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THE BANKING SYSTEM OF UKRAINE IN WARTIME

This article aims to assess changes in the banking system of Ukraine in 2022 under martial law (at the macro level) and the vulnerability of banks to financial stress (at the micro level). The proposed method uses cluster analysis of the main ratios for banking stability based on the agglomerative hierarchical clustering algorithm.

The analysis of changes at the macro level under martial law shows that anti-stress measures ensured that a significant negative stress reaction was avoided. The analysis of the vulnerability of banks to financial stress shows that a significant number of banks had problems with funding and turned to the Central Bank, but by the end of the year, the funding market had stabilized. The worst situation concerned non-performing loans, but most of those are covered by reserves. Changes in legislation in Ukraine under martial law provided almost 100% coverage of household deposits in banking institutions.

Keywords: bank, liabilities management, martial law, non-performing loans, funding, Deposit Guarantee Fund

1. INTRODUCTION

Military conflicts are one of the most unpredictable factors that can cause severe financial stress and lead to deep systemic instability in the banking sector. Russia's military aggression against Ukraine is the largest geopolitical crisis since the end of World War II and has a significant negative impact on the economy of the country suffering from aggression. Ukraine's GDP decreased by 30,3% in 2022% (IMF, 2023b). Financial stress was also experienced by banking institutions in Ukraine, especially in the first months of the war. The Central Bank of the country – the National Bank of Ukraine (NBU) – did not publish data on the importance of prudential standards both for the banking system of Ukraine and in the context of banks in March-May 2022.

Important research questions are how military action affects the country's banking system, especially in the first months of the war, and how banks adapt to the ability to operate under martial law. This study is valuable as empirical material for central banks to develop effective anti-stress policies for banks' response to military operations, especially given the significant increase in geopolitical risks. In addition, previous military conflicts were less extensive and destructive and mainly concerned countries with a specific Muslim banking model (Afghanistan, Syria) or countries with small economies (Africa).

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For comparison, in terms of population, Ukraine (at the end of 2021) was the fifth among EU countries (after Germany, France, Spain and Italy). According to the World Bank (2023), in terms of GDP in 2021, the aggressor country (Russia) was in 11th place, and Ukraine was in 53rd place in the world.

The purpose of the article is to assess changes in the banking system of Ukraine in 2022 during martial law (at the macro level), as well as the vulnerability of Ukrainian banks to financial stress (at the micro level).

2. LITERATURE REVIEW

At the international level, the issue of the impact of war on financial stability is primarily published in the reports of international financial organizations. A chapter concerning "The Financial Stability Implications of the War in Ukraine" is published in Global Financial Stability Report (IMF, 2022). The impact of geopolitical risks on macro-financial stability in the global dimension, in particular on Russia's attack on Ukraine, is analyzed in the Global Financial Stability Report in 2023 and it is noted that „this could pose macro-financial stability risks by increasing banks' funding costs, reducing their profitability, and lowering their provision of credit to the private sector. These impacts are likely to be disproportionately larger for banks with lower capitalization ratios" (IMF, 2023a).

In the Financial Stability Review of the European Central Bank is noted that „the outbreak of war in Ukraine has compounded existing macro-financial vulnerabilities" (ECB, 2022), but it does not describe the actual and potential impact of the war on the banking system in the EU.

The results of research on the situation in the banking sector of Ukraine during the war are mainly published by researchers from Ukraine in domestic scientific publications. In the database of scientific publications *ScienceDirect* (Elsevier) as of 10.04.2023, when searching for "war in Ukraine", only 9 publications are available in subject areas such as economics, econometrics and finance, and none of them concerns banking systems, and when searching for "martial law" – 0 in subject areas such as economics, econometrics and finance. The search in the Polish scientific database *BazEkon* for the word "wojna" (in the title of the article) showed 424 results, for the word "martial" – 16, and for the word "war" – 27 334 results and none of them regarding the banking system of Ukraine during the war. In the *Biblioteka nauki* database, when searching for "war" (for 2022–2023), 213 results were obtained (regarding publications in the field of economics, finance and management) and only 3 publications related to the banking system of Ukraine during the war, written by authors from Ukraine.

Lobozynska et al. (2022), Druhov and Druhova (2022), Pshik and Oleynyuk (2022) studied the efficiency of the direct methods of the NBU in regulating the money market.

Arzhevitin et al. (2023) present a generalized description of the main components of the systemic risk of instability of the banking system based on a structural and functional analysis of its elements according to the official reports of the NBU for 2022 and previous years, as well as the prospects for its further development.

Zarutska et al. (2022) compare the key features of the banking system as of January 1 and September 1, 2022, and the corresponding changes in business models using the method of structural and functional groups of banks (SFGB).

The review shows a limited number of scientific publications, in particular in English, on the situation of Ukrainian banks during the war and confirms the need to increase research on a detailed analysis of the financial situation of banks during martial law in various dimensions (stability, changes in business models, reactions of bank customers, changes in the marketing policy of banks, etc.).

3. METHODOLOGY AND DATA

The study of the Ukrainian banking sector consisted of two stages. At the first stage (the macro level), using a traditional analytical approach, an attempt was made to study the fluctuations in the main balance sheet data of the banking sector, to assess changes in the main indicators of the aggregated balance sheet structure of the banking sector, as well as to check the level of prudential ratios of Ukrainian banks.

At the second stage (the micro level), several indicators were highlighted that helped partially determine (given the existing limitations) the level of vulnerability of banking institutions to shock, that is, "the black swan" that turned out to be Russia's military aggression in Ukraine.

To identify different groups of Ukrainian banks, taking into account existing approaches (Roengpitya et al., 2017; Farnè, Vouldis, 2017; Hryckiewicz, Kozłowski, 2017; Ayadi, De Groen, 2014), the main indicators are highlighted (low-dimensional context of variables):

(1) NBU/Lb = Amounts due to the National Bank of Ukraine/Liabilities;
(2) NPL/L = Non-performing loans/Loans;
(3) DGF/D = Compensation by Deposit Guarantee Fund/Household deposits.

The correlation of the selected indicators is low ($|\rho| < 0{,}7$) and the coefficient of variation is > 10%, which allows them to be used for cluster analysis (table 1).

Table 1. Correlation matrix of banking ratios on 01.01.2023

Ratio	DGF/D	NBU/Lb	NPL/L
DGF/D	1,00	0,08	0,18
NBU/Lb	0,08	1,00	0,16
NPL/L	0,18	0,16	1,00
Coefficient of variation, %	17,61	242,09	79,97

Source: Prepared by Author.

The following is a cluster analysis of the data set of these indicators for Ukrainian banks in quarterly periods (01.01.2022, 01.04.02.2022, 01.07.2022, 01.10.2022, 01.01.2023) to determine the modification of banking groups under the influence of war. Groups are identified using the agglomerative hierarchical clustering algorithm of Ward. The distance is set to "Euclidean". Calculations are carried out in the R using package NbClust (Charrad et al., 2014). This research used Tau (Rohlf, 1974; Milligan, 1981) index as the criterion for evaluating the optimal number of clusters.

The sample of banks covers all banks in Ukraine. Financial data of banks are obtained from the database of the National Bank of Ukraine.

The limitations of the study can be outlined by quoting the IMF document concerning Ukraine:

> While the banking system remains operational and liquid, and rising NPLs are largely provisioned, it is difficult to assess the true impact of the war on the

> financial system. […] One year after the war, the authorities recognize that the emergency measures are causing distortions, obscuring the true health of the banking sector, and inhibiting effective financial system operations and oversight (IMF, 2023b).

4. RESULTS

4.1. Analysis of the banking system of Ukraine

Even before the war began, data on the banking sector of Ukraine indicated its weak role in ensuring economic development and problems with loan servicing by bank customers. Thus, according to the World Bank (2023), the value of the domestic credit to the private sector by banks indicator (% of GDP) in 2020 in Ukraine was 20,9%, in Poland – 49,8%, and in Germany – 84,3%. For comparison, in Syria (the war has been going on since 2011), the value of this indicator in 2020 was 20,7%, and in Afghanistan (the war lasted from 2001 to 2021) – 3% (this should take into account the limited comparison of data with these countries, since the development of credit there is also limited by religious law).

The value of the non-performing loans (NPL) ratio in Ukraine in 2021 was 31,7%, in Poland – 2,9% (The World Bank, 2023), and the value of the NPL ratio based on a balanced sample of 93 significant institutions in the EU – 2,06% (ECB, 2022). For comparison, in Afghanistan at the end of 2018, the value of the NPL ratio was 8,9% (in 2010 – 49,9%), and in Ukraine in 2018 – 54,4% (in 2010 – 15,3%) (The World Bank, 2023).

After the outbreak of the war, on 01.04.2022, most of the key balance sheet components of the Ukrainian banking sector noted negative dynamics (table 2) – the significant drop affected the equity, corporate deposits and term household deposits.

NBU, based on its resolutions, launched the anti-crisis measures to maintain banking sector stability. The most important steps to stabilize the financial sector are as follows (National Bank of Ukraine, 2022):

(1) cross-border movement of capital is restricted, and the exchange rate is fixed;
(2) access to refinancing has been expanded (in particular, starting 24 February, one-year unsecured refinancing loans to cover up to 30% of retail deposits were made available to banks);
(3) the NBU will not apply sanctions against banks for violating prudential standards, open currency position limits, and deadlines for the filing of statistical reports if such violations have been due to russian aggression;
(4) banks are forbidden to distribute capital, including by paying dividends;
(5) a blanket coverage has temporarily been introduced for retail deposits;
(6) a number of new regulatory requirements have been postponed, some other were suspended;
(7) loan repayment holidays for borrowers have been regulated (in particular, during martial law and 30 days after it is lifted, credit institutions are prohibited by law from charging penalties and fines or raising interest rates on loans;
(8) some operational requirements have been simplified. Banks are allowed to use cloud services based in Europe, the United States, and Canada to prevent data destruction. A number of customer identification requirements have been eased. The limit for simplified remote verification procedures has been raised to UAH 400,000 per month from UAH 40,000. Onsite AML/CFT inspections have been suspended until martial law is lifted.

The anti-stress measures taken by the NBU and commercial banks were reflected in the growth of some banking balance sheet data on 01.01.2023, even in comparison with pre-war data (on 01.01.2022). Thus, assets grew by 14,6%, mainly due to a significant increase in investment in securities (23,09%), the value of the corporate loan portfolio remained almost unchanged, and the size of the household loan portfolio decreased by 13,47%. At the end of the year, banks' equity further indicates negative dynamics (-14,47%), but there was an increase in corporate and current household deposits. It was also possible to stop the outflow of term household deposits, the volume of which even slightly increased at the end of the year (by 4,02%).

Table 2. The banking sector of Ukraine in 2022

Key performance indicators of banks	Growth rate on previous period, %				Growth rate (base period is 01.01.2022), %		
	01.04.2022	01.07.2022	01.10.2022	01.01.2023	01.07.2022	01.10.2022	01.01.2023
Assets	-4,05	3,69	6,10	8,58	-0,50	5,57	14,63
Amounts due from the National Bank of Ukraine	39,71	14,05	13,95	29,90	59,34	81,56	135,85
Corporate loans	-0,32	0,08	5,40	-4,20	-0,24	5,15	0,73
Retail loans	3,21	-5,89	-2,04	-9,06	-2,87	-4,86	-13,47
Investments in securities and long-term investments	-10,80	3,73	9,66	21,31	-7,47	1,47	23,09
Equity	-18,55	10,88	-8,32	3,31	-9,69	-17,20	-14,47
Liabilities	-1,98	2,85	7,94	9,15	0,80	8,80	18,76
Amounts due to corporates	-10,72	6,87	9,36	12,41	-4,59	4,34	17,28
Amounts due to individuals (including saving (deposit) certificates)	5,64	2,43	9,49	8,41	8,21	18,47	28,43
Term household deposits	-9,29	-6,80	12,27	9,60	-15,46	-5,09	4,02

Source: Prepared by Author.

Analysis of indicators of the balance sheet structure of the banking system of Ukraine (table 3) allows you to formulate the following conclusions (comparison of data on 01.01.2023 to 01.01.2022):

(1) the share of loans in assets decreased by almost 8% (the most significant drop was noted in Q4). The structure of the loan portfolio is further dominated by corporate loans (77,34% of the total loan portfolio);

(2) the role of the investment portfolio in banks' assets has slightly increased (about 3%);

(3) a negative signal is a decrease in the share of equity in banks' assets (up to 9,29%);

(4) there is also a decrease in the share of term household deposits in the deposit portfolio of banks by more than 8%.

Table 3. Indicators of the Ukrainian banking sector

Indicator	01.01.2022	01.04.2022	01.07.2022	01.10.2022	01.01.2023
Amounts due from the National Bank of Ukraine / Assets	1,70	2,48	2,73	2,93	3,50
Total loans / Assets	51,89	54,33	51,67	50,49	44,02
Corporate loans / Total loans	74,67	74,08	75,18	76,42	77,34
Retail loans / Loan	22,78	23,39	22,33	21,09	20,26
Investments in securities and long-term investments / Assets	40,42	37,58	37,59	38,85	43,40
Equity / Assets	12,44	10,56	11,29	9,76	9,29
Amounts due to corporates /Liabilities	42,19	38,43	39,93	40,46	41,66
Amounts due to individuals / Liabilities	40,43	43,58	43,40	44,03	43,73
Term household deposits / Total customer deposits	43,20	37,09	33,75	34,61	34,99

Source: Prepared by Author.

When we analyze the banking indicators of financial stability based on prudential standards (table 4), their values do not exceed the limits set by the NBU. However, it should be borne in mind that capital ratios are not yet calculated under the Basel III methodology.

Table 4. Prudential ratios in the Ukrainian banking sector

Ratio	01.01.2022	01.07.2022	01.10.2022	01.01.2023
R2. Regulatory capital adequacy (sufficiency) ratio (no less than 10 %)	18,01	17,16	18,85	19,68
R3. Core capital adequacy ratio (no less than 7%)	11,99	11,40	12,75	13,12
R7. Maximum credit risk exposure per single counterparty / Regulatory capital (no more than 25%)	18,6	17,86	19,61	17,80
R9. Maximum credit exposure to related parties (no more than 25%)	3,71	4,94	4,30	2,81
R12. Total investment in securities (no more than 60%)	0,17	0,26	0,02	0,02

Source: Prepared by Author.

A negative signal about the stability of the banking sector of Ukraine is the fact that on 01.01.2023, one of the largest systemically important banks, which is a state-owned bank, does not comply with the requirements for the values of the R2, R3 and R7 ratios. Two other commercial banks also do not comply with the R7 ratio.

Regarding the liquidity of the banking sector of Ukraine, commercial banks have been required for several years to calculate the LCR and NCFR ratios under international practice, and the value of these ratios on 01.01.2023 for all banks is not less than the minimum levels set by the NBU.

4.2. Cluster analysis of banks

Before the war, 38% of Ukrainian banks (table 5) could be attributed to a stable group, for which the characteristic feature was both a low level of non-performing loans and a low level of using of NBU funds to maintain stable financing of banking activities. At the same time, almost 50% of funds on household deposits were not covered by the guarantee of Deposit Guarantee Fund (DGF). The maximum amount of compensation for deposits was 200 thousand UAH. A specific feature of the functioning of the deposit guarantee system in Ukraine, in comparison with the EU, is that guarantees apply only to households.

Table 5. Key indicators of banking clusters on 01.01.2022 (%, mean value)

Group of banks	Number of banks	Number of SIB	NPL/L	NBU/Lb	DGF/D
Group 1	27	9	13,16	9,05	53,35
Group 2	5	1	87,59	6,14	57,80
Group 3	9	0	12,53	36,30	64,30
Group 4	3	0	1,92	61,63	25,54
Group 5	10	2	23,38	0,34	83,86
Group 6	17	1	6,49	1,85	27,04

Source: Prepared by Author. SIB – systemically important banks.

During this period, we can distinguish groups of banks for which were already observed high values of ratios indicating a deterioration in their financial soundness. Thus, eight banks (11% of the total number) in groups 3 and 4 had problems concerning financing for banking activities, and for banks in Group 4, the average level of deposit coverage with DGF guarantees was also the lowest.

Banks from Group 2 (five institutions) already had a very high average level of non-performing loans in the pre-war period. It is worth noting that this group included the largest systemically important bank PrivatBank, nationalized in December 2016.

For ten banks in Group 5, the highest level of deposit coverage with DGF guarantees was a characteristic feature. And the banks from Group 6 had the most stable financial situation, but the level of deposit coverage by DGF guarantees was modest.

The low level (for most banks) of deposit coverage by DGF guarantees can be caused both by the presence of deposits for significant amounts (more than 200 thousand UAH) and deposits that fall under the exclusion from the guarantee under Part Four of Article 26 of the law of Ukraine on the deposit guarantee system for individuals, in particular, by the presence of deposits of banking insiders.

Data on 01.04.2022 (table 6) reflect how the first months of the war affected the change in the financial situation of banks. The number of banks decreased from 71 to 69 – licenses were withdrawn from two banks with Russian capital, in which the NPL/L level exceeded 80% at the beginning of 2022.

The share of Group 1 (stable banks) was 44%, but there was also a significant decrease value of DGF/D ratio that may be caused by the withdrawal of small deposits from banks by households with low incomes as a reaction to the deterioration of the economic situation in Ukraine due to the war.

Table 6. Key indicators of banking clusters on 01.04.2022 (%, mean value)

Group of banks	Number of banks	Number of SIB	NPL/L	NBU/Lb	DGF/D
Group 1	30	10	7,68	6,78	36,58
Group 2	11	2	39,21	8,33	63,06
Group 3	15	0	9,88	36,40	63,51
Group 4	3	0	1,71	66,75	26,30
Group 5	9	2	8,72	1,02	82,40

Source: Prepared by Author. SIB – systemically important banks.

We can also note the negative impact of the war in the increase in the number of banks (from eight to eighteen institutions) that used significant amounts of financial support from the NBU to finance their activities (groups 3 and 4 in Table 6). In addition, the number of institutions with a high average level of non-performing loans has doubled (up to ten banks), and two systemically important banks have already been in this group.

On April 13, 2022, the rules of law were modified to avoid a significant outflow of deposits from the banking system. During the period of martial law in Ukraine and three months from the date of its termination, the DGF pays each depositor of the insolvent bank all amounts of the deposit, including interests, except for the cases provided for in part four of Article 26 of the law of Ukraine on the deposit guarantee system for individuals.

Three months after the termination of martial law in Ukraine, the maximum amount of compensation for deposits will be at least 600 thousand UAH.

Data at the beginning of the second half of 2022 already reflect how the implemented anti-stress measures of state institutions and bank managers affected the financial stability of banks (table 7).

Table 7. Key indicators of banking clusters on 01.07.2022 (%, mean value)

Group of banks	Number of banks	Number of SIB	NPL/L	NBU/Lb	DGF/D
Group 1	32	11	8,36	3,64	99,75
Group 2	15	2	31,87	2,88	99,996
Group 3	3	1	60,21	15,41	99,995
Group 4	1	0	100,00	0,00	100,00
Group 5	7	0	18,53	28,08	99,998
Group 6	7	0	7,47	48,61	99,998
Group 7	2	0	3,01	81,33	100,00
Group 6	2	0	5,13	0,00	0,00

Source: Prepared by Author. SIB – systemically important banks.

Based on cluster analysis using Index Tau, eight groups of banks were identified. Almost half of the banks were in the group of stable financial institutions. Banks with a high level of non-performing loans were divided into three groups, in particular, banks with a very high level of NPL – more than 60%, and one bank (with foreign capital) has an

100% non-performing loan portfolio. Three systemically important banks have already been classified to groups with a high level of non-performing loans.

The number of banks with a high level of financing from NBU funds (groups 5–7) has slightly decreased (to sixteen). There was a group of two banks where funds from the NBU exceeded 80%, as well as a group of seven banks characterized by high values of both the NPL indicator and financing from the central bank.

The last group, which consists of two banks with foreign capital, was the most financially stable. These banks do not use household deposits to finance banking activities.

On 01.10.2022, the number of banks decreased by two institutions (table 8). One of the banks on 01.07.2022 (table 7) belonged to the group with a high NPL (Group 2) and the other – to the group with problems in ensuring stable funding (Group 6).

Table 8. Key indicators of banking clusters on 01.10.2022 (%, mean value)

Group of banks	Number of banks	Number of SIB	NPL/L	NBU/Lb	DGF/D
Group 1	40	12	13,70	2,38	99,56
Group 2	12	2	47,93	1,44	99,996
Group 3	1	0	100,00	0,00	100,00
Group 4	4	0	35,14	35,69	99,997
Group 5	8	0	10,15	32,64	99,998
Group 6	2	0	6,24	0,00	0,00

Source: Prepared by Author. SIB – systemically important banks.

The share of banks with stable financial soundness (Group 1) has increased to almost 60%, which indicates an increasing adaptation of the banking sector to functioning under martial law. The number of banks that had problems with liabilities management decreased, but a group of four banks stands out, for which both indicators (NPL/L and NBU/Lb) exceeded 30%. The average level of NPL for banks with small financing from the NBU (Group 2) decreased to about 48% (60% on 01.07.2022).

At the beginning of 2023, the number of banks with relatively stable financial soundness increased even more – up to 70% of the total number in the banking sector (table 9).

Table 9. Key indicators of banking clusters on 01.01.2023 (%, mean value)

Group of banks	Number of banks	Number of SIB	NPL/L	NBU/Lb	DGF/D
Group 1	47	11	15,40	3,61	99,59
Group 2	11	3	43,97	3,83	99,996
Group 3	5	1	72,72	0,00	99,996
Group 4	2	0	52,41	60,19	99,998
Group 5	2	0	5,54	0,00	0,00

Source: Prepared by Author. SIB – systemically important banks.

A positive signal is also a significant reduction in banks' problems with funding management – only two banks (Group 4) have an NBU/Lb value of about 60%; for other groups – the average value of this indicator does not exceed 3.83%. However, the involvement of four systemically important banks in groups with high and even very high NPL levels (Group 2 and 3) is an alarming signal.

In general, if we compare the data of the selected indicators with the beginning of 2022 (in the pre-war period), the situation with funding has significantly improved, but we can note a significant increase of non-performing loans.

5. CONCLUSIONS

The analysis of changes at the macro level in the banking system of Ukraine in 2022 during martial law showed that the anti-stress measures taken by the NBU and commercial banks ensured the avoidance of a significant negative stress reaction reflected in the dynamics and structure of the aggregate balance sheet of Ukrainian banks, it was possible to stop the outflow of term households deposits, but equity of banks further decreases. In terms of financial stability, reflected by the values of prudential ratios, the banking system of Ukraine remains relatively stable, but one of the largest systemically important banks has problems with capital adequacy. During 2022, banking licenses were withdrawn only for four banks out of seventy one.

The analysis of the vulnerability of Ukrainian banks to financial stress (at the micro level), reflected by ratios of the non-performing loans, the role of financing from the NBU and the level of deposit coverage by the Deposit Guarantee Fund, showed that during the year a significant number of banks had problems with ensuring stable financing of their activities and turned to the NBU as the lender of the last resort, but the situation is stabilized and at the end of the year only two banks use NBU resources at a significant level.

The worst situation was to the non-performing loans, the median of which was 18,9% at the end of 2022, and for 27% of banks exceeds 35% (including four systemically important banks), but the positive fact is that most non-performing loans are covered by reserves. Changes in legislation in Ukraine provided almost 100% coverage of household deposits in banking institutions during martial law, but the negative feature is the absence of any guarantee umbrella for corporate deposits.

Thus, the situation in the banking system of Ukraine at this difficult time was kept stable, but its further development in the future is characterized by a high level of uncertainty, as Russia's aggression against Ukraine continues.

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