost their political weight; c) unfair preparing of financial statements by some banks.

Probability of default. More than half of the banks that obtained 2 points during 2013-2014, foreshadowed the introduction of a temporary administration. Banks with 3 points turned out to be under the DGF with a probability of 1/3. Whereas 4 points were given to future bankrupts only in 10% of cases (a year and earlier before the default), and 90% of times fell on deservedly healthy banks. 5 points have not received any troubled bank for the entire 2-year history of the rating (fig.5).

For a more detailed analysis of changes in the ratings of problem banks, we calculated 9 distributions of ratings depending on the quarter to the point "H" – the date of introduction of the temporary administration of the Deposit Guarantee Fund.

Comparing the obtained distributions with the general median rating, its standard deviations (three horizontal lines), as well as the ratings of other healthy banks (Health Banks) in 2013–2015, we see a clear downward trend in the ratings of problem banks, which began already in a year (!) to default.

For 3-4 quarters before the default, most of the ratings of future problem banks descended into the lower half of the rating table (<3.5). 2 quarters before the default, the median rating for the respective banks went down to a critically low level of 2.7. Until now, not a single bank, which later fell into the hands of the Fund, has received more than 2.5 stars for the results of the last quarter before the default (t-1) according to the methodology.

In general, the ratings of troubled banks began to fall long before bankruptcy, so they can be safely used as a warning signal.

The ratings were particularly accurate for 1-3 quarters before the introduction of the DGF. This can be taken into account in financial planning. If the terms of deposit agreements are longer than 6-9 months, it is desirable for depositors to more closely monitor the dynamics of the bank's rating.
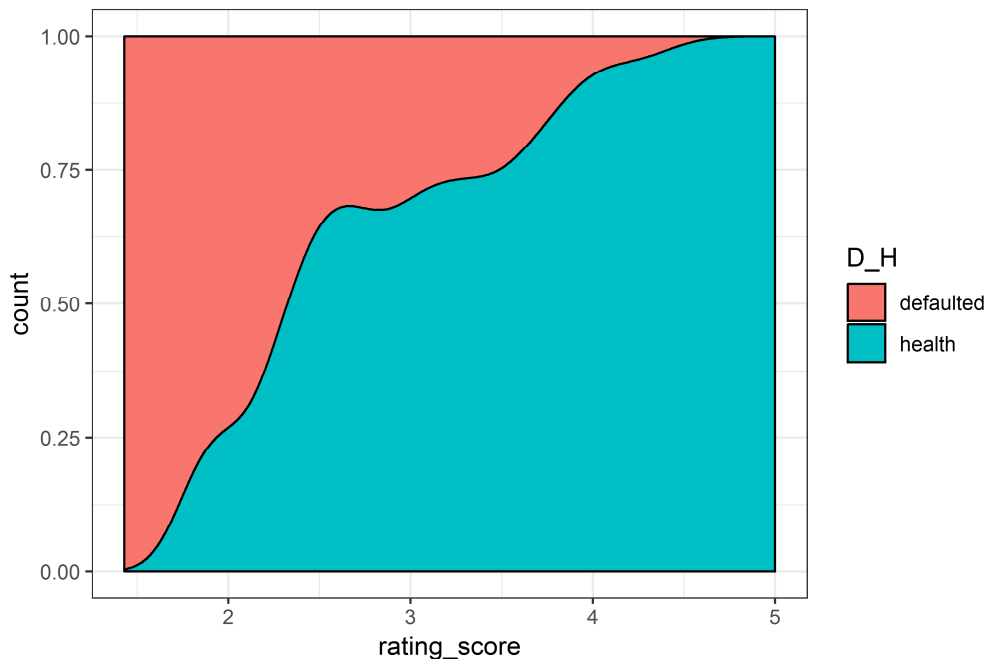
Fig.5. Empirical probability of default for each rating score. Density of defaulted banks is calculated within 10 quarters before DGF temporary administration entry [5]

Conclusion. Presented research indicated the rather high predictive ability of open data based rating methodologies which can be used as the basis for regtech solutions. This is reflected in the higher share of banks' defaults, as the overall rating of banks decreases, as well as the problem banks, which were inclined to reduce the rating year to default.

Indicators with the highest signaling position were indicators of retail deposits dependence ratio, ROA and cash-to-resources ratio. It should be stressed on high predictive ability of type of ownership, because no European bank defaulted in Ukraine during systemic crisis. Traditional indicators of asset quality, previously used in methodology as well as deposit growth coefficients appeared less effective in bankruptcy prediction. In order to enrich our methodology with qualitative component and consider hidden non-quantitative factors, expert correction was used. This consensus expert opinion has shown itself as a strong predictive factor.

Despite of high signal power of presented methodology, there is still a room for further development based on calibration of variables weights. Movement in direction to more effective open data based methodologies of bank solvency ratings is extremely important due to early warning detection of potentially insolvent institutions for the need of financial inclusion, transparency and sustainability in the banking sector.

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Рейтингування банків в умовах системної нестабільності.

Досліджено прогнозну здатність рейтингових методологій банків на основі скорингового підходу, фінансових показників і відкритих даних про банки України. У результаті порівняльного аналізу динаміки рейтингових індексів для груп діючих та неплатоспроможних банків під час системної кризи та посткризового відновлення 20142018 рр. було встановлено, що рейтинги, засновані на відкритих даних, можуть мати високу здатність раннього попередження банкрутств, оскільки інтегральні показники надійності банків, що зазнали дефолту, виявилися нижчими за середні значення по системі. Неплатоспроможні банки були схильні поступово втрачати свої позиції в рейтингу за декілька кварталів до дефолту. Емпіричні результати ретроспективного аналізу було використано для вибору найбільш значущих індикаторів раннього попередження дефолтів банків, які стали основою оновленої методології, заснованої на відкритих даних українських банків.

Ключові слова: банківська система, системний ризик, рейтинг надійності банків, фінансова криза, дефолт.

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Rating of Banks under Systemic Instability.

This article investigates the predictive ability of rating methodologies of banks based on scoring approach, financial ratios and open data on Ukrainian banks. As a result of the comparative analysis of rating indexes dynamics for groups of active and bankrupt banks during the system crisis and recovery 2014-2018, it was found that ratings based only on open data may have a high ability to bankruptcy early warning, because the final scores for the further defaulted banks were below the median values of the system. Moreover, insolvent banks were inclined to gradually lose their position in the rating for a few quarters before the default. The findings from the retrospective analysis were used to select the most significant default indicators for banks, which are the basis of the updated methodology based on newly disclosed data on a bank-by-bank basis.

Key words: banking system, systemic risk, bank solvency rating, financial crisis, default.

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Рейтингование банков в условиях системной нестабильности.

Исследована прогнозная способность рейтинговых методологий банков на основе скорингового подхода, финансовых показателей и открытых данных о банках Украины. В результате сравнительного анализа динамики рейтинговых индексов для групп действующих и неплатежеспособных банков во время системного кризиса и посткризисного восстановления 20142018 гг. установлено, что рейтинги, основанные на открытых данных, могут иметь высокую способность раннего предупреждения банкротств, поскольку интегральные показатели надежности банков, подвергшихся дефолту, оказались ниже средних значений по системе. Неплатежеспособные банки были склонны постепенно терять свои позиции в рейтинге за несколько кварталов до дефолта. Эмпирические результаты ретроспективного анализа были использованы для выбора наиболее значимых индикаторов раннего предупреждения дефолтов банков, которые стали основой обновленной методологии, основанной на открытых данных украинских банков.

Ключевые слова: банковская система, системный риск, рейтинг надежности банков, финансовый кризис, дефолт.