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THE DEVELOPMENT OF METHODOLOGY OF BANKS' FINANCIAL STABILITY ASSESMENT BY TAXONOMETRIC METHOD

Abstract. The article examines the methodology of assessing bank's financial stability. It is researched scientific evolution of financial stability nature definition, discerning endogenous and exogenous approaches. It is proved that financial stability simultaneously feels effect from endogenous and exogenous factors and it should be taking into consideration while managing financial stability of a bank, as well as assessing its level. It is grounded a set of requirements while constructing methodological approach for assessing bank's financial stability that are as follows: it is necessary to form a set of indicators that would allow to characterize the bank's activity in complex; it is important to consider the dynamic nature of financial stability; it is significant to take into account how any indicator effects on the bank's financial stability. It is proved taxonomy method as an effective technology of processing quantitative indicators of bank's financial stability. We propose to normalize values of indicators by the Euclidean distance tool in order to figure out their deviation from the determined standard values. It is proposed to use a set of indicators for assessing the bank's financial stability, that are grouped as follows: 1) the quality of capitalization; 2) the level of liquidity; 3) quality of assets; 4) risk-validity of business activity; 5) currency risk; 6) credit risk; 7) profitability; 8) operational risk; 9) interest rate risk; 10) factors of the macroeconomic environment. In general, it is proposed to use thirty-eight indicators which are presented by point and dynamic ones. Practical approbation of the proposed methodological approach is carried out on the example of systemically important banks of Ukraine.

The purpose of the article is to improve methodology of assessing bank's financial stability using taxonomy approach. The proposed method, in contrast to the existing ones, provides: 1) flow method construction of a set of indicators; 2) implementation of point and dynamic indicators; indicators-stimulators / destimulators and of a mixed type; 3) indicative consideration of macroeconomic environment factors. The application of such an approach allows to

comprehensively determine the level of bank's financial stability and to quantify the impact of the macroeconomic environment on it.

Keywords: bank's financial stability, taxonomy method, dynamic indicator, integrated index of bank's financial stability, normalization of indicators, indicator-stimulator, indicator-destimulator.

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РОЗВИТОК МЕТОДОЛОГІЇ ОЦІНЮВАННЯ ФІНАНСОВОЇ СТАБІЛЬНОСТІ БАНКІВ ТАКСОНОМЕТРИЧНИМ МЕТОДОМ

Анотація. Досліджено методику оцінювання фінансової стійкості банків. Досліджено наукову еволюцію визначення сутності фінансової стабільності, розрізняючи ендогенний та екзогенний підходи. Доведено, що фінансова стійкість одночасно відчуває вплив ендогенних та екзогенних факторів і це потрібно враховувати при управлінні фінансовою стабільністю банку, а також оцінювати її рівень. Обґрунтовано комплекс вимог при побудові методологічного підходу до оцінювання фінансової стійкості банку, а саме: варто сформувати набір показників, які б дозволили комплексно характеризувати діяльність банку; важливо враховувати динамічний характер фінансової стабільності; потрібно враховувати інші показники, що впливають на фінансову стабільність банку.

Обґрунтовано метод таксономії як ефективну технологію обробки кількісних показників фінансової стійкості банку. Ми пропонуємо нормалізувати значення показників за допомогою інструменту «Евклідова відстань», щоб визначити їхнє відхилення від визначених стандартних значень. Для оцінювання фінансової стійкості банку пропонуємо використовувати набір показників, які згруповано так: 1) якість капіталізації; 2) рівень ліквідності; 3) якість активів; 4) ризик-обґрунтованість підприємницької діяльності; 5) валютний ризик; 6) кредитний ризик; 7) рентабельність; 8) операційний ризик; 9) процентний ризик; 10) фактори макроекономічного середовища.

Метою статті є вдосконалення методології оцінювання фінансової стійкості банків з використанням таксономічного підходу. Застосування такого підходу дозволяє комплексно визначити рівень фінансової стабільності банку та кількісно оцінити вплив на нього макроекономічного середовища.

Ключові слова: фінансова стійкість банку, метод таксономії, динамічний показник, інтегральний індекс фінансової стійкості банку, нормалізація показників, індикатор-стимулятор, індикатор-дестимулятор.

Формул: 6; рис.: 1; табл.: 2; бібл.: 32.

Introduction. The concept of «financial stability» is undoubtedly complex and extremely diverse in terms of internally generated content components and external divergent factors of influence. That explains the expansion of object-diversified approach to research and interpretation of its content. We mean the fact that financial stability now is not just a characteristic of financial system or financial sector, but as well is a feature of any financial or nonfinancial institution. So, on the one hand we agree with M. Dziamulych, O. Stashchuk and others that banks' activity, especially lending of innovations of the real sector of economy, directly influences on financial stability of national economy [1]. But, on the other hand financial stability or instability of the national economy as well can be provoked by the efficiency of management of any other type of enterprises [2]. Although financial stability is to be considered one of the main priorities of any enterprise in current extremely dynamic economic environment [3]. At the same time, we consider position of V. Y. Vovk rather controversial and we don't agree that «effective functioning and sustainable development of the banking system is possible only in conditions of general financial stability of the country's economy» [4]. Firstly, banking system's financial stability is one of the fundamental preconditions of financial stability of the whole economy. Secondly, we insist that any bank should be active in ensuring its financial stability by developing its own unique methodology of business processes management and assessing potential threats of its financial instability.

Analysis of research and statement of the problem. Should be mentioned that in general there are two conceptual ways to describe causes of financial instability. The first one is the concept of endogenous nature, which is based on G. Minsky's work «Hypothesis of financial instability» [5]. In this case financial instability is interpreted as an inalienable endogenous characteristic of the financial system. As a result, financial fragility is the integral property of the financial system to experience cyclical instability in the process of financing the investments of business entities by banks.

The second one accentuates on exogenous nature of financial stability. J. Stiglitz and E. Weiss in their work «Credit rationing in markets with imperfect information» ground that financial instability occurs due to the effects of asymmetric information and the authors link financial instability with the imperfection of financial markets [6]. The latter is also provoked by the asymmetry of information awareness of creditors and borrowers towards each other. Researchers have argued that reducing of the investment in the real sector of economy and curtailing output could cause a «shock» in financial markets if they are imperfect. Another scientific work that complements the content of the concept of the exogenous nature of financial instability belongs to the authorship of B. Bernanke and M. Gertler — «Financial fragility and economic activity» [7]. Among foreign scholars who determine the content of financial stability through awareness of the signs of financial instability, there is also a group of modern researchers, namely: F. Allen [8], O. Aspachs [9], A. Demiguc-Kunt [10], V. Order [11]. They interpret financial instability exclusively as an exogenous phenomenon that arises as a result of imperfect (asymmetric) information, exogenous shocks and price instability. Financial fragility is seen as a state of the financial system in which minor shocks can lead to essential macroeconomic instability.

On our minds, financial stability simultaneously feels effect from endogenous and exogenous factors. And it should be taking into consideration while managing financial stability of a bank, as well as assessing its level. The latter is **the main aim** of this paper and we propose a methodology of assessing bank's financial stability by developing instruments for adequate valuation its level from the point of endogenous and exogenous effects.

Results of research. Systematizing scientific achievements on the development of methodology for assessing the banks' financial stability, it is appropriate to identify the following approaches: 1) indicative assessment of the probability of banking crises based on the diagnosis of macroeconomic indicators found in the works of B. Eichengreen [12], L. Laeven [13]; 2) focus on the assessment of imbalances formed cause of information asymmetry in the financial relationships (F. Mishkin [14], L. Kodres [15]). Methodological basis of this approach is agency theory; 3) assessment based on aggregate microeconomic indicators; 4) diagnostic based on the balance approach, in particular, the use of the Z-score indicator (L. Lepetit [16], F. Strobel [17], I.-R. Badea [18]). The approaches that take into account the banks' life cycle use balanced scorecard method [19; 20]; 5) the transition from evaluation on the basis of balance sheet indicators to market ones is found in the paper of L. Mörttinen [21]; 6) a comprehensive approach to valuation, which takes into account the importance of stabilization measures of the central bank; efficiency of banks' performance of basic functions; structural changes in the banking sector and features of systemically important institutions is proposed by O. Kolodiziev, I. Chmutova and V. Lesik [22] and by Karcheva G. T., Chibisova V. Yu, Pantielieieva N. N, Rogova N. V. [23]; 7) econometric analysis (S. Kolodii and L. Gariaga [24]); 8) system approach by assessing complex institutional environment (O. Baranovskyi [25]; M. Khutorna [26]; O. Prokopenko [27]).

We reckon that the importance of the quality of the methodological basis for assessing the bank's financial stability is undeniable in terms of the effectiveness of its provision and maintenance in the long run. At the same time, the improving of the methodology for assessing the bank's financial stability should anticipate:

1) it is necessary to form a set of indicators that would allow to characterize the bank's activity in complex, and at the same time each indicator is to reveal the most significant aspects of bank's functioning, which negative changes directly impact on its financial stability. The multifaceted nature of financial stability should also be reflected in the content of such indicators. In particular, it is necessary to take into account indicators that characterize both internal and external threats to the bank's financial stability. Therefore, it is necessary to use such indicators that would identify the most vulnerable spheres in its activities for further effective management decisions aimed at increasing the level of the financial stability of the banking institution. In this context, N. Pogorelenko carries out a comparative analysis of methodological approaches to assessing the bank's financial stability in terms of the content structure of the set of indicators [28]. Developing these results, we note that, firstly, the indicators of assessing the bank's financial stability always include those that characterize the level of its capitalization and liquidity. Secondly, special attention is paid to indicators of profitability, as well as diversification of business activities. However, there are mostly no indicators that characterize the quality of assets and liabilities; the same concerns to the bank's risks that prevailingly are limited to the credit risk. It should also be noted that taking into account the impact of the macroeconomic environment only in the context of the banking sector's financial stability is insufficient, as some banks are also subjecting the macroeconomic environment, which undoubtedly affects both their current and future financial stability;

2) it is important to consider the dynamic nature of financial stability. It has to be implemented by indicators' usage that reflect current and most expected prospective tendencies of the bank's activities or its business environment. In particular, O. Golovko and E. Olefir consider this, but defining it as a qualitative component in assessing the financial stability [29]. We persist in quantifying the bank's financial stability through the set of indicators that includes both point indicators (indicators that reflect the state of the bank or its macroeconomic environment at a given time) and those that characterize certain trends;

3) it is significant to take into account how any indicator effects on the bank's financial stability. Thus, some scholars deem that the set of indicators for assessing the bank's financial stability should include only one-vector dynamics indicators, otherwise it «does not clearly define the general trend of financial stability» [30]. We cannot agree with this position, because, firstly, there are a number of methodological approaches to the normalization of indicators' values that

allows the formation of integrated indices, based on both indicators-stimulators and indicators-disincentives. Secondly, it is necessary to emphasize that a large number of financial indicators of bank's activities are of the combined type that means at certain intervals they are stimulants, and at others — disincentives. In particular, this applies even to liquidity ratios, which are primarily indicators-stimulators — the exceeding the thresholds means a satisfactory balancing of bank's assets and liabilities and it has a positive impact on its financial stability. However, the bank's financial stability is not only its ability to ensure equilibrium in the long run by counteracting / adapting / absorbing internal and external shocks, but also maintaining a continuity, effectiveness and financial efficiency, as well as ensuring sustainable purposeful financial development of the bank. Therefore, if the liquidity ratios several times exceed thresholds, especially in a favorable macroeconomic environment, then the same indicator must be considered as an indicator of the combined type;

4) it is to determine the technology of processing quantitative indicators, which would allow the use of the most important of them in terms of ensuring the bank's financial stability, regardless of any other characteristics (e.g., relative or absolute indicators; static or dynamic; indicators-stimulators, indicators-destimulators or mixed type). In this case it is appropriate to use multidimensional statistical methods, which are among the most effective tools for studying complex economic processes. On our minds, among the worthiest methods are cluster, taxonomy, factor, correlation and regression analysis.

As a methodological basis for developing the methodology of the bank's financial stability assessment, we choose taxonomic analysis, which we consider an effective tool for assessing economic phenomena characterized by latent features' manifestation. This is fully consistent with the phenomenon we are studying — the bank's financial stability. It is empirically proved that for a long time internal threats can accumulate in bank's environment and be latent, no way affecting the financial stability of the institution until there is a certain «shock» of internal and / or external origin. It should be noted that taxonomy is the methodology of multidimensional objects' ranking, and the key concept of taxonomy method is the distance / similarity of objects to the standard / anti-standard in the set of various symptoms [31]. In order to assess the level of similarity of the actual value of the indicator to its standard / anti-standard value it is proposed to use the Euclidean distance.

While applying the taxonomy method for assessing the level of the financial stability it is necessary to distinguish the following semantic stages: Firstly, it is necessary to outline the factors of bank's financial stability, formalize them through a set of quantitative indicators and form observations matrix. It is necessary to choose such indicators that most accurately and reasonably characterize the bank's financial stability; Secondly, the obtained values of indicators are to be normalized by the Euclidean distance tool using formula (1):

$$z_{ij} = \frac{x_{ij} - \overline{x_j}}{\sigma_j}, \tag{1}$$

where z_{ij} — normalized value of the j-th indicator calculated for the i-th bank; x_{ij} — the actual value of the j-th indicator, calculated for the i-th bank; $\overline{x_j}$ — average value of the j-th indicator, calculated for a certain sample of banks; σ_j — standard deviation of the value of the j-th indicator.

It should be noted that adequate assessment of financial stability requires defining the average value of the indicator as the average value for the analyzed sample of banks, rather than the average over the selected time horizon. We consider this important because financial stability of an individual bank is always influenced by both macroeconomic factors and the peculiarities of the functioning of other banks in the market. Moreover, it is known that most of the indicators used to assess the financial performance of banks do not have strictly defined thresholds and depend on the general condition of the banking sector. Thus, until 2008, most Ukrainian banks set a threshold value for the indicator «share of NPL in bank's loan portfolio» at 4%, and during 2014—2016 loan portfolio is considered to be of satisfactory if NPL is no more than 20%. That is why normalizing of indicators' values is proposed to determine on the basis of data of certain banks' cluster.

Thirdly, it is important to form a vector of standard values for selected indicators of banks' financial stability that can be realized by such approaches: 1) the expert method, i.e. by interviewing reputable experts on the recommended values of selected indicators; 2) empirical method, i.e. to take into account the value of selected indicators for those banks that are currently declared insolvent, which allows to determine their limit value (maximum or minimum depending on the nature of the impact — stimulating or disincentive); 3) the method of scientific logic, which is based on the identification and consideration of causal relationships between the quantitative ratios of certain financial indicators and considered determinants of a financially stable bank. At the same time, when determining the threshold values of indicators, first of all, it is important to rely on the principle of prudence and set standard values, which implementation, on the one hand, can be ensured by the bank in the current macroeconomic conditions. And on the other hand, their maintenance in time will promote its sustainable development.

Fourthly, it is to calculate the integrated index of bank's financial stability by the formulas:

$$IIFS_i = 1 - \frac{C_i}{C_O}, \tag{2}$$

$$C_i = \sqrt{\sum_{j=1}^{n}(z_{ij} - E_j)^2}, \tag{3}$$

$$C_O = \overline{C_i} + 2\sigma_O, \tag{4}$$

$$\sigma_O = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(C_i - \overline{C_i})^2}, \tag{5}$$

where $IIFS_i$ — integrated index of i-th bank's financial stability of the; C_i — Euclidean distance of the normalized value of the j-th indicator, calculated for the i-th bank, from the standard value of the j-th indicator; E_j — standard value of the j-th indicator; n — the number of indicators; C_O — average cluster Euclidean distance of the vector of actual values of indicators from the vector of standard values; $\overline{C_i}$ — average value of C_i, calculated by m-number of banks; σ_O — the standard deviation of the vector of the actual values of the indicators of the studied cluster of banks from the standard; m — the number of banks in the studied cluster.

It is proposed to use a set of indicators for assessing the bank's financial stability, that are grouped as follows: 1) the quality of capitalization; 2) the level of liquidity; 3) quality of assets; 4) risk-validity of business activity; 5) currency risk; 6) credit risk; 7) profitability; 8) operational risk; 9) interest rate risk; 10) factors of the macroeconomic environment. In general, it is proposed to use thirty-eight indicators which are presented by point and dynamic ones. It should be noted that we don't include indicators used for banking regulation and supervision by the National Bank of Ukraine. The only exceptions are the liquidity coverage ratios of LCR, because of behavioral-based approach calculation by taking into account actions of economic agents in the face of sharp negative changes in the macroeconomic environment.

As the prerequisite for bank's financial stability is its financial stability, so, in our deep conviction, the object of financial stability should be only those banks that fully and at all times time comply with all legal norms, requirements and economic standards set by the National Bank of Ukraine [32]. In our opinion, non-compliance with at least one economic standard automatically characterizes bank's financial stability as unsatisfactory and only after correcting this situation the bank returns to the continuum of financial stability. In addition, in our opinion, the object of financial stability assessment should be only those banks that operate in the financial services markets for at least three consecutive years, during which it is advisable to consider their activities only from the standpoint of ability to ensure financial resistance.

Regarding the specification of proposed indicators, we pay attention to the following:

1) the construction of indicators is based on the flow method, according to which the bank's activity is considered as a purposeful of financial resources' turnover according to banking activity priorities under certain internal and external factors. In this case implementation of quantitative comparison of different types of bank's financial flows allows to assess the internal environment of

the banking institution from the standpoint of its compliance with the determinants of financial stability;

2) the number of proposed indicators should be considered as an open and dynamic set and it is to be systematically renewed under the changes of the banks' external environment. In particular, among the indicators that characterize bank's profitability are: «deviation of the *ROE* from its average value for the previous three years, %» and «deviation of the *ROA* from its average value for the previous three years, %». At the same time their practical implementation is reasonable only if a bank has been generating profit during the previous three years. Concerning Ukraine, it cannot be implemented yet;

3) while constructing indicators that characterize factors of the macroeconomic environment we base on the results of correlation and regression analysis, as well as the possibility of establishing clear quantitative standard values for them. Taking into account the technology of taxonomy method, we note that the logic of taking into account macroeconomic factors in assessing banks' financial stability is to determine the level of favorable macroeconomic environment for banks through the prism of selected indicators.

It is important to note that the technology of taxonomy method allows to predict the expected change of the integrated index of bank's financial stability under the macroeconomic environment changes, as well as to identify the most significant factors. The latter applies not only to factors of the macroeconomic environment, but also to any factor of bank's financial stability, which is formalized as a quantitative indicator of its assessment.

Of particular importance, from the standpoint of ensuring the adequacy and validity of the proposed methodological approach to assessing bank's financial stability is the process of establishing standard values to the proposed set of indicators. Note that, according to the methodology of the taxonomy approach, the standard values of indicators are selected from the matrix of normalized observations by the following algorithm: for indicators-stimulators, it is selected the maximum value of the normalized indicator among the cluster of studied banks; for indicators-destimulators — the minimum value among a similar sample. Such an approach is acceptable for rating banks by certain characteristics, but cannot be used to assess their financial stability. That is why the substantiation of the standard values for the proposed indicators is carried out by such methods – expert, empirical and approach of scientific logic. It means that while setting the standard values, firstly, we consider the opinion of experts (senior management of banks of Ukraine; the regulator and scientists). Secondly, we took into account the experience of past financial crises and the gap between financial data of two groups of banks — those that were later declared insolvent and those that currently continue to operate in the financial services markets of Ukraine. Thirdly, we apply scientific logic while determining the standard values for proposed indicators. The results of this work are presented in *Table 1*. We identify both indicators-stimulators / destimulators and indicators of mixed type, i.e. those that at certain intervals positively characterize the bank's financial stability and at others — negatively.

Table 1

Standard values of the proposed indicators for assessing the bank's financial stability

The content of indicator	The nature of the effect of the indicator on the FSB (stimulator / destimulator)	Standard value of the indicator, in coefficient
Indicators that characterize bank's capitalization		
Ratio between indicators «Tier 1 capital / credit risk weighted assets» and «regulatory capital / credit risk weighted assets».	Stimulator	0,7
Ratio of Tier 2 capital to Tier 1 capital	Destimulator	1,0
Ratio of equity to funds	Stimulator	0,1
Ratio of rate of change in regulatory capital to rate of change in credit risk weighted assets	Stimulator	1,0

Table 1 (*continued*)

The content of indicator	The nature of the effect of the indicator on the FSB (stimulator / destimulator)	Standard value of the indicator, in coefficient
Indicators that characterize bank's liquidity		
Ratio of long-term assets to long-term liabilities (maturity more than 1 year)	Stimulator	1,0
Ratio of high quality liquid assets to net expected cash outflow	Stimulator	1,0
Ratio of high quality liquid assets to net expected foreign currency cash outflow	Stimulator	1,0
Ratio of deposits to loans (except interbank)	Stimulator — Destimulator	[0,8; 1,5]
Ratio of rate of change in deposits to rate of change in loans (except interbank)	Stimulator	1,0
Indicators that characterize bank's assets quality		
Ratio of NPL to gross loans	Destimulator	0,1
Ratio of rate of change in NPL to rate of change in gross loans	Destimulator	0,05
Ratio of income producing assets to gross assets	Stimulator — Destimulator	[0,8; 0,95]
Ratio of rate of change in income producing assets to rate of change in gross assets	Stimulator	1,0
Indicators that characterize risk-validity of bank's business activity		
Ratio of the gap between granted loans (except interbank loans) and deposits to regulatory capital	Destimulator	0,3
Ratio of rate of change in net operating income to rate of change in provisions against losses for loan impairment	Stimulator	1,0
Ratio of rate of change in loans to rate of change in provisions against losses for their impairment	Stimulator	0,8
Ratio of rate of change in equity to rate of change in net income producing assets	Stimulator	1,0
Indicators that characterize bank's currency risk		
Ratio of open currency position to regulatory capital	Destimulator	0,1
Ratio of gross foreign currency loans to foreign currency liabilities	Destimulator	1,2
Gap between indicators «ratio of gross foreign currency loans to foreign currency liabilities» and «ratio of net foreign currency loans to foreign currency liabilities»	Destimulator	0,15
Indicators that characterize bank's credit risk		
Ratio of provisions for loan impairment to credit debt under credit risk	Stimulator	0,95
Ratio of credit risk assessed on NPL to credit debt under credit risk	Destimulator	0,15
The weighted average value of the credit risk degree for gross loans	Destimulator	0,5
The weighted average value of the degree of credit risk for foreign currency loans	Destimulator	0,15
Indicators that characterize bank's profitability		
Annual rate of change in ROE	Stimulator	1,0
Annual rate of change in ROA	Stimulator	1,0
Indicators that characterize bank's operational risk		
Ratio of interest income to gross income	Stimulator	0,5
Ratio of commission income to gross income	Stimulator	0,2
Ratio of non-interest expenses to gross income	Destimulator	0,3
Indicators that characterize bank's market risk		
Deviation of the indicator «weighted average interest rate on loans» from the same, calculated on banking sector's data	Stimulator	0,01
Deviation of the indicator «weighted average rate on deposits» from the same, calculated on banking sector's data	Destimulator	0,01
Deviation of the bank's spread indicator from the same, calculated on banking sector's data	Stimulator	0,01
Indicators that characterize macroeconomic environment		
Ratio of loans granted by the banking sector to GDP, ratio	Stimulator — Destimulator	[0,5; 1,5]
Ratio of consumer expenditures of households to GDP	Destimulator	0,3
Ratio of foreign exchange reserves to monetary aggregate M2 in dollars equivalents	Stimulator	0,6

Source: developed by the authors.

Note that such adjustments to the methodology of taxonomic analysis (we are talking about the method of determining the vector of standard values) also require amendments in the process of calculating Euclidean distances of normalized values of indicators (C_i). To do this, apply the following:

1) for indicators-stimulators:

$$C_{ij} = \begin{bmatrix} z_{ij} - E_j^n, if \ x_{ij} > E_j; \\ \dfrac{z_{ij}}{E_j^n}, if \ x_{ij} < E_j; \end{bmatrix}$$

2) for indicators-destimulators:

$$C_{ij} = \begin{bmatrix} z_{ij} - E_j^n, if \ x_{ij} < E_j; \\ \dfrac{z_{ij}}{E_j^n}, if \ x_{ij} > E_j; \end{bmatrix}$$

3) for indicators of mixed type:

$$C_{ij} = \begin{bmatrix} \dfrac{z_{ij}}{E_j^{n\_min}}, if \ x_{ij} < E_j^{min}; \\ \dfrac{\left(z_{ij} - E_j^{n\_min}\right) + \left(z_{ij} - E_j^{n\_max}\right)}{2} \\ , if \ x_{ij} > E_j^{min} \ and \ x_{ij} < E_j^{max}; \\ \dfrac{z_{ij}}{E_j^{n\_max}}, if \ x_{ij} > E_j^{max} \end{bmatrix}$$

where C_{ij} is the Euclidean distance of the normalized value of the j-th indicator, calculated for the i-th bank, from the normalized standard value of the j-th indicator; E_j^n – normalized standard value of the j-th indicator; E_j^{min}, E_j^{max} – minimum and maximum standard value of the j-th indicator of mixed type; $E_j^{n\_min}, E_j^{n\_max}$ — normalized minimum and maximum standard values of the j-th indicator of mixed type.

Then the Euclidean distance of the normalized value of the j-th indicator for the i-th bank (C_i) is calculated by the formula:

$$C_i = \sqrt{\sum_{j=1}^n \left(C_{ij}\right)^2}. \tag{6}$$

To ensure the appropriate level of interpretation of the obtained calculations and informativeness of the integrated index of bank's financial stability, it is necessary to apply the ranking of its values. Firstly, the value of proposed integrated index of bank's financial stability varies in the range [0; 1]. For ranking it is appropriate to use the method of «golden ratio» by Fibonacci law. As a result, three intervals are formed, which characterize the levels of bank's financial stability — low, satisfactory and high levels. At the same time, it seems logical to mark out «gray» zones of transition between these levels, because, on our minds, it is debatable when changing the value of the integrated indicator to a thousandth of a decimal causes another level of bank's financial stability. An illustration of the authors' position is shown in *Fig*.
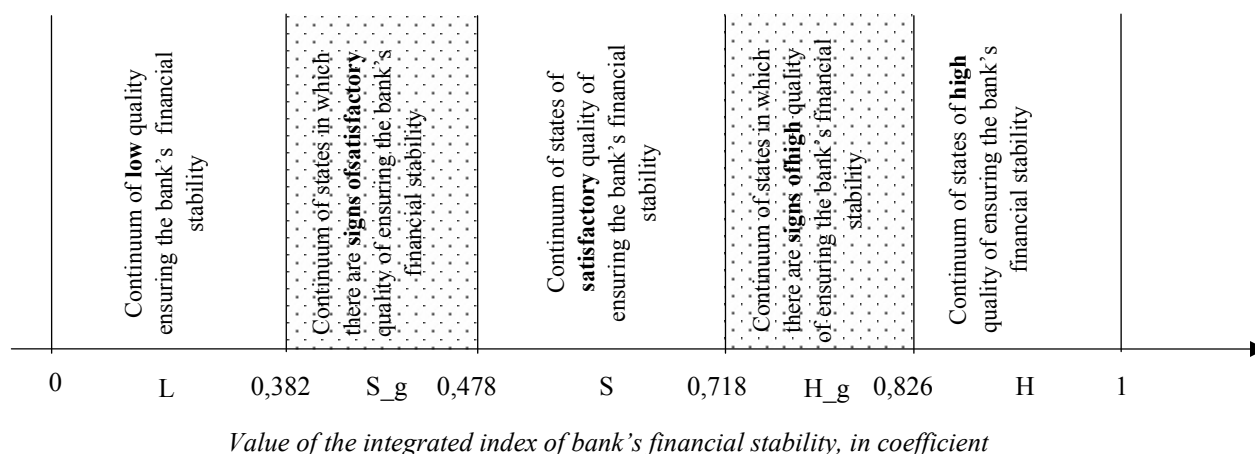
Value of the integrated index of bank's financial stability, in coefficient

Notation: L — low; S_g — transient state with signs of satisfactory; S — satisfactory; H_g — transient state with signs of high; H — high level of bank's financial stability.

Fig. **Gradation of the value of the integrated index of bank's financial stability according to the methodology of «golden section»**

Source: developed by the authors.

Practical approbation of the proposed methodological approach is carried out on the example of systemically important banks of Ukraine (*Table 2*).

Table 2

Dynamics of values of the integrated index of financial stability in terms of systemically important banks of Ukraine

Title of a bank	On 01.01.2020			On 01.01.2021			Absolute deviation of GIIFS
	IIFS_internal *	GIIFS**	Level	IIFS_internal	GIIFS	Level	
PrivatBank	0,627	0,626	S	0,615	0,610	S	-0,016
Alfa-bank	0,694	0,692	S	0,523	0,519	S	-0,173
PUMB	0,834	0,831	H	0,769	0,761	H_g	-0,070
OTP Bank	0,843	0,840	H	0,736	0,729	H_g	-0,111
Oschadbank	0,777	0,774	H_g	0,584	0,579	S	-0,195
Raiffeisen Bank «Aval»	0,830	0,827	H	0,739	0,732	H_g	-0,095
UkrSibbank BNP Paribas Group	0,815	0,812	H_g	0,709	0,703	S	-0,109
Ukrgasbank	0,793	0,790	H_g	0,708	0,702	S	-0,088
Universal Bank	0,687	0,686	S	0,566	0,562	S	-0,123
KredoBank	0,778	0,776	H_g	0,701	0,695	S	-0,081
Pivdenny Bank	0,786	0,783	H_g	0,692	0,686	S	-0,098
Tascombank	0,771	0,769	H_g	0,710	0,704	S	-0,066
Ukreximbank	0,697	0,695	S	0,473	0,469	S_g	-0,226
A-bank	0,784	0,776	H_g	0,732	0,716	S	-0,060

*Notation: * integrated index of financial stability, which takes into account only those indicators that characterize the internal environment of the bank; ** gross integrated index of financial stability, which is based on the whole set of indicators, including those that characterize macroeconomic environment; *** the significance of the impact of macroenvironment is defined as the percentage deviation of the value of GIIFS from IIFS_internal.*

Source: formed by authors on the basis of own calculations.

The values of the integrated index of banks' financial stability allow to draw the following conclusions:

1) just as the time horizon of the assessment was chosen 2020 — a year, which was characterized by an unprecedented lockdown of the economy, so it should be noted that all systemically important banks in Ukraine are financially stable. Moreover, according to the proposed ranking of the levels of bank's financial stability, the value of the integrated index of the vast majority of institutions was in the maximum proximity to the zone H_g;

2) it is important to note that the largest systemically important bank of Ukraine — Privatbank — in both years is characterized by a satisfactory level of financial stability. At the same

time, according to our estimates, it is one of the studied banks, which is characterized by the least quantitative impact of the macroeconomic environment on financial stability, both in 2019 and 2020. Such ability to absorb macroeconomic challenges and turn them into its own market advantages are important features of high-quality bank's financial stability. It is also important to focus on the smallest value of the absolute deviation of GIIFS (*Gross Integrated Index of Financial Stability*), which indicates the ability of the bank to stable (in the sense of constant) functioning. Although this does not guarantee the financial stability of the bank, but it is one of its significant prerequisites, especially in conditions of macroeconomic shocks. In addition, the fact that PrivatBank owns more than 30% of the retail deposit market necessitates special regulating status and obligatory implementation of an integrated risk management system;

3) in spite of very complicated macroeconomic environment in 2020 according to the accomplished analysis the level of financial stability of three of the systemically important banks of Ukraine are classified as those «with signs of a high level». At the same time, the negative impact of the macroenvironment on these banks is higher than on the vast majority of other studied institutions.

Conclusions. Based on the study, the proposed methodological approach to assessing the bank's financial stability due to the multifaceted nature of the selected indicators allows to comprehensively diagnose the bank's financial stability. Concerning the use of a vector of standard values it allows to identify weaknesses in the bank. Also, the technology of taxonomy method assures factor analysis of the integrated index of financial stability and determining the range of the most significant areas of current impact on the bank's financial stability. Another defining feature of the proposed methodological approach is to take into account the factors of the macroeconomic environment and the ability to quantify the impact of its dynamism on the banks' financial stability. The obtained results, based on panel data of systemically important banks of Ukraine, allowed to reveal the strengthening of the negative impact of changes in the macroeconomic environment caused by COVID-19 on the value of the integrated index of their financial stability and caused its reduction, as a rule, to a satisfactory level.

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