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Business Models of Ukrainian Banks: the Impact of the Revolution of Dignity, the COVID–19 Pandemic, and Russia's Military Aggression

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Abstract

The purpose of the article is to identify key banking activity models in Ukraine and show how they changed under the influence of the Revolution of Dignity, the COVID–19 pandemic, and the imposition of martial law. The proposed method uses cluster analysis of the main indicators for banking activity (concerning assets, liabilities and income) based on Ward's agglomerative hierarchical clustering algorithm and the Tau index in the NbClust package as the criterion for evaluating the optimal number of clusters. The research covers all Ukrainian banks, spanning the period 2013–2022.

In 2014 (after the Revolution of Dignity), the actions of the National Bank of Ukraine (NBU) had a positive impact on the models of Ukrainian banks: there was no opaque model of banks and banking models became more transparent and more resilient to financial shocks. Between 2021 and 2022, five banking models were identified: universal banks, wholesale funding banks, corporate-investment banks, retail banks, and commission banks. The negative impact of COVID–19 on the Ukrainian economy was reflected in all banking models by the following: (1) a significant increase in the role of securities in assets, which was caused by a decrease in lending due to an increase in their riskiness; (2) the use of central bank funds to liabilities management, which was evidence of a deterioration in financing conditions in the deposit market.

The following main changes in Ukraine's banking system at the end of 2022 (during the war) were identified: (1) a decrease in the number of banks that mainly use funds from the NBU to support their activities; (2) the closure of only four banks by the NBU (including two with majority shareholders from Russia) during the year; (3) an increase in the share of the non-government debt securities portfolio in banks' assets; (4) declines in *ROE* and *ROA* for all banking models

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during the war, and three banking models became unprofitable; (5) the significantly higher share of non-performing loans in the credit portfolio for all banking models, especially for the retail banking model.
The value-added of this research is the analysis of how banking models in Ukraine have changed at the micro level (reflected in the financial statements) *inter alia* in wartime.

Keywords: bank, assets and liabilities management, martial law, corporate-investment banking, deposit-based funding

JEL: C38, G21, G32, M19

Introduction

Ukraine's banking system began to take shape in 1991 after the collapse of the Soviet Union. Its evolution was characterized by the emergence of European continental banking models, so funding was carried out mostly from deposit sources, and loans dominated among assets. Many banking institutions were opened, including many small banks, whose purpose was to finance the real business of the ultimate beneficiaries of banks (the insider banking business model). There were also many abusive practices in the activities of banks, and their financial stability was low. In 2014, the National Bank of Ukraine (NBU) significantly changed its approach to supervision, which was reflected in the withdrawal of a significant number of banking institutions. As a result of the NBU's actions, the models of existing commercial banks have become more transparent and more resilient to financial shocks.

In recent years, banks in Ukraine have faced new "black swans". First, there was the development of the COVID–19 pandemic, and from February 2022, they had to modify their activities under martial law introduced in response to Russia's military aggression against Ukraine.

Considering the existing challenges, the purpose of the article is to identify key models of banking activity in Ukraine and how they have changed under the influence of the Revolution of Dignity, the COVID–19 pandemic, and the imposition of martial law.

Literature review

Recent research on the subject can be analyzed from three perspectives: (1) approaches to identifying business models of banks based on cluster analysis, (2) defining banking models in Ukraine, and (3) characteristics of the changes in Ukraine's financial system during the war. Hanafizadeh and Marjaie (2021) noticed an obvious growth in citations of banking business model articles. Between 2002 and 2020, the number of articles discussing banking business models has increased from two articles to 25 articles per year.

Modern researchers use various approaches based on cluster analysis to identify banks' business models and analyze their changes. Farnè and Vouldis (2017, pp. 14, 20) used an enhanced version of the methodology proposed by Vichi and Kiers (2001), which developed the factorial k-means algorithm that involves both factor analysis (reducing dimensionality) and the k-means procedure (clustering objects and finding their centroids in this low-dimensional subspace). In this article, Hartigan's heuristic rule was used to select the number of clusters.

Ayadi and De Groen (2014, pp. 6, 10–13) used six instruments to form the clusters: (1) loans to banks (as a % of assets); (2) trading assets (as a % of assets); (3) bank liabilities (as a % of assets); (4) customer deposits (as a % of assets); (5) debt liabilities (as a % of assets); (6) derivative exposures (as a % of assets). They used Ward's clustering method and Calinski and Harabasz's pseudo-F index to diagnose the appropriate number of clusters.

Roengpitya et al. (2017, pp. 1, 4–5) also identified bank business models based on balance-sheet characteristics by applying Ward's agglomerative clustering algorithm and Calinski and Harabasz's F-index as a goodness-of-fit measure for a clustering outcome. Hryckiewicz and Kozłowski (2017, p. 3) used a portfolio approach, i.e., they examined bank activities and funding sources in the context of specific combinations of assets with a liability structure. They investigated systemically important banks[1] using the k-medoid clustering approach.

Mergaerts and Vander Vennet (2016, p. 74) used three profitability indicators and the Z-score as a proxy for banks' distress to investigate the long-term performance impact of bank business models in Europe from 1998 to 2013. They developed an approach based on factor analysis that uses the common variance of the business model variables to capture latent strategies. They focused on two factors. The first captures the retail orientation of the banks, while the second captures the degree of functional diversification, i.e., a lower loan ratio in exchange for a higher share of non-interest income. They documented the continuous nature of business models using multidimensional scaling that approximates the true distances between the banks using a two-dimensional representation as accurately as possible so that similar banks are grouped together.

Regarding banking models in Ukraine, Onyshchenko (2015) used seven main variables to identify business models: (1) bank loans (as a % of assets); (2) bank liabilities (as a % of assets); (3) corporate loans (as a % of assets); (4) corporate liabilities (as a % of assets); (5) household loans (as a % of assets); (6) household liabilities (as a % of assets); (7) trading assets (as a % of assets). She used cluster analysis to identify three main business models of banks: (1) retail-oriented, (2) diversified, and (3) corporate (as of 1.01.2015).

1 A systemically important bank is one whose failure might cause a financial crisis.

In another paper, Onyshchenko and Zaiats (2019) identified five main business models of banks: (1) traditional, (2) corporate, (3) retail, (4) universal, and (5) investment. They did this using six variables: (1) interbank loans (as a % of assets), (2) corporate loans (as a % of assets), (3) household loans (as a % of assets), (4) investment portfolio (as a % of assets), (5) corporate deposits (as a % of assets), and (6) household deposits (as a % of assets) (as of 1.01.2018). However, their choice of variables for analysis is open to criticism as some have a high level of negative pairwise correlation (e.g., the share of household deposits and corporate deposits in assets or the share of household loans and corporate loans in assets).

Rashkovan and Pokidin (2016, pp. 1, 17–18) analyzed seven business model variables (balance sheet): (1) Assets/Branches (UAH); (2) Average loan maturity (years); (3) Average loan size (thousands UAH); (4) Equity and subordinated banks ratio; (5) Retail loans ratio – the proportion of retail loans to revenue-generating assets; (6) Retail deposit ratio – the proportion of retail funding to the sum of overall liabilities minus subordinated debt; (7) Loans ratio – the share of loans (excluding interbank) to assets. They identified six distinct bank business models using Kohonen's self-organizing maps: (1) Households-to-Corporates, (2) Retail, (3) Universal, (4) Corporate, (5) Investment/Wholesale, and (6) Frozen/Undecided. The data they used was semi-annual, spanning January 2013 to July 2016.

Kornyliuk and Kornyliuk (2018) analyzed the specific origin of business models in the Ukrainian banking system from 2014 to 2017 using K-mean clustering. Five basic business models were identified (universal, retail, corporate, "retail finance to corporate lending," and frozen). They used balance sheet variables: (1) Retail loans to total loans; (2) Retail deposits to liabilities; (3) Non-deposit resources to liabilities; (4) Equity to assets ratio; (5) Net assets (logarithm).

Zarutska et al. (2020) proposed the structural-functional groups of banks methodology (the SFGB method) to determine and analyze banking business models, and to form the risk profil of each bank. To perform cluster analysis (using self-organizing Kohonen maps), it is suggested to use the 33 financial indicators based on National Bank of Ukraine statistics for the period from 1.01.2019 to 1.10.2019. They identified ten business models of Ukrainian banks. Meanwhile, again using the SFGB method, Zarutska et al. (2022) compared the key features of the banking system as of January 1 and September 1, 2022, and analyzed how Ukrainian banks' business models had changed in wartime.

The 2022 Russian invasion of Ukraine changed the situation in Ukraine's financial system. Pshik and Oleynyuk (2022) and Korneev (2022) described how the financial system functions in extreme conditions of martial law. Druhov and Druhova (2022) and Lobozynska, Skomorovych, and Vladychyn (2022) analyzed the main measures introduced by NBU when the Russian Federation invaded Ukraine.

Recent publications on changes in the situation of the Ukrainian financial system, and the banking sector in particular, mainly describe the measures taken by regulators. They also document proposals to ensure the financial system's stability. In contrast, this article analyzes how the models of banks' activities have changed at the micro level (reflected in the financial statements) *inter alia* in wartime.

Research methodology

In contrast to existing approaches (Ayadi and De Groen 2014; Farnè and Vouldis 2017; Hryckiewicz and Kozłowski 2017; Roengpitya et al. 2017) and similar to my previous publications (Kravchuk 2020; Kravchuk and Stoika 2021) a feature of this study is the use of a mixed approach to identify models of banking activities in Ukraine, i.e., accounting not only "choice variables" (with respect to banking activities and reflected in the composition of the balance sheet), but also "outcome" variables i.e., the results of the "choice" variables.

To identify different models of Ukrainian banks, the main indicators are highlighted (low-dimensional context of variables):

1. IL/A = Interbank lending/Total assets;
2. S/A = Securities/Total assets;
3. RL/A = Retail loans[2]/Total Assets;
4. D/Lb = Customer deposits/Total liabilities;
5. RD/D = Retail deposits (households)/Total customer deposits;
6. II/ICI = Interest income/Interest income + Commission income.

Variables were chosen based on an initial analysis of the structure of assets and liabilities in Ukraine's banking system as a whole. Its key features on 31.12.2022 (in contrast to the balance sheet structure of systemically important EU banks) are the absence of derivatives in the assets and liabilities of the balance sheet, as well as the minor role of debt securities as a source of banking funding (0.002% for the banking system as a whole, while the highest value is only 0.08% in Bank Avangard). This feature is probably positive for the current environment since the securities and derivatives market in Ukraine does not really operate in the period of martial law.

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).

2 Gross loans – loans not adjusted for reserves.

Table 1. Correlation matrix of banking ratios on 31.12.2022

Group of banks	IL/A	S/A	RL/A	D/Lb	RD/D	II/ICI
IL/A	1.00	– 0.20	– 0.15	0.14	– 0.19	0.18
S/A	– 0.20	1.00	– 0.42	– 0.19	– 0.51	0.10
RL/A	– 0.15	– 0.42	1.00	0.20	0.59	0.10
D/Lb	0.14	– 0.19	0.20	1.00	0.12	0.06
RD/D	– 0.19	– 0.51	0.59	0.12	1.00	– 0.20
II/ICI	0.18	0.10	0.10	0.06	– 0.20	1.00
Coefficient of variation, %	65.09	46.90	224.70	19.33	60.13	24.54

Source: author's elaboration based on data from NBU – National Bank of Ukraine (n.d.).

The following is a cluster analysis of the data set of these indicators for Ukrainian banks in different periods on a yearly basis (2013, 2019, 2021, 2022) to determine how various factors influence the modification of banking models (e.g., regulation and supervisory changes in 2014, the COVID–19 pandemic in 2020/2021, the ongoing war from 2022). Groups are identified using Ward's agglomerative hierarchical clustering algorithm. The distance is set to "Euclidean". Calculations are carried out in R using the NbClust package (Charrad et al. 2014). This research used the Tau (Rohlf 1974; Milligan 1981) index as the criterion for evaluating the optimal number of clusters.

The Tau index is computed between corresponding entries in two matrices. The first contains the distances between items, while the second 0/1 matrix indicates whether or not each pair of points is within the same cluster (Charrad et al. 2014, p. 10).

The Tau index is computed using the following equation:

$$Tau = \frac{s(+) - s(-)}{\left[\left(N_t\left(N_t - 1\right)/2 - t\right)\left(N_t - 1\right)/2\right)\right]^{1/2}},$$

where:

$s(+)$ represents the number of times two points not clustered together had a larger distance than two points that were in the same cluster, i.e., $s(+)$ is the number of concordant comparisons,

$s(–)$ represents the reverse outcome, i.e., $s(–)$ is the number of discordant comparisons.

Nt is the total number of distances and t is the number of comparisons of two pairs of points, where both pairs represent within-cluster comparisons or both pairs are between-cluster comparisons (Charrad et al. 2014, p. 10).

To analyze the main models of the Ukrainian banks, the following additional indicators are also used:

1. *L/A* = Loans[3]/Total assets;
2. *GS/A* = Internal government loan bonds (IGLB)/Total assets;
3. *OFA/A* = Others financial assets/Total assets;
4. *NBU/Lb* = Amounts due to the National Bank of Ukraine/Total liabilities;
5. *IB/Lb* = Interbank borrowing (Amounts due to banks)/Total liabilities;
6. *Dnc/D* = Customer deposit in national currency/Total customer deposits;
7. *L/D* = Loan[2]/Total customer deposits;
8. *NPL/L* = Non-performing loans/Loans;
9. *ROE*;
10. *ROA*.

The sample of banks covers all banks in Ukraine. The financial data of the banks were obtained from the database of the National Bank of Ukraine (n.d.).

Results

In this research, a business model is understood as a strategy that translates into similar balance sheet and income statement ratios.

Bank financial data on 31.12.2013 made it possible to identify the business models of 180 Ukrainian banks that were formed in the regulatory and economic conditions before the Revolution of Dignity in 2014. In the first stage, two banks were excluded from the sample, for which most of the indicators had a zero value. One group of banks was identified whose characteristic feature was a high OFA/A ratio (more than 20% of total assets). In the next stage, using six indicators of banking activity, four more groups of banks were identified based on cluster analysis (Table 2).

Table 2. Key indicators of banking clusters on 31.12.2013 (%)

Group of banks	*IL/A*	*S/A*	*RL/A*	*D/Lb*	*RD/D*	*II/ICI*
Group 1 (106) Universal banks						
mean	7.08	5.77	8.61	69.30	66.48	84.63

3 Gross loans – loans not adjusted for reserves.

Group of banks	*IL/A*	*S/A*	*RL/A*	*D/Lb*	*RD/D*	*II/ICI*
max	3.89	34.15	37.54	98.09	91.36	99.32
min	0.00	0.00	0.17	8.38	33.53	53.69
Group 2 (38) Corporate banks						
mean	3.72	7.15	4.13	87.10	27.97	87.18
max	54.45	40.39	16.64	99.94	55.55	99.93
min	0.00	0.00	0.00	66.02	0.00	60.60
Group 3 (18) Corporate-wholesale banks						
mean	5.18	20.28	1.21	37.73	18.60	90.76
max	30.60	73.30	6.74	78.87	51.25	99.76
min	0.00	0.00	0.00	0.58	0.00	64.37
Group 4 (5) Retail banks						
mean	3.86	0.10	69.58	57.81	88.27	65.80
max	8.24	0.47	80.58	89.74	95.33	98.94
min	1.31	0.00	52.44	11.96	73.02	38.85
Group 5 (11) Speculative banks						
mean	5.18	5.01	15.56	48.43	57.66	86.63
max	15.23	22.09	72.74	95.12	86.51	97.03
min	0.00	0.00	0.07	3.70	1.95	65.04

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

In Table 3, additional indicators are given to more clearly identify the specifics of the selected models.

The largest group was the universal banking model, in which the characteristic features were the diversification of the structure of assets and liabilities with predominant deposit-based funding (both corporate and retail deposits). Asset policy was mainly aimed at corporate lending. The credit portfolio's mean share of non-performing loans was about 12%. Investments in securities accounted for a small share of assets, mainly for liquidity management. In terms of income structure, interest income was significantly dominant.

The specifics of Group 2 (Corporate banks) involved funding their activities from corporate depositors, and their credit portfolio structure is dominated by corporate lending. Meanwhile, Group 3 (Corporate-wholesale banks) diversified their funding portfolio by actively using interbank markets (some banks also used resources from the Central bank or foreign parent banking institutions) and corporate depositors. The asset strategy was mainly aimed at corporate lending, and the share of securities

in assets is more than twice as high as for banks with universal and corporate models.

Table 3. Additional indicators of banking clusters on 31.12.2013 (%, mean values)

Group of banks	*L/A*	*GS/A*	*OFA/A*	*NBU/ Lb*	*IB/Lb*	*Dnc/D*	*L/D*	*NPL/L*	*ROE*	*ROA*
Group 1 (106) Universal banks	60.66	–	2.36	–	19.88	64.43	159.50	11.89	– 0.03	0.05
Group 2 (38) Corporate banks	64.13	–	1.41	–	6.73	76.90	117.56	6.20	4.02	0.64
Group 3 (18) Corporate-wholesale banks	38.23	–	0.89	–	35.01	72.15	556.35	8.82	– 16.07*	– 1.64
Group 4 (5) Retail banks	76.50	–	1.58	–	29.40	88.21	245.06	8.69	8.63	1.12
Group 5 (11) Speculative banks	35.19	–	34.38	–	18.15	60.84	93.04	16.90	0.61	0.05

* Without Credytprombank.
Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

The business model of Group 4 focused mostly on household loans (69.58% of total assets). This model was also the most profitable (with the highest *ROE* and *ROA* values among all groups). The last group was marked by the most opaque business model – 34% of the balance sheet comprised other financial assets. The mean share of non-performing loans in the credit portfolio was about 17%. This group included 11 banks, nine of which closed in subsequent years. Some models (universal, corporate and retail) are characterized by a high loan-to-deposit ratio (the mean value is more than 150%). It means that the banks may not have enough liquidity to cover unforeseen fund requirements.

The Revolution of Dignity in Ukraine in 2014 has played a significant role in modifying the business models of Ukrainian banks. The reform of the Central Bank, including improved banking supervision, led to the closure of a significant number of banks. On 31.12.2019, only 75 banks were operating in Ukraine. The key was a modification of existing business model variants (Table 4). In particular, there was no model of speculative opaque banks with a significant share of other financial assets in the balance sheet.

Table 4. Key indicators of banking clusters on 31.12.2019 (%)

Group of banks	*IL/A*	*S/A*	*RL/A*	*D/Lb*	*RD/D*	*II/ICI*
Group 1 (53) Universal banks						
mean	6.58	24.02	7.67	90.44	47.41	72.39
max	21.75	63.27	52.71	98.62	78.23	94.96
min	0.49	1.10	0.09	62.10	12.65	45.54
Group 2 (7) Corporate banks						
mean	7.49	21.20	3.45	47.89	43.85	86.76
max	11.49	47.01	19.65	73.38	72.62	91.57
min	1.65	0.00	0.00	2.98	21.57	76.74
Group 3 (9) Corporate-investment banks						
mean	11.10	57.70	0.84	70.02	1.70	88.38
max	26.47	76.16	5.87	98.29	8.44	99.85
min	0.01	18.23	0.00	19.52	0.00	46.53
Group 4 (3) Retail banks						
mean	3.34	4.87	76.14	92.66	89.03	84.27
max	5.82	5.96	83.60	93.76	99.37	89.32
min	0.99	3.77	68.70	92.10	92.10	80.63
Group 5 (3) Commission banks						
mean	4.74	10.55	8.23	78.75	38.49	17.87
max	12.82	23.27	17.67	87.90	50.16	23.43
min	0.01	0.00	3.09	67.65	24.68	13.71

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

In Table 5, additional indicators are given to more clearly identify the specifics of the selected models.

Universal banks were characterized by more dominant, deposit-based funding (both corporate and retail) compared to 2013 and diverse asset structures. There was a significantly larger share of securities in assets compared to 2013. In terms of income structure, the share of interest income decreased. In 2019, this model was much more profitable compared to 2013.

Corporate banks' lending operations were characterized by primarily cooperating mainly with corporate clients and maintaining a more diversified structure of banking funding – approximately 21% of total liabilities were interbank funds. A negative indication

concerning the rationality of using this banking model is that the mean share of non-performing loans in the credit portfolio was about 44%.

Table 5. Additional indicators of banking clusters on 31.12.2019 (%, mean values)

Group of banks	*GS/A*	*L/A*	*OFA/A*	*NBU/Lb*	*IB/Lb*	*Dnc/D*	*L/D*	*NPL/L*	*ROE*	*ROA*
Group 1 (53) Universal banks	7.90	48.13	0.60	0.21	1.31	65.84	79.92	23.77	9.65	1.37
Group 2 (7) Corporate banks	9.22	63.26	0.09	0.00	21.01	57.66	610.37	43.68	7.04	1.41
Group 3 (9) Corporate-investments banks	21.23	18.61	0.04	0.00	13.63	76.67	32.03	14.77	15.07	3.03
Group 4 (3) Retail banks	0.70	78.86	1.12	0.00	0.16	90.75	92.11	32.13	34.19	4.03
Group 5 (3) Commission banks	0.00	32.54	9.99	0.00	0.02	86.20	56.74	12.90	7.41	1.10

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

Another model at that time was corporate investment banking. Banks in this cluster invested more than 60% (mean value) of their assets in securities, and the share of government securities in assets was about 21%. Furthermore, the credit portfolio was significantly dominated by corporate loans. The funding of activities (in contrast to classical investment banks in international practice) in this model was carried out mainly by corporate deposits.

In contrast to 2013, retail banks (Group 5) were characterized by the use of retail deposit resources (83% of the total customer deposits) for household lending (the average value for the group was about 90% of the credit portfolio). This model was the most profitable (as of 2013).

In addition to the models found in articles by Ukrainian researchers (described in the literature review), we identify the commission banking model in 2019–2022. Its main feature was the organization of activities aimed at providing banking services that generate commission income.

In 2019, only the corporate model was characterized by a high value of the loan-to-deposit ratio (mean value is more than 610%) in contrast to 2013.

A negative feature of all banking models in 2019 is a significantly higher level of share of non-performing loans in the credit portfolio (mean value was 24%) compared to EU banking practice. This may be due to the improved quality of supervisory procedures

that Ukraine's central bank began using after reforming its model to international standards in 2014.

Analysis of the banks' financial dataset on 31.12.2021 makes it possible to determine the impact of the COVID–19 pandemic on how banks modified their business models in Ukraine. The number of banks had decreased to 71 compared to 2019 (Table 6).

Table 6. Key indicators of banking clusters on 31.12.2021 (%)

Group of banks	*IL/A*	*S/A*	*RL/A*	*D/Lb*	*RD/D*	*II/ICI*
Group 1 (43) Universal banks						
mean	9.55	32.10	5.46	80.78	40.20	71.97
max	30.35	56.98	25.59	98.82	70.37	92.61
min	0.69	0.00	0.00	0.78	18.39	37.76
Group 2 (9) Corporate investment banks						
mean	16.98	55.99	3.21	88.84	7.56	83.42
max	47.52	72.14	18.71	99.06	20.88	90.30
min	2.11	28.85	0.00	72.61	0.00	71.00
Group 3 (9) Wholesale funding banks						
mean	3.92	78.60	1.25	44.96	19.43	81.37
max	13.74	90.92	2.85	62.35	34.03	99.43
min	0.64	68.75	0.00	8.31	1.77	69.44
Group 4 (4) Retail banks						
mean	5.66	14.93	62.26	89.57	83.65	73.39
max	11.51	32.82	86.51	94.70	97.96	89.21
min	2.42	4.41	43.62	84.08	78.27	54.21
Group 5 (6) Commission banks						
mean	6.75	55.74	0.89	65.38	22.97	33.47
max	11.69	73.44	2.32	90.56	41.74	57.34
min	0.97	40.73	0.13	39.32	2.53	8.30

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

In Table 7, additional indicators are given to more clearly identify the specifics of the selected models.

Table 7. Additional indicators of banking clusters on 31.12.2021 (%, mean values)

Group of banks	*GS/A*	*L/A*	*OFA/A*	*NBU/Lb*	*IB/Lb*	*Dnc/D*	*L/D*	*NPL/L*	*ROE*	*ROA*
Group 1 (43) Universal banks	17.10	45.96	0.65	7.00	3.20	65.99	319.99	17.50	13.63	1.73
Group 2 (9) Corporate investment banks	26.96	20.25	0.17	4.82	3.92	68.39	27.17	16.78	12.24	1.52
Group 3 (9) Wholesale funding banks	67.27	7.60	0.12	40.38	4.82	79.61	38.59	10.52	2.86	– 1.01
Group 4 (4) Retail banks	5.20	67.08	2.30	2.35	0.52	84.33	85.92	18.83	36.12	4.96
Group 5 (6) Commission banks	37.99	19.52	4.24	17.35	3.99	65.38	30.98	30.42	29.96	4.04

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

The number of universal banks decreased from 53 to 43 in 2021 (Table 8). The universal model is characterized by financing banking activities from deposit sources during this period, and some banks had to take loans from the NBU. In the asset structure, the average share of government securities in assets increased (from 7.9% to 17.1%). The credit portfolio is dominated by corporate loans. In terms of income structure, the share of interest income is further reduced. The profitability of the model increased during the COVID–19 pandemic period. However, two banks, which had the universal banking model in 2019, could not quickly adapt to the changing market conditions, and they were closed by the NBU.

In the group with the corporate-investment banking model, only five banks maintained the same model in 2021, while four had modified their activities to the corporate-investment model. The share of government securities in assets had slightly increased for corporate investment banks, from 21% to almost 27%. This banking model was less profitable compared to 2019. As in previous periods, these banks were mostly funded by corporate deposits.

In 2021, we could not identify the corporate banking model from 2013–2019. Most banks from this group had modified to the universal model.

Table 8. Inter-cluster migration on 31.12.2021/31.12.2019

Group of banks	2019				
2021	Group 1 Universal (53)	Group 2 Corporate banks (7)	Group 3 Corporate-investment banks (9)	Group 4 Retail banks (3)	Group 5 Commission banks (3)
Group 1 (43) Universal banks	37	6	0	0	0
Group 2 (9) Corporate investment banks	4	0	5	0	0
Group 3 (9) Wholesale funding banks	6	1	2	0	0
Group 4 (4) Retail banks	1	0	0	3	0
Group 5 (6) Commission banks	3	0	1	0	2
Insolvent banks	2	0	1	0	1

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

During the COVID–19 pandemic period, we identified another banking model – wholesale funding banks (nine institutions, six of which used the universal model in 2019). A feature of most banks was significant financial support from the NBU, which was reflected in their balance sheet, indicating miscalculations in the construction and adaptation of models by these banks to the current environment. In assets structure dominated investment in the government securities – more than 67% of total assets.

Retail banks were still the most profitable (as was the case in 2013 and 2019). This model was partially modified in some banks based on the growing role of investments in securities (the maximum value was about 33% of assets). The commission banking model was used by six institutions, four of which had moved from other clusters (mainly from the universal banking model). By 2021, they had changed their operating format, focusing on banking products that generate commission income.

Evidence of the negative impact of COVID–19 on Ukrainian banking models: (1) a significant increase in the role of government securities in assets, caused by a decrease in credit activity due to an increase in their riskiness; (2) the use of central bank funds to manage liabilities (except for banks that use the retail business model). This confirms the deterioration in financing conditions in the deposit market. But at that time, the share of non-performing loans in credit portfolio for most banks (except for the commission model) had significantly decreased compared to 2019.

On February 24, 2022, Russia began its armed aggression against Ukraine. The NBU introduced a number of restrictions on how commercial banks function under martial

law. Analysis of banks' financial data from 31.12.2022 (Table 9) allows us to determine how banks' business models initially reacted to the situation. The number of banks decreased to 67 in comparison with the previous period (after the declaration of martial law, the licenses of two Russian banks were revoked).

Table 9. Key indicators of banking clusters on 31.12.2022 (%)

Group of banks	*IL/A*	*S/A*	*RL/A*	*D/Lb*	*RD/D*	*II/ICI*
Group 1 (44) Universal banks						
mean	12.65	36.17	5.76	87.64	41.14	80.24
max	30.83	71.43	37.75	98.89	81.30	97.18
min	2.78	7.40	0.01	61.02	13.20	57.01
Group 2 (10) Corporate investment banks						
mean	13.19	64.78	1.28	90.03	6.16	94.89
max	27.53	92.03	6.74	99.28	19.14	99.52
min	5.96	35.65	0.00	61.37	0.00	86.73
Group 3 (4) Wholesale funding banks						
mean	5.23	74.10	0.12	37.10	19.51	75.34
max	8.68	79.05	0.18	53.52	32.73	97.06
min	0.77	60.16	0.05	24.92	1.56	49.41
Group 5 (2) Retail banks						
mean	2.01	4.22	78.19	95.77	88.48	90.46
max	2.55	7.38	83.13	97.36	99.83	93.70
min	1.48	1.06	73.25	94.18	77.14	87.22
Group 5 (7) Commission banks						
mean	6.22	39.99	1.20	85.53	37.57	33.11
max	20.27	56.88	2.12	98.86	57.90	53.77
min	1.57	17.25	0.32	61.48	26.86	9.41

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

In Table 10, additional indicators are given to more clearly identify the specifics of the selected models.

Table 10. Additional indicators of banking clusters on 31.12.2022 (%, mean values)

Group of banks	*GS/A*	*L/A*	*OFA/A*	*NBU/Lb*	*IB/Lb*	*Dnc/D*	*L/D*	*NPL/L*	*ROE*	*ROA*
Group 1 (44) Universal banks	10.63	38.60	0.83	4.17	0.74	65.74	54.45	23.27	– 6.89	– 0.47
Group 2 (10) Corporate investment banks	17.05	15.46	0.11	1.49	3.42	74.80	18.28	25.85	9.16	0.05
Group 3 (4) Wholesale funding banks	36.50	8.04	1.32	30.10	4.80	82.03	90.09	28.70	– 12.13	– 3.50
Group 4 (2) Retail banks	0.9	80.74	0.58	0.00	0.07	91.04	83.85	52.34	– 94.38	– 8.42
Group 5 (7) Commission banks	12.30	25.19	2.59	1.95	0.00	71.83	32.89	26.42	23.16	4.19

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

The group of universal banks slightly decreased: 38 banks remained unchanged in their model, two banks moved to the commission model, three institutions were closed by the NBU, and six banks from other clusters migrated to the universal model (Table 11).

Table 11. Inter-clusters migration on 31.12.2022/31.12.2021

Group of banks	2021				
2022	Group 1 Universal (43)	Group 2 Corporate investment banks (9)	Group 3 Wholesale funding banks (9)	Group 4 Retail banks (4)	Group 5 Commission banks (6)
Group 1 Universal banks (44)	38	1	2	2	1
Group 2 Corporate-investment banks (10)	0	7	3	0	0
Group 3 Wholesale banks (4)	0	1	2	0	1
Group 4 Retail banks (2)	0	0	0	2	0
Group 5 Commission banks (7)	2	0	1	0	4
Insolvent banks	3	0	1	0	0

Source: author's elaboration based on data from National Bank of Ukraine (n.d.). In parentheses – the number of banks in the group.

In 2022, this model was characterized by a diversified asset structure, but the share of government bonds in assets had decreased significantly. The financing of activities was further dominated by deposits (both corporate and household). However, in contrast to the results of Zarutska et al. (2022, p. 16), who reported that the primary business

model of banks remained the classic model of corporate lending, with retail financing in the last eight months of 2022, our results indicate that retail financing did not dominate for the universal model at the end of 2022. In terms of income structure, the share of interest income had increased.

In 2022 (during wartime), fewer banks used mostly NBU funds to support their activities. At the end of 2022, there were four banks compared with nine in 2021. The corporate-investment model of banking in Ukraine is characterized by an increase in investments in securities (compared to 2021), but the share of government bonds in assets decreased significantly. The number of banks that used retail banking decreased, the share of the retail loan in total assets for these banks significantly increased, and retail deposits remained the main source of financing for their activities. However, this model is now unprofitable during wartime.

The most profitable model was commission banking, which is the least sensitive to the risk of changes in interest rates. The share of commission income is about 76% of the total interest and commission income. Funding of banking activities in this model is carried out partly based on customer deposits.

Most Ukrainian banks invested mainly in non-government securities. A comparison of S/A and GS/A ratios shows that a significant share of such instruments in investment portfolios was typical for all models. Non-government securities during wartime are low-liquid, and the current situation significantly increases the liquidity risk for Ukrainian banks. At the end of 2022, the NBU raised the minimum reserve requirements for banks, allowing up to 50% of these reserves to be formed in government securities. This may have an impact on modifications to the asset structure of most banks.

The *ROE* and *ROA* of all banking models decreased in wartime, and three banking models became unprofitable. Another negative feature of all banking models in 2022 is the significantly higher share of non-performing loans in the credit portfolio, especially for the retail banking model (mean value is about 52%) compared to 2021.

Conclusions

The research identified the key models of banking activity in Ukraine and demonstrated how they changed under the influence of the Revolution of Dignity, the COVID–19 pandemic, and the imposition of martial law.

The specific features of Ukrainian banks in all periods of analysis (in contrast to the balance sheet structure of systemically important EU banks) are the absence of derivatives in the assets and liabilities of the balance sheet, as well as the minor role of debt securities as a source of funding.

The actions of the National Bank of Ukraine in 2014 (after the Revolution of Dignity) had a positive impact on the models of Ukrainian banks. First of all, on 31.12.2019, there were no opaque banking models, the characteristic feature of which was the significant role of other financial assets in the balance sheet structure. At that time, the following specific models of banks were identified: universal banks, corporate banks, corporate investment banks, retail banks, and commission banks. The universal model was used by 71% of banks; few banks did not have deposits as the main source of funding. In contrast to classical investment banks in international practice, in the corporate-investment banking model in Ukraine, the funding of activities was carried out mainly by corporate deposits.

During the COVID–19 pandemic, banking business models were modified. In 2021, there was no corporate banking model, as there had been between 2013 and 2019. Most banks from this group had modified their activity to the universal model. Additionally, the specific wholesale funding model was identified, i.e., banks whose characteristic feature was a high share of central bank funding in liabilities (the mean value was 20% of total assets). The negative impact of COVID–19 on the Ukrainian economy was reflected in all banking models by the following: (1) a significant increase in the role of government securities in assets, which is caused by a decrease in lending due to an increase in their riskiness; (2) the use of central bank funds to manage liabilities, which was evidence of a deterioration in financing conditions in the deposit market.

In 2022, Ukrainian banks faced new challenges related to the introduction of martial law due to Russia's armed aggression. Five banking models were again identified: (1) universal banks, (2) wholesale funding banks, (3) corporate-investment banks, (4) retail banks, and (5) commission banks. The following main changes in the banking system of Ukraine at the end of 2022 (during the war) were identified: (1) fewer banks using mainly funds from the NBU to support their activities; (2) the closure by the NBU of only four banks during the year (including 2 with majority shareholders from Russia); (3) an increase in the share of the non-government debt securities portfolio in banks' assets; (4) declines in *ROE* and *ROA* for all banking models during the war, and three models became unprofitable; (5) the significantly higher share of non-performing loans in the credit portfolio for all banking models, especially for the retail banking model (the mean value is about 52%).

Given that Russia's war against Ukraine continues, it is most likely that the models of Ukrainian banks will continue to change to ensure financial stability during martial law. After the end of the war, and in light of Ukraine's declared trajectory towards EU integration, banking models will change significantly under the influence of the following two key factors: (1) participation in financing the reconstruction of the country;

(2) the need to comply with the requirements of European legal acts concerning banking activities, which will be implemented in Ukraine in the future.

The National Bank of Ukraine, using data on the modification of business models of commercial banks, should improve its banking supervision system, strengthening the preventive component based on changes in microprudential indicators, following the Basel III methodology.

The modification of Ukrainian banks' business models has not had a significant impact on the banking systems of Central and Eastern European countries due to the low level of financial capital of these countries in the banking sector of Ukraine. However, the development of this sector after the war could be an attractive investment object for financial institutions of the region.

The value-added of this research is the analysis of how the models of banks' activities in Ukraine have changed at the micro level (reflected in the financial statements), *inter alia*, in wartime.

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Modele biznesowe ukraińskich banków: wpływ Rewolucji Godności, pandemii COVID–19 i agresji militarnej Rosji

Celem niniejszego artykułu jest identyfikacja kluczowych modeli działalności bankowej na Ukrainie i ich zmian pod wpływem Rewolucji Godności, pandemii COVID–19 i wprowadzenia stanu wojennego. Zaproponowana metoda badawcza wykorzystuje analizę skupień głównych wskaźników działalności bankowej na podstawie hierarchicznej metody aglomeracyjnej Warda i indeksu Tau jako kryterium oceny optymalnej liczby skupień. Badanie obejmuje wszystkie ukraińskie banki w latach 2013–2022.

Działania Narodowego Banku Ukrainy w 2014 r. (po Rewolucji Godności) miały pozytywny wpływ na modele ukraińskich banków: modele bankowe stały się bardziej transparentne i odporne na wstrząsy finansowe. W latach 2021–2022 zidentyfikowano pięć modeli bankowych: banki uniwersalne, banki finansowania hurtowego, banki korporacyjno-inwestycyjne, banki detaliczne oraz banki prowizyjne.

Negatywny wpływ COVID–19 na ukraińską gospodarkę znalazł odzwierciedlenie we wszystkich zidentyfikowanych modelach banków w następujący sposób: 1) znacząco wzrosła rola papierów wartościowych w aktywach z powodu spadku akcji kredytowej ze względu na wzrost jej ryzyka; 2) wzrosło wykorzystanie funduszy od banku centralnego do zarządzania zobowiązaniami, a to potwierdza pogorszenie warunków finansowania na rynku depozytów.

Zidentyfikowano następujące istotne zmiany w systemie bankowym Ukrainy pod koniec 2022 r. (w czasie wojny): 1) zmniejszenie liczby banków wykorzystujących głównie fundusze od NBU do wspierania swojej działalności; 2) wycofanie w ciągu roku tylko czterech banków przez Narodowy Bank Ukrainy (w tym dwóch z większościowymi akcjonariuszami z Rosji); 3) wzrost udziału portfela nieskarbowych dłużnych papierów wartościowych w aktywach banków; 4) spadki wartości wskaźników *ROE* i *ROA* we wszystkich modelach bankowych w czasie wojny, a trzy modele bankowe stały się nieopłacalne; 5) znacznie wyższy poziom udziału kredytów zagrożonych w portfelu kredytowym dla wszystkich modeli bankowych, zwłaszcza dla modelu bankowości detalicznej.

Wartością dodaną badania jest analiza zmian modeli działalności banków w Ukrainie na poziomie mikro (odzwierciedlonych w sprawozdaniach finansowych), zwłaszcza w czasie wojny.

Słowa kluczowe: bank, zarządzanie aktywami i pasywami, stan wojenny, bankowość korporacyjno-inwestycyjna, finansowanie depozytowe