

DOI: 10.55643/ser.2.48.2023.492

Tetiana Kubakh

PhD in Finance, Doctoral in Finance,
Educational and Scientific Institute of
Business, Economics and Management,
Sumy State University, Sumy, Ukraine;
e-mail: t.kubakh@biem.sumdu.edu.ua
ORCID: [0000-0003-3810-6380](https://orcid.org/0000-0003-3810-6380)
(Corresponding author)

Viktoriia Koilo

PhD in Finance, Associate Professor of
the Department of Ocean Operations
and Civil Engineering, Norwegian
University of Science and Technology
(NTNU), Ålesund, Norway;
ORCID: [0000-0001-7953-9970](https://orcid.org/0000-0001-7953-9970)

Alyona Efimenko

Student of the Department of Financial
Technology and Entrepreneurship,
Educational and Scientific Institute of
Business, Economics and Management,
Sumy State University, Sumy, Ukraine;
ORCID: [00009-0002-1599-2551](https://orcid.org/00009-0002-1599-2551)

Received: 18/04/2023

Accepted: 07/06/2023

Published: 30/06/2023

© Copyright
2023 by the author(s)



This is an Open Access article
distributed under the terms of the
[Creative Commons CC-BY 4.0](https://creativecommons.org/licenses/by/4.0/)

USE OF TAXONOMIC ANALYSIS IN ASSESSING BANK LIQUIDITY

ABSTRACT

Given the military actions that increase economic and financial threats in Ukraine, one of the main tasks for ensuring the stable functioning of the banking system is to ensure the liquidity of the bank. Successful implementation of this issue depends on an efficient, systematic, comprehensive assessment of liquidity indicators in order to make effective management decisions to balance the bank's assets and liabilities by terms and amounts. The world practice has developed a powerful toolkit for assessing bank liquidity, while the challenges of today require diversification of approaches to addressing this issue.

The purpose of the article is to define the theoretical essence and practical component of bank liquidity, which makes it possible to more thoroughly determine the areas of analysis and evaluation, as well as to apply taxonomic analysis to determine the level of bank liquidity.

Based on the study of scientific approaches, the author has formed her own interpretation of the category of "bank liquidity". It is proposed to analyze and evaluate the bank's liquidity on the basis of the formed system of indicators, which includes regulatory indicators from the regulator. The state of liquidity of the banking system of Ukraine is studied, which allows a comprehensive assessment of the factors influencing the liquidity of a bank as a structural element. On the example of JSC CB Raiffeisen Bank, the liquidity analysis was carried out using a system of indicators, and shortcomings in the bank's work were identified. For a more in-depth study on the example of the bank, a taxonomic analysis was carried out to determine the level of liquidity of JSC CB "Raiffeisen Bank".

Based on the analysis and assessment of the liquidity of the systemically important bank and the domestic banking system, a surplus was identified. This trend is not positive for the potential development of Ukraine's economy and also reduces the level of profit in the context of a single bank. The taxonomic analysis makes it possible to further predict the development of the integral liquidity indicator, which contributes to the formation of an effective management policy.

Keywords: bank liquidity, banking system liquidity, taxonomic analysis of liquidity

JEL Classification: C19, C59, E42, G21

INTRODUCTION

Today's challenges require banks to pay special attention to the analysis and management of bank liquidity. The economic downturn, job cuts, migration, uncertainty and the risk of increased economic losses due to a full-scale war between Ukraine and Russia have made the issue of a bank's resource base more relevant.

A qualitative analysis of liquidity is a prerequisite for the smooth functioning of a banking institution, the ability to fulfil its obligations, the ability to expand the volume of active operations and withstand the negative effects of crises of various kinds. Maintaining an optimal level of liquidity while maintaining a sufficient level of profitability is the key to the effective functioning of not only an individual bank but also the entire banking system.

LITERATURE REVIEW

The active study of the essence of liquidity began with John Maynard Keynes' General Theory of Employment, Interest and Money, in which he examines the liquidity function and defines it as the relationship between the interest rate and the money supply. The interest rate is not only a reward to the investor for investing in assets but also compensates for the deprivation of liquidity. With regard to the issue of bank liquidity, the scientist draws attention primarily to the need for the bank to fulfil its obligations [1]. J. Sinkey emphasizes bank liquidity in his work, defining that a bank needs liquidity primarily to be prepared to withdraw deposits and meet the demand for loans. Sudden changes in flows create liquidity problems for banks [2]. Technological progress and the introduction of its achievements in the banking system, as well as the growth of the degree and amount of risk, have led to the need to find new approaches to managing bank liquidity. One of the methods was the provisioning of funds, which was reflected in the work of the economist E. Reed. The scientist noted that a bank is liquid if the amount of its cash and other liquid assets, as well as the ability to quickly mobilize funds from other sources, are sufficient to repay debt and financial obligations in a timely manner. In addition, the bank must have sufficient liquid reserves to meet almost any unforeseen financial needs [3].

Among the modern domestic scholars who present their developments in disclosing the essence, assessment and management of liquidity by a bank, we should identify: V.I. Shyiko [4], who formed a system of signs of the definition of "liquidity of a banking institution", structured methods of liquidity management, and proposed an assessment methodology based on the use of an integral indicator and determining the quality of assets by calculating the concentration ratios of structured assets; O.M. Sheptukha [5] drew attention to the fact that the evidence of bank liquidity is the ability to quickly mobilize funds and fulfil liability obligations; D.A. Radnina, V.V. Volkova [6] proposed to select the most influential factors on the bank's liquidity with the help of the statistical package EViews, and the use of economic and mathematical modelling allowed to determine how the selected factors affect the bank's liquidity; L.D. Pavlenko, O.V. Krukhmal, A.I. Zaritskaya [7], proved the interaction with the categories: "liquidity of the banking system", "liquidity of the balance sheet", "liquidity of assets and liabilities", and also structured the tools for monitoring bank liquidity in accordance with the requirements of current legislation and separated indicators of early detection of a liquidity crisis; Y.S. Rebryk [8], based on her research, concluded that in the context of the escalation of the systemic financial crisis, bank management should reorient to the mechanism of conservative financial policy, the central element of which will be measured to manage bank liquidity and proposed a methodological approach to diagnosing a liquidity crisis in the context of a species structure.

Foreign scholars have also made a significant contribution to the study of the problem of bank liquidity, among which we should highlight: A. Tarazi, I. Distinguin and C. Roulet [9], who studied the relationship between bank regulatory capital and bank liquidity, concluded that banks of different sizes are characterized by the use of different measures to ensure liquidity, and therefore it is necessary to differentiate the approaches of central banks to determine and regulate the liquidity of the banking system; J. Gupta, S. Kashiramka, K.C. Ly, H. Pham [10], modeled the relationship between capital and liquidity and concluded that it is inexpedient to unify the requirements for the values of these indicators and the need to take into account the size of the bank and the level of economic development of the state; A. Alaoui Mdaghri, L. Oubdi, [11], investigated the impact of liquidity ratios defined by the requirements of Basel III such as NSFR and LCR on the creation of bank liquidity and determined their negative impact on economic growth and positive on the financial stability of the banking system; A. M. AL-QUDAH [12], studied the impact of macroeconomic indicators on bank liquidity and concluded that inflation has a positive impact, while GDP has a negative impact, which requires bank management to actively work with the forecasts of the state development to ensure the required level of bank liquidity.

AIMS AND OBJECTIVES

The purpose of the study is to analyze bank liquidity using taxonomic analysis, based on a system of indicators determined as a result of the study of the regulatory framework of the banking system regulator and previous studies by domestic and foreign experts. Also, to identify the main trends in the liquidity of the domestic banking system, which will allow us to identify the factors of influence.

METHODS

The article uses general scientific and specific methods of scientific cognition. The theoretical and methodological basis for writing the article is the works of domestic and foreign scholars and practitioners on bank liquidity, ensuring the stability of the banking system, financial system and economic growth. Methods of theoretical generalization were used in the study of the category "bank liquidity". In addition, the methods of system analysis, comparison, induction and deduction

were used. Methods of graphical interpretation and generalization were used to visualize and systematize the results obtained. Practical tasks were also solved by using the empirical method of taxonomy.

RESULTS

As you know, the term "liquidity" is of Latin origin and is translated as "liquid" or "fluid", but in a more economic sense, it is translated as "ease" of sale, etc. But over time, the term "liquidity" has acquired its own meaning in each language. For example, in Italian, this term is translated as "pay" and "pay", while the French translate liquidity as "liquidate, sell", when in the English sense liquidity is "fluidity", "fluidity" or it can be translated as "mobility" [5].

The scientific understanding of this category is not well-established, due to the difference in the purposes of analysis and research by domestic and foreign scholars (Table 1).

Table 1. Scientific approaches to the interpretation of the concept of "bank liquidity".	
Author	Characteristics
J. M. Keynes	The ability to timely and fully pay off its obligations through active balance sheet items
J. Dovgan	Bank liquidity - mobility of bank assets to ensure own fulfilment of pre-arranged obligations and requirements arising in the course of activity
V. Kornivska	Historically formed the image of the relationship between economic agents that developing as a unity of ability, instrument and institution
V. Stepanova	The ability to fulfil its obligations, as well as the availability of funds that can be mobilized from other sources and that allow to fulfil obligations
M. Lytvyniuk, V. Demydenko	Basic indicator of customer security in situations where the bank is obliged to repay its debts as soon as possible
T. Novikova, O. Antonenko, O. Baulina	The ability to fulfil monetary obligations, balancing between the maturity and amount of repayment of placed assets and the maturity and amount of liabilities
O. Dziublyuk, V. Rudan	The bank's ability to fulfil its on- and off-balance sheet obligations in a timely manner and in full, and to meet the possible needs of solvent customers for credit funds in a timely manner and in full, provided that a constant positive margin between the average cost of funds granted and attracted is maintained
O. Fusman	The ability to fulfil obligations without violating regulatory requirements due to the structure of the balance sheet, the ability to finance the growth of the loan and investment portfolio, in particular through external borrowings
P. Rose	Bank is considered liquid if it has access to funds that can be raised at a reasonable price at the time when they are needed. This means that the bank either already has the necessary amount of liquid funds or can quickly obtain them through borrowing or selling assets.

Based on research, there are three approaches to defining the category of "bank liquidity":

- the ability of the bank to repay its liabilities;
- the ability to repay its liabilities while expanding its lending and investment activities;
- identification with the amount of funds.

In view of the above, bank liquidity should be understood as the ability of a bank to fulfil its obligations in a timely manner, which is ensured by the ability to convert assets into cash on demand and is determined by the balance between the terms and amounts of assets and liabilities of a banking institution.

To control the liquidity of banks in order to reduce the risk of bankruptcy, a number of instruments are used, which are both external, namely, the standards set by the National Bank of Ukraine (NBU), and internal, a number of ratios that allow to assess the liquidity position of an individual bank in more detail.

The NBU's regulations serve as a mechanism for managing, monitoring and controlling banks' liquidity, were introduced in 2001 and defined in Resolution No. 368 of 28.08.2001 "On Approval of the Instruction on the Procedure for Regulating the Activities of Banks in Ukraine". Integration of the banking system into the international financial environment, financial condition and economic development of Ukraine required revision of approaches to liquidity control, and thus changes in regulatory values and the indicators themselves. Until 2020, financial institutions were required to analyze and provide statistical and reporting information on three ratios: the instantaneous liquidity ratio (H 4), the current liquidity ratio (H 5), and the short-term liquidity ratio (H 6); the first two ratios were replaced by the liquidity coverage ratio (LCR) for all currencies (LCRBB) and in foreign currency (LCRIB) and the net stable funding ratio (NSFR). To date, banks must calculate these standards and comply with the following regulatory values for LCR - 100%, NSFR - 100% from 01.04.2022, and indicator H6 was canceled from 23.03.2022 after the full introduction the NSFR ratio, as specified in the NBU Resolution №. 59 of 23.03.2022. But banking institutions may optionally calculate this standard for themselves, but it is not submitted to the National Bank of Ukraine [13,14,15,16].

Thus, as of 2022, the NBU has determined the following liquidity ratios:

- Liquidity Coverage Ratio (LCR), in all currencies (LCR_BB), in foreign currency (LCR_IB);
- Net Stable Funding Ratio (NSFR) [14].

Additionally, economists offer a number of other indicators that allow to deepen the analysis and assessment of a banking institution's liquidity (Figure 1).

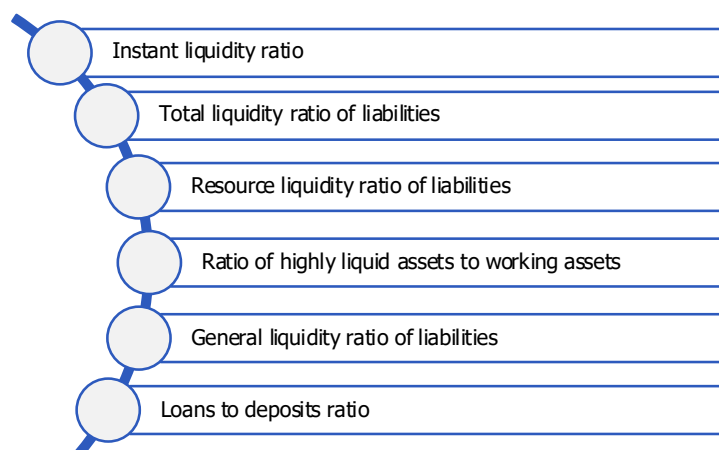


Figure 1. Liquidity indicators of a banking institution.

The instantaneous liquidity ratio demonstrates the bank's ability to settle deposits with cash held on the bank's current accounts or in the cash desk of the financial institution. In turn, the total liabilities liquidity ratio shows how much the bank is able to pay off its liabilities using its full set of assets. The ratio of highly liquid assets to working assets primarily refers to the share of highly liquid assets in the total amount of all assets of a banking institution. When the ratio of resource liquidity of liabilities shows how well the bank's income-generating resources are protected so that the financial institution can fulfil its obligations, this ratio also emphasizes how much the bank can repay the debt by returning these resources. The loan-to-deposit ratio shows the extent to which the loans granted are secured by deposits from all possible parties involved. The general liquidity ratio is characterized by the fact that a banking institution demonstrates its ability to pay off its liabilities by transforming assets and selling real estate [17].

The main threats to a bank's liquidity are crisis phenomena, both internal and external, which can lead to a loss of confidence in the bank and cause an outflow of customer funds. It should be noted that panic among the public due to the inability to conduct timely digital transactions or withdraw funds in accordance with the terms of service exacerbates the bank's liquidity problems, which requires financial institutions to avoid the risk of a shortage of funds.

At the same time, the analysis of the Ukrainian banking system over the past 10 years shows an excess of liquidity, which certainly guarantees the system's stability but slows down the country's economic development (Figure 2). This trend was made possible primarily due to regular and significant government payments to the population, as well as trust in domestic banks.

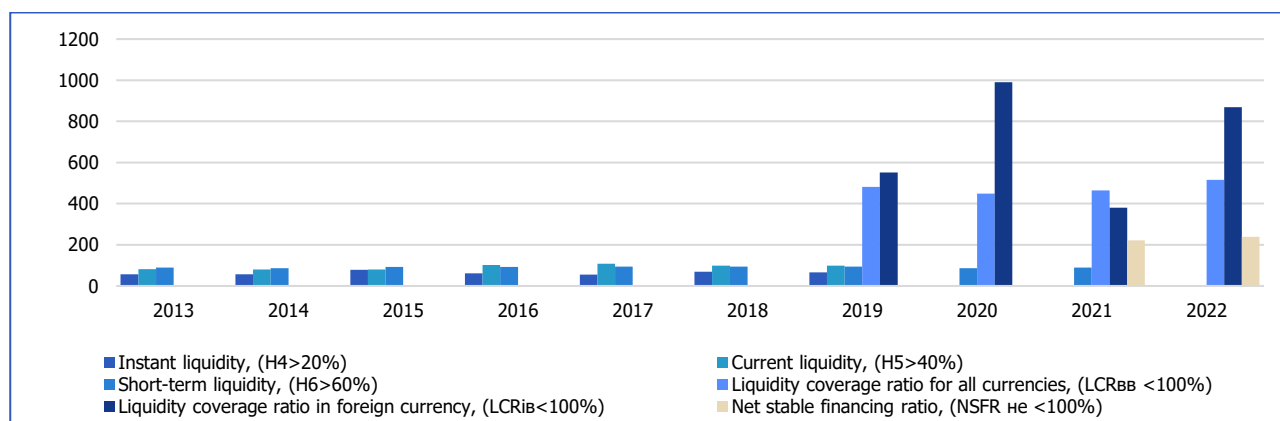


Figure 2. Liquidity ratios of the Ukrainian banking system in 2013-2022, %. (Source: based on data from [19])

Deficits and surpluses of bank liquidity are not conducive to the development of an individual bank. Thus, the analysis of the practical component of a banking institution's liquidity is currently relevant. To succeed, financial institutions must ensure adequate liquidity management, control, and monitoring. Banks face intense competition in the financial market due to their current operations.

The NBU sets standard definitions for each liquidity term to reduce the likelihood of a financial failure. If a bank fails to meet these standards, it may lose access to new loans. Each type of liquidity provides different assets and liabilities for a more accurate calculation. The central bank also determines the bank's liquidity ratios, which are then used by the financial institution to calculate its indicators [11]. In order to determine the trends in changes that occur with the liquidity of a banking institution, it is quite effective to use the method of building an integrated indicator. Particular attention is drawn to taxonomic analysis, which allows obtaining comprehensive information on the state of the bank's liquidity and implementing the necessary measures to correct it.

Taking into account the systemic importance and maximum value of the "net assets" indicator and the second place in terms of viable banks in Ukraine in 2022 according to the Mind rating system, as well as the fact that the bank was one of the fifteen largest banks in the Ukrainian system, according to the NBU classification, the subject of the study was JSC CB Raiffeisen Bank [18, 20]. Table 2 shows the estimated values of these indicators for the bank under study.

After analyzing the key liquidity indicators of a banking institution, we can confidently say that the liquidity ratios for this financial institution during the analyzed period were within the normal range and had positive dynamics and even increased in some positions. It can be concluded that JSC CB Raiffeisen Bank has an excess of liquid funds, as well as in the banking system of Ukraine in general.

Table 2. Liquidity ratios of Raiffeisen Bank for 2018–2022. Notes: in calculating some indicators, the base period was changed: liquidity coverage ratio, all currencies, (LCRv) - 2019; liquidity coverage ratio in foreign currency, (LCRiv) - 2019; net stable funding ratio, (NSFR) - 2020. (Source: compiled by the author based on data from [22, 23])

Indicators	NBU standard	Year					Growth rate 2022/2018 (base case)
		2018	2019	2020	2021	2022	
Instant liquidity ratio, (H4)	< 20%	35.73	–	–	–	–	–
Current liquidity ratio, (H5)	< 40%	42.04	–	–	–	–	–
Short-term liquidity ratio, (H6)	< 60%	74.59	79.55	87.26	83.73	91.06	22.08
Liquidity coverage ratio all currencies, (LCRv)	< 100%	–	207.3	361.38	232.50	321.68	55.18
Liquidity coverage ratio in foreign currency, (LCRiv)	< 100%	–	309.76	629.78	237.33	365.38	17.96
Net stable funding ratio, (NSFR)	< 100%	–	–	–	120.64	156.35	29.60
Instantaneous liquidity ratio	< 20%	62.73	47.65	190.48	128.16	126.06	100.97
Total liquidity ratio	>100%	102.92	102.51	103.31	103.14	102.76	–0.16
Resource liquidity ratio	70 – 80%	71.18	86.81	81.92	81.46	82.97	16.56
Ratio of highly liquid assets to working assets	< 20%	24.74	26.87	37.54	29.08	27.81	12.41
General liquidity ratio	> 100%	74.43	89.89	88.23	86.81	87.09	17.01
Loans-to-Deposits Ratio	>100%	729.67	426.18	559.42	558.40	403.39	–44.72

Analyzing the above data, we can clearly see the negative dynamics of liquidity changes in crisis periods such as 2019 and 2022. That is, these indicators, although not significantly, differed from those periods when there were no problems in the banking sector. In 2019, the instant liquidity ratio decreased by 15.08 units compared to 2018 and amounted to 47.65%. The significant decrease in this indicator is a result of quarantine restrictions that negatively affected the economic activity of business entities, which had a negative impact on the liquidity of the banking institution. In the following years, this indicator has a significant growth rate and amounted to 100.97% for the period, which indicates that banks managed to overcome the crises that arose as a result of the challenges posed by the spread of the COVID-2019 virus infection and the full-scale invasion of the Russian Federation (Table 2). There was also a slight decrease in the total liquidity ratio, which characterizes the bank's ability to pay off its liabilities with all its assets. The growth rate of this indicator was 0.16%.

A more negative trend is characteristic of the ratio of loans issued to deposits attracted, which in 2022 had a minimum value of 403.39%, approximately the same value was observed in 2019, when the crisis was provoked by the introduction of quarantine restrictions. The growth rate of this ratio is negative and amounts to 44.72. This indicates a reduction in the bank's loan portfolio, which is a negative signal not only for the bank, but above all for the potential development of the Ukrainian economy.

All the vital liquidity ratios of the analyzed bank are within the normative values, and in some cases even exceed these values, which, on the one hand, is good because it indicates that the banking institution has sufficient liquid funds to timely pay off its obligations, but on the other hand, a significant excess may indicate that this financial institution has significant liquidity balances - this leads to the emergence of unearned profit (lost profit).

In order to assess general (generalized) liquidity, the paper uses taxonomic analysis. Z. Helvig was the first to use this method in his research. He introduced the concept of a taxonomic indicator, a complex metric derived from all the characteristics that define the economic phenomenon under consideration. Taxonomy, which was originally used for classification in botany and zoology, has now come to be used frequently in economics. Using taxonomic methods, one can get an idea of the distribution of a random variable with several variables, which is similar to a distribution spectrum. It also involves dividing the data set into separate non-overlapping subsets [24, 25]. As a result, the information obtained through taxonomic research makes it possible to reveal the financial nature of the real situation.

Accordingly, in accordance with the purpose of the study, we will determine the taxonomic indicator of liquidity of JSC CB Raiffeisen Bank. Based on the data of the previously calculated indicators (Table 2), we will form a matrix of observations for 2018-2022, characterizing the dynamics of changes in liquidity (Figure 3). The construction of this matrix began with the short-term liquidity ratio.

$$X = \begin{bmatrix} 74,59 & 62,73 & 102,92 & 71,18 & 24,74 & 74,43 & 7,30 \\ 79,55 & 47,65 & 102,51 & 86,81 & 26,87 & 89,89 & 4,26 \\ 87,26 & 190,48 & 103,31 & 81,92 & 37,54 & 88,23 & 5,59 \\ 83,73 & 128,16 & 103,14 & 81,46 & 29,08 & 86,81 & 5,58 \\ 91,06 & 126,06 & 102,76 & 82,97 & 27,81 & 87,09 & 4,03 \end{bmatrix}$$

As can be seen from the observation matrix, the initial baseline data for each indicator is expressed in a specific way for each indicator and in different units of measurement. For this reason, it is necessary to use the following formula to standardize the values:

$$z_{ij} = \frac{x_{ij} - \bar{x}}{\sigma_i} \quad (1)$$

where, z_{ij} – the standardized value of i in time period j ; x_{ij} – the value of indicator i in time period j ; $\bar{x}$ – the arithmetic mean value of indicator i for all periods; σ_i – the standard deviation of indicators.

In order to apply this formula, it is necessary to calculate some indicators, such as the arithmetic mean for each indicator, and Table 3 shows these calculations.

Table 3. Arithmetic mean for the coefficients.

Показники	$\bar{x}$
Short-term liquidity ratio, (H6)	83.24
Instantaneous liquidity ratio	111.02
Total liquidity ratio	102.93
Resource liquidity ratio	80.87
Ratio of highly liquid assets to working assets	29.21
General liquidity ratio	85.29
Loans-to-Deposits Ratio	5.35

After calculating the arithmetic mean, you should also calculate the standard deviation for each liquidity ratio. This calculation is based on the following formula:

$$\sigma_i = \sqrt{\frac{\sum_{j=1}^m (x_{ij} - \bar{x})^2}{m}} \quad (2)$$

where, m – number of years (periods) to be studied.

Table 4. Systematized standard deviation data for liquidity ratios.

Показники	σ_i
Short-term liquidity ratio, (H6)	2.57
Instantaneous liquidity ratio	22.96
Total liquidity ratio	0.13
Resource liquidity ratio	2.32
Ratio of highly liquid assets to working assets	1.97
General liquidity ratio	2.48
Loans-to-Deposits Ratio	0.52

After the calculations have been carried out, we can derive standardized data on the liquidity ratios of Raiffeisen Bank's banking condition (2018-2022), presented in the form of a matrix:

$$Z_{ij} = \begin{bmatrix} -3,36 & 2,10 & -0,08 & -4,18 & -2,27 & -4,38 & 3,75 \\ -1,44 & -2,76 & -3,23 & 2,56 & -1,19 & 1,85 & -2,09 \\ 1,56 & 3,46 & 2,92 & 0,45 & 4,23 & 1,18 & 0,46 \\ 0,19 & 0,74 & 1,62 & 0,25 & -0,07 & 0,61 & 0,44 \\ 3,04 & 0,66 & -1,31 & 0,91 & -0,71 & 0,73 & -2,54 \end{bmatrix}$$

After the final output of the standardized data matrix, the liquidity benchmark vector should be calculated. This benchmark will help to understand what is a stimulant and what is a discourager of liquidity for a given financial institution. Stimulators are those indicators that have a direction towards the maximum point of significance, and discouragers are those indicators that have the opposite value to stimulators, i.e. they have a downward trend. Table 5 shows the characteristics of the benchmark vector.

Table 5. Characteristics of the benchmark vector of a banking institution's liquidity.

Indicator	Nature of impact
Short-term liquidity ratio, (H6)	Stimulator
Instantaneous liquidity ratio	Stimulator
Total liquidity ratio	Stimulator
Resource liquidity ratio	Stimulator
Ratio of highly liquid assets to working assets	Stimulator
General liquidity ratio	Stimulator
Loans-to-Deposits Ratio	Stimulator

Given that an increase in liquidity indicators increases the level of liquidity reserve, they were identified as stimulants.

At the next stage of the calculation, the maximum value of the vector, the benchmark for the development of the analyzed liquidity ratios, was calculated:

$$P_0 = (3,04; 3,46; 2,92; 2,56; 4,23; 1,85; 3,75)$$

After defining and characterizing the reference vector, the distance between the individual elements of the standardized matrix and between the reference object should be calculated. This calculation is performed using the following formula:

$$C_{i0} = \sqrt{\sum_{j=1}^m (Z_{ij} - Z_{0j})^2} \quad (3)$$

The gaps between the objects for the relevant period will have the following values:

$$C_{2018} = \sqrt{(-3,36 - 3,04)^2 + (2,10 - 3,46)^2 + (-0,08 - 2,92)^2 + (-4,18 - 2,56)^2 + (-2,27 - 4,23)^2 + (-4,38 - 1,85)^2 + (3,75 - 3,75)^2} = 13,35$$

$$C_{2019} = \sqrt{(-1,44 - 3,04)^2 + (-2,76 - 3,46)^2 + (-3,23 - 2,92)^2 + (2,56 - 2,56)^2 + (-1,19 - 4,23)^2 + (1,85 - 1,85)^2 + (-2,09 - 3,75)^2} = 12,65$$

$$C_{2020} = \sqrt{(1,56 - 3,04)^2 + (3,46 - 3,46)^2 + (2,92 - 2,92)^2 + (0,45 - 2,56)^2 + (4,23 - 4,23)^2 + (1,18 - 1,85)^2 + (0,46 - 3,75)^2} = 4,23$$

$$C_{2021} = \sqrt{(3,04 - 3,04)^2 + (0,66 - 3,46)^2 + (-1,31 - 2,92)^2 + (0,91 - 2,56)^2 + (-0,71 - 4,23)^2 + (0,73 - 1,85)^2 + (-2,54 - 3,75)^2} = 7,32$$

$$C_{2022} = \sqrt{(0,19 - 3,04)^2 + (0,74 - 3,46)^2 + (1,62 - 2,92)^2 + (0,25 - 2,56)^2 + (-0,07 - 4,23)^2 + (0,61 - 1,85)^2 + (0,44 - 3,75)^2} = 9,68$$

After this calculation, we find the average value of the gap of the reference vector for the entire period under analysis. The value of the average distance will be equal to:

$$\bar{C} = \frac{13,35 + 12,65 + 4,23 + 7,32 + 9,68}{5} = 9,45$$

Another step in the taximetric analysis is to calculate the standard deviation for liquidity ratios. This indicator is calculated using the following formula:

$$S_0 = \sqrt{\frac{1}{m} \sum_{i=1}^m (c_{i0} - \bar{c}_0)^2} \quad (4)$$

Based on the data obtained, according to the calculation, it was found that the standard deviation for the liquidity of Raiffeisen Bank is 3,38. Based on the miscalculations, we determine the maximum possible deviation for the benchmark vector, so this indicator is calculated using the formula:

$$C_0 = \bar{C} + 2S_0 \quad (5)$$

The calculation shows that the maximum possible deviation for the bank's liquidity ratios is 16.21. The values of the development level indicators for liquidity are determined by the following formula:

$$d_i = \frac{c_{i0}}{C_0} \quad (6)$$

For each analyzed year, it will have the following values:

$$d_{2018} = \frac{13,35}{16,21} = 0,82$$

$$d_{2019} = \frac{12,65}{16,21} = 0,78$$

$$d_{2020} = \frac{4,23}{16,21} = 0,26$$

$$d_{2021} = \frac{7,32}{16,21} = 0,45$$

$$d_{2022} = \frac{9,68}{16,21} = 0,59$$

The last stage in determining the liquidity of Raiffeisen Bank for 2018-2022 is the calculation of the taxonomy ratio. It is determined by the formula:

$$K_i = 1 - d_i \quad (7)$$

During the analyzed period, the taxonomic indicators have shown rather sharp fluctuations (Figure 2).

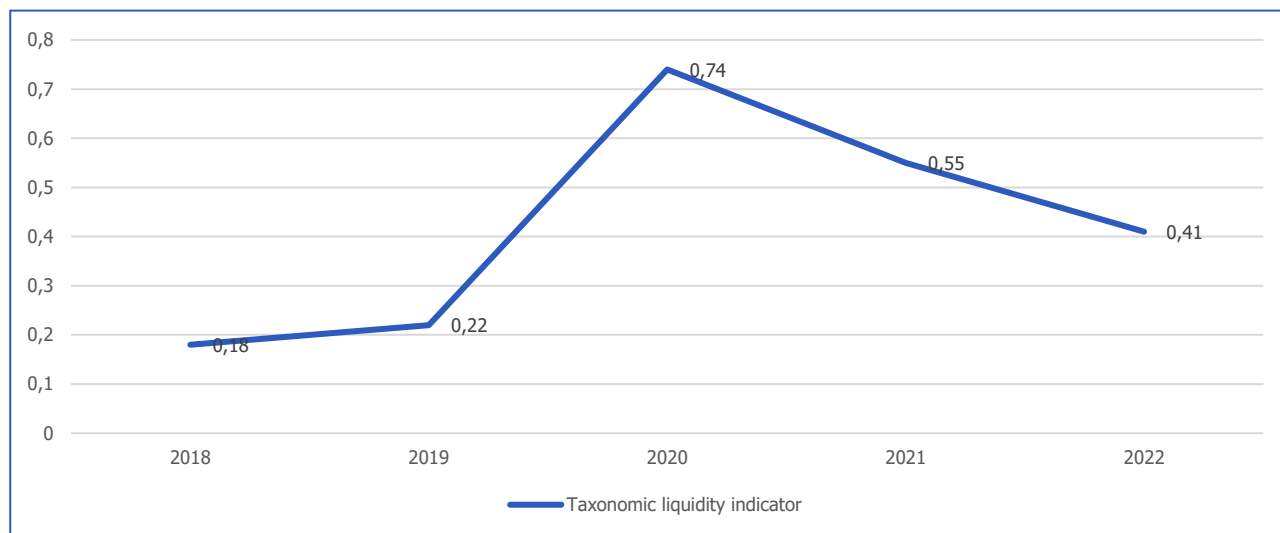


Figure 3. Taxonomic liquidity indicator of Raiffeisen Bank, 2018 - 2022.

The minimum value was observed in 2018, with a slight increase of 0.04 units in 2019. The best state of the bank's liquidity was recorded in 2020, which was facilitated by a significant increase in most liquidity indicators. A slight decrease in the general liquidity ratio in this period reveals the bank's ability to repay its liabilities with highly liquid assets and through the sale of property by an average of 85%.

The next two years, 2021-2022, are characterized by a downward trend, which may lead to a deterioration in the bank's liquidity position. The war in Ukraine has increased the risks of loan default and reduced production capacity, which prompts the bank to reduce its loan portfolio. At the same time, job losses and uncertainty about the future contribute to the reduction of the bank's resource base due to the closure of time deposit accounts, but may increase the share of funds on current accounts, which increases liquidity risks.

DISCUSSION

The current state of the banking system and economic instability require banks to pay considerable attention to monitoring and managing bank liquidity. The existence of a fairly wide range of tools to address this issue has been introduced by the regulator. At the same time, the dynamism and instability require the bank to additionally use other methods, including taxonomic analysis, which allow tracking the general trend and predicting the direction of development of the bank's liquidity.

CONCLUSIONS

The liquidity of the banking system in general and of an individual bank in particular is one of the issues that should be given considerable attention in order to ensure the efficient and uninterrupted functioning of both the system and the entity. This is especially important in the face of crises of different nature and level. Differences in the goals of the bank, depositors and supervisors contribute not only to the difference in approaches to the definition of the essence of bank liquidity by domestic and foreign scholars, but also to the mechanism of liquidity provision itself.

When analyzing the liquidity of an individual banking institution in order to make the necessary management decisions, a prerequisite is to understand the general liquidity trend in the system. In order for a bank to fulfill its obligations in full and in a timely manner, it is necessary to comply with the liquidity ratios LCR and NSFR implemented by the NBU, not only

to bring the domestic banking system closer to European prudential supervision standards, but also to maintain the stability of the entire banking system.

An integral part of the analysis, assessment, control, and management of bank liquidity is the use of ratios that are not a mandatory part of the regulator's banking supervision. At the same time, it is an effective tool that reveals in more detail the specifics of the bank's activities in ensuring the balance between assets and liabilities by maturity and amount.

In order to improve the efficiency of analysis and evaluation, as well as liquidity management of the bank, taxonomic analysis was applied on the example of Raiffeisen Bank. This method allowed to assess the level of liquidity of the bank on the basis of the integral coefficient of the taxonomy, to identify excess liquidity and the main strengths and weaknesses in the activities of the financial institution.

We consider it promising for further scientific research to study forecasting methods that will allow developing an action plan that will balance the bank's active and passive operations in terms of amount and timing.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

Conceptualization: Tetiana Kubakh

Data curation: Tetiana Kubakh

Formal Analysis: Alyona Efimenko

Methodology: Tetiana Kubakh, Alyona Efimenko

Resources: Tetiana Kubakh, Alyona Efimenko

Supervision: Tetiana Kubakh

Validation: Tetiana Kubakh

Investigation: Tetiana Kubakh, Alyona Efimenko

Visualization: Alyona Efimenko

Writing – review & editing: Tetiana Kubakh

Writing – original draft: Tetiana Kubakh, Alyona Efimenko

REFERENCES

1. John Maynard Keynes (1936). *The General Theory of Employment, Interest and Money*. Publisher: Macmillan.
2. https://www.marxists.org/reference/subject/economics/keynes/general_theory/
3. Joseph F. Sinkey, Jr. (2002). *Commercial bank financial management*. Publisher: Prentice Hall.
4. Ryd, E. et al. (1993) *Kommercheskye banky*. Publisher: Prohress.
5. Shyiko, V.I. (2018). Otsiniuvannia upravlinnia likvidnistiu bankivskoi ustanovy. *Ekonomichna nauka*, 12, 68-74.
<http://www.investplan.com.ua/?op=1&z=6150&i=12>
6. Sheptukha, O.M. (2019). Suchasnyi stan ta problemy bankivskoi likvidnosti v Ukraini. *Skhidny Yevropa: ekonomika, biznes ta upravlinnia*, 3(20), 468 – 473.
7. Radnina, D.A., & Volkova, V.V. (2021). Otsinka likvidnosti banku v umovakh ekonomichnykh peretvoren. Vinnytsia: Donetskyyi natsionalnyi universytet imeni Vasylya Stusa.
8. Pavlenko, L.D., Krukhmal, O.V., & Zaritska, A.I. (2021). Instrumenty upravlinnia likvidnistiu banku v umovakh transformatsii mizhnarodnykh pravovykh norm u natsionalne zakonodavstvo. *Efektivna ekonomika*, 1(20).
<https://essuir.sumdu.edu.ua/handle/123456789/88506>
9. Rebryk, Yu.S. (2011). Rannia diahnostyka kryzy likvidnosti banku na osnovi rozrakhunku kompozytsiinoho indykatora. *Ekonomichniy analiz*, 9(3), 258–262.
https://essuir.sumdu.edu.ua/bitstream-download/123456789/52838/7/Rebryk_early_diagnosis_liquidity_crisis.pdf
10. Tarazi, A., Distinguin, I., & Roulet, C. (2013). Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking & Finance*, 37(9), 3295–3317.
<https://dx.doi.org/10.2139/ssrn.1884811>
11. Gupta, J., Kashiramka, S., Ly, K. C., & Pham, H. (2023). The interrelationship between bank capital

- and liquidity creation: A non –linear perspective from the asia –pacific region. *International Review of Economics and Finance*, 85, 793 –820.
<https://doi.org/10.1016/j.iref.2023.02.017>
12. Alaoui Mdaghri, A., & Oubdi, L. (2022). Basel III liquidity regulatory framework and bank liquidity creation in MENA countries. *Journal of Financial Regulation and Compliance*, 30(2), 129 –148.
<https://doi.org/10.1108/JFRC-01-2021-0002>
 13. AL-QUDAH, A. M. (2020). Macroeconomic and bank –specific variables and the liquidity of jordanian commercial banks. *Journal of Asian Finance, Economics and Business*, 7(12), 85 – 93.
<https://doi.org/10.13106/JAFEB.2020.VOL7.NO12.085>
 14. Minimalne znachennia koefitsiienta LCR stanovy 100% vid 1 hrudnia 2019 roku. Natsionalnyi bank Ukrainy. <https://bank.gov.ua/ua/news/all/minimalne-znachennya-koefitsiyentu-lcr-stanovit-100-vid-1-grudnya-2019-roku-7362>
 15. Pro zaprovadzhennia koefitsiienta chystoho stabilnogo finansuvannia (NSFR): Postanova Natsionalnogo banku Ukrainy vid 24.12.2019 r. № 158. <https://zakon.rada.gov.ua/laws/show/v0158500-19#Text>.
 16. Pro vnesennia zmin do deiakyykh normatyvno – pravovykh aktiv Natsionalnogo banku Ukrainy: Postanova Natsionalnogo banku Ukrainy vid 23.03.2022 r. №59.
<https://zakon.rada.gov.ua/laws/show/v0059500-22#Text>
 17. Pro zatverdzhennia Instruksii pro poriadok rehuliuвання diialnosti bankiv v Ukraini : Postanova Natsionalnogo banku Ukrainy vid 28.08.2001 r. № 368: stanom na 30 hrud. 2022 r.
<https://zakon.rada.gov.ua/laws/show/z0841-01#Text>
 18. Herasymovych, A.M. (2004). Analiz bankivskoi diialnosti: navch. posib. Publisher: KNEU.
 19. Yershova, O.V., & Kushnir, S.O. (2016). Diahnostyka likvidnosti ta zahrozy bankrutstva banku na prykladi PAT «Raiffaizen Bank Aval». *Ekonomichni nauky*, 21, 158-161. URL:
http://nbuv.gov.ua/UJRN/Nvkhdu_en_2016_21%281%29_42
 20. Ofitsiyni sait Natsionalnogo banku Ukrainy.
<https://bank.gov.ua/ua/statistic/supervisionstatist/dاتا-supervision#1>
 21. Natsionalnyi bank onovyv perelik systemno vazhlyvykh bankiv (2023).
<https://bank.gov.ua/ua/news/all/natsionalniy-bank-onovyv-perelik-sistemno-vajlivih-bankiv-16072>
 22. Ti, shcho vystoialy. Reitynh bankiv (2022).
<https://mind.ua/publications/20246130-ti-shcho-vistoyali-rejting-bankiv-2022>.
 23. Zvitnist AT KB «Raiffaizen Bank».
<https://raiffeisen.ua>
 24. Shyiko, V.I. (2018). Otsiniuvannia upravlinnia likvidnistiu bankivskoi ustanovy. *Ekonomichna nauka*, 12, 68-74.
http://www.investplan.com.ua/pdf/12_2018/15.pdf
 25. Riepina, I.M. (2011). Taksonomichniy analiz efektyvnosti formuvannia ta vykorystannia aktyviv pidpriemstva. *Formuvannia rynkovoi ekonomiky*, 26, 440 – 457.
<https://ir.kneu.edu.ua/handle/2010/1614?show=full>
 26. Krykhovetska, Z. M., Shchypailo, S. I., & Kropelnyska, S. O. (2021). Taksonomichniy analiz finansovoho potentsialu rozvytku pidpriemstva. *Ekonomichna nauka*, 11, 90 – 97.
<http://www.economy.in.ua/?op=1&z=5058&i=14>.
 27. Kovalenko, V.V. (2020). Rehuliuвання likvidnosti bankiv Ukrainy: problemy ta perspektyvy. Derzhavne upravlinnia: udoskonalennia ta rozvytok, 7.
<http://www.dy.nayka.com.ua/?op=1&z=1702>
 28. Dovhan, Zh. M. (2017). Finansovy menedzhment u banku. Publisher: Ekonomichna dumka.
 29. Kornivska, V.O. (2013). Likvidnist u terminakh ekonomichnoi teorii: postkryzovi oriientyry rozvytku. *Ekonomichna teoriia*, 3, 16 – 27.
http://nbuv.gov.ua/UJRN/ecte_2013_2_3
 30. Stepanova, V. (2015). Hroshi, finansy i kredyt: Vplyv finansovoi nestabilnosti na likvidnist bankivskoi systemy Ukrainy. *Visnyk Berdianskoho universytetu menedzhmentu i biznesu*, 4(32), 98 – 103.
http://nbuv.gov.ua/UJRN/vbumb_2015_4_23.
 31. Lytvyniuk, M., & Demydenko, V. (2017). Likvidnist banku ta bankivskoi systemy yak pokaznyk efektyvnosti diialnosti banku ta yii vplyv na prybutkovist komertsiinoho banku. *Ekonomika i suspilstvo*, 10, 631–636.
https://economyandsociety.in.ua/journals/10_ukr/10_8.pdf
 32. Novikova, T., Antonenko, O., & Baulina, O. (2016). Upravlinnia likvidnistiu bankivskoi systemy Ukrainy: suchasnyi stan ta problemy, 2, 32–44.
http://nbuv.gov.ua/UJRN/Fkd_2016_2_6
 33. Dziubliuk, O., & Rudan, V. (2016). Upravlinnia likvidnistiu bankivskoi systemy Ukrainy. Publisher: «Vektor».

34. Fusman, O. (2013). Likvidnist u zabezpechenni stabilnosti banku. *Visnyk KNTEU*, 4, 57–68.
<http://visnik.knute.edu.ua/files/2013/04/6.pdf>

Кубах Т., Койло В., Єфіменко А.

ВИКОРИСТАННЯ ТАКСОНОМІЧНОГО АНАЛІЗУ ПРИ ОЦІНЦІ ЛІКВІДНОСТІ БАНКУ

З огляду на воєнні дії, які посилюють економічні та фінансові загрози в Україні, одним із головних завдань для стабільного функціонування банківської системи є забезпечення ліквідності банку. Успішне виконання цього питання залежить від дієвої, системної, усебічної оцінки показників ліквідності з метою ухвалення ефективних управлінських рішень із метою збалансування активів та пасивів банку за строками та сумами. Світова практика напроцьовувала потужний інструментарій оцінки ліквідності банку, водночас виклики сьогодення вимагають урізноманітнювати підходи до вирішення цього питання.

Метою дослідження є визначення теоретичної сутності та практичної складової ліквідності банку, що дає можливість більш ґрунтовно визначити напрями аналізу та оцінки, а також застосування таксономічного аналізу для визначення рівня ліквідності банку.

На основі вивчення наукових підходів сформовано власне тлумачення категорії «ліквідність банку». Запропоновано проводити аналіз та оцінку ліквідності банку на основі сформованої системи показників, до складу якої включено нормативні показники від регулятора. Досліджено стан ліквідності банківської системи України, що дозволяє комплексно оцінити чинники впливу на ліквідність банку як структурного елемента. На прикладі АТ КБ «Райффайзен Банк» проведено аналіз ліквідності з використанням системи показників, виявлено недоліки в роботі банку. Для більш глибокого дослідження на прикладі банку було проведено таксономічний аналіз, який дозволив визначити рівень ліквідності АТ КБ «Райффайзен Банк».

На основі аналізу й оцінки стану ліквідності системоутворюючого банку та вітчизняної банківської системи виявлено профіцит. Ця тенденція не є позитивною для потенційного розвитку економіки України, а також у розрізі окремо взятого банку зменшує рівень прибутку. Таксономічний аналіз дає можливість надалі прогнозувати розвиток інтегрального показника ліквідності, що сприяє формуванню ефективної управлінської політики менеджменту.

Ключові слова: ліквідність банку, ліквідність банківської системи, таксономічний аналіз ліквідності

JEL Класифікація: C19, C59, E42, G21