“Development of a methodology for assessing systemically important Ukrainian banks and a Z-score”

AUTHORS	Oleksandra Hirna http://orcid.org/0000-0002-1645-589X Vira Druhova http://orcid.org/0000-0001-9826-3201 http://www.researcherid.com/rid/X-1824-2018 Lidiia Dudynets http://orcid.org/0000-0003-2800-2780 Olha Vernei http://orcid.org/0000-0002-2559-4867 Dariusz Wawrzyniak https://orcid.org/0000-0002-0896-6171

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Oleksandra Hirna (Ukraine), **Vira Druhova** (Ukraine), **Lidiia Dudynets** (Ukraine), **Olha Vernei** (Ukraine), **Dariusz Wawrzyniak** (Poland)

DEVELOPMENT OF A METHODOLOGY FOR ASSESSING SYSTEMICALLY IMPORTANT UKRAINIAN BANKS AND A Z-SCORE

Abstract

The indicator-based method recommended by the Basel Committee is one of the most common approaches to identifying systemically important banks. National authorities often establish their own methodology by adding modern tools that, in their opinion, adequately capture systemic risk in their domestic economy.

The paper shows that the updated methodology for assessing systemically important Ukrainian banks can be verified on publicly available data. The analysis confirms that the updated version of the National Bank's assessment methodology is in line with those recommended by international banking institutions, but does not fully capture the current systemic risk factors.

Systematization of literary and statistical sources indicates that one of the main sources of systemic risk in Ukraine is the establishment of a state monopoly in the banking market. Thus, the assessment methodology should be supplemented by instruments to evaluate the performance of the banking business. The indicator-based method and the minus one bank Z-score approach were tested to identify Ukrainian systemically important banks from 2010 to 2017.

The loss of the leading role of PrivatBank in ensuring banking stability after the transition to state ownership since 2016, as well as the equalization of the systemic risk contribution of banks with state, foreign and domestic capital, was discovered. The study empirically confirms that Z-index, which combines the positive characteristics of the static asset return ratio and bankruptcy probability, can be used to determine the methodology as an indicator of the performance of systemically important banks, primarily state-owned banks.

Keywords systemic risk measure, transparency, banking supervision, bank performance, Z-score

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Oleksandra Hirna, Ph.D., Associate Professor, Faculty of Finance, Department of Finance, Banking and Insurance, Lviv Institute of the SHEI "Banking University", Ukraine.

Vira Druhova, Ph.D., Associate Professor, Faculty of Finance, Department of Finance, Banking and Insurance, Lviv Institute of the SHEI "Banking University", Ukraine. (Corresponding author)

Lidiia Dudynets, Ph.D., Associate Professor, Faculty of Finance, Department of Finance, Banking and Insurance, Lviv Institute of the SHEI "Banking University", Ukraine.

Olha Vernei, Ph.D., Head of Foreign Students Department, Faculty of Finance, Department of Finance, Banking and Insurance, Lviv Institute of the SHEI "Banking University", Ukraine.

Dariusz Wawrzyniak, Ph.D., Professor, Head of Banking Department, Wroclaw University of Economics and Business, Poland.

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INTRODUCTION

It is believed that competition and financial globalization in the banking sector stimulate financial innovation, open new markets and enhance efficiency. On the downside, it causes new banking risks. The global 2008–2009 financial crisis has highlighted the problem of systemically important financial institutions (SIFI) that hold a significant share of the financial market and whose potential bankruptcy is likely to disrupt the stability of the financial system. SIFI are generating systemic risk, since their aggregated neighborhood effects can potentially endanger the viability of the financial system. Therefore, SIFI have become the subject of enhanced prudential supervision. They should be required to hold a systemic importance buffer (capital), meet a special standard for liquidity and take other measures to support financial stability. In 2014, the National Bank of Ukraine (NBU) initiated the

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identification of domestic systemically important banks (D-SIBs) in Ukraine. The assessment methodology was updated in 2019.

While developing their SIFI assessment methodology, national authorities are based on recommendations from international banking bodies and international practice. On the other hand, national regulators have the right and obligation to establish their own assessment methodology that takes into account the specific national characteristics of the economy and financial systems, as well as put in place any additional requirements and other policy measures they consider to be appropriate to ensure financial stability.

In this context, the study of the correspondence between the established assessment methodology and the characteristics of the internal financial and economic system and its ability to capture all components of systemic risk in the national economy is important and necessary for the proper identification of systemically important institutions and their effective use for regulatory policy purposes.

1. LITERATURE REVIEW

The basis of the systemic risk analysis is the proper measurement of systemic risk, which has become an academic focus in the post-crisis period. There are three main approaches to identifying systemically important banks – the indicator-based measurement approach recommended by the Basel Committee, the assessment of the bank's contribution to systemic risk (the systemic risk distribution methods), and the network analysis. Depending on the direction of the assessment, the methods can be also divided into two different types, namely, assessing the vulnerability of individual banks and evaluating the financial system as a whole (Bengtsson, Holmberg, & Jonsson, 2013; Buriak, Lyeonov, & Vasylieva, 2015). The systemic risk measures could be grouped by the type of data they require as follows: macroeconomic measures, granular foundations and network measures, forward-looking risk measures, stress-test measures, cross-sectional measures, and measures of illiquidity and insolvency (Bisias, Flood, Lo, & Valavanis, 2012).

According to the indicator-based methods, individual indicators of systemic significance are quantified, weighted and transformed into a systemic score. The contribution of each bank to the whole system is found out by comparing its individual systemic score with the established level of systemic score or the average score.

The systemic risk distribution methods explore market-based models that extract the default probabilities used by market participants when pricing financial instruments. This approach uses high-frequency data about market prices and the financial condition of issuers. The examples of the distribution method indicators, which assess the vulnerability of individual banks, are as follows: the Marginal Expected Shortfall (MES), the expected capital shortfall of a financial institution in case of crisis (SRISK), and the VaR of banks, provided that the financial system is under stress (ΔCoVaR-Bank).

Alternatively, researchers also propose direct methods to capture how important a particular financial institution is for the system as a whole. Some methods were adopted to measure the whole systemic risk, conditional on a particular financial institution being in distress. Such valuation techniques include the Systemic Expected Shortfall (SES), which is developed by combining MES with leverage ratio and measures the propensity of a specific institution to be undercapitalized when the whole system is undercapitalized, and the VaR of the financial system, provided that a particular bank is in distress (ΔCoVaR-System). There are also other approaches that look into how individual institutions contribute to system-wide stress through network effects (the network methods) (Bengtsson, Holmberg, & Jonsson, 2013; Bisias, Flood, Lo, & Valavanis, 2012).

Most of the existing measures rely on either confidential accounting data or share market data, and often require additional assumptions. Thus, it is difficult to use publicly available accounting data

to measure systemic risk. From that point of view, it is a useful methodical approach for identifying systemically important domestic banks based on the leave-one-out approach and a measure of the bank insolvency risk Z-score, the so-called minus one bank Z-score, developed by Li, Tripe, and Malone (2017). Z-score is one of the most popular risk measures, which evaluates a bank's probability of insolvency. Probabilistic techniques usually require a preliminary assessment of the level of the market risk or predetermined acceptable portfolio risk. Instead, Z-score does not require prior assumptions and is based on the financial statements of institutions. An additional advantage of the Z-score is the ability to calculate and interpret it at the individual bank level, as well as for groups of banks and the banking system as a whole.

Indicator-based methods have been traditionally used to assess systemically important banks. The international standards of assessing and regulating systemic risk are being developed by the Financial Stability Board (FSB) and the Basel Committee on Banking Supervision (BCBS) in cooperation with the national supervisory authorities through the consultative documents aligning with international best practices. The framework for Global systemically important banks (G-SIB) was first issued by the BCBS in November 2011 and updated in July 2013. Published in July 2018, a revised version of the assessment methodology requires systemically important banks to hold higher capital buffers and provide incentives for G-SIBs to reduce their systemic importance.

Every financial institution has a potential impact on the financial system or the real economy. However, the extent of this impact varies significantly and is closely linked to the specific features within the country. As a result, the methodologies for assessing G-SIBs and D-SIBs are based on the same principles and dimensions, although they may consist of different instruments. Consequently, it is important for national authorities to establish their own methodology by selecting indicators, which they consider adequate to capture systemic risk in their domestic economy. In October 2012, the G-SIB framework was adapted for using with D-SIBs by the BCBS. The D-SIB framework focuses on the impact that the distress of banks may have on a domestic economy. According to the BCBS recommendations, national supervisory authorities should assess D-SIBs based on at least one of the following criteria: size, interconnectedness, substitutability and complexity of banks according to the D-SIB assessment guidelines published by the European Banking Authority (EBA) in 2014.

The national supervisory authorities modify a set of tools to consider the country's internal specifics while setting out an assessment methodology for identifying D-SIBs. To take into account quantitative and qualitative factors, national authorities often use public consultations (including Australia, the UK, Switzerland, Canada, etc.). Table 1 gives some common examples of how these modifying tools have been implemented.

In 2015, the National Bank of Ukraine started the annual evaluation of D-SIBs, when the new bank capital requirements were approved by the NBU Board Resolution On Amendments to the Instruction on Banking Regulation in Ukraine No. 312 dated May 12, 2015. The Procedure for identifying systemically important banks (PISIB-2014) was carried out in accordance with the Regulation approved by the NBU Board Resolution No. 863 dated December 25, 2014 (NBU, 2014). On June 19, 2019, the methodology was updated by the NBU Board Resolution No. 79 (PISIB-2019).

In 2015, the NBU recognized eight banks as D-SIBs: PrivatBank, Ukreximbank, Oschadbank, Delta Bank, Raiffeisen Bank Aval, Ukrsotsbank, Prominvestbank, and Sberbank of Russia. During 2016–2018, the systemically important banks were the following state-owned banks: PrivatBank, Ukreximbank, and Oschadbank. In 2019, the new methodology significantly expanded the list of systemically important banks. According to the NBU, 14 systemically important banks are the following: PrivatBank, Oschadbank, Ukreximbank, Ukrgasbank, Alfa-Bank, Ukrsotsbank, Raiffeisen Bank Aval, FUIB, Ukrsibbank, Tascombank, Universal Bank, Kredobank, OTP Bank, and Bank Pivdennyi.

The definition and characterization of the role of systemically important Ukrainian banks are widely disclosed in numerous publications of researchers and practitioners, such as Shulha and

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Table 1. Modifying tools in an assessment methodology for identifying D-SIBs

Sources: Compiled by authors based on open sources (2019).

Modifying tools	Examples of implementation	Country
Shifting the systemic importance cut-off score (between 275 and 425 basis points as recommended by EBA)	275 basis points	Ukraine
	350 basis points	Austria, Ireland
	425 basis points	Latvia and Slovakia
Optional indicators (EBA, 2014, p. 14-15)	Deposits guaranteed under the deposit guarantee system	Ukraine
	Number of payment transactions Number of branches and subsidiaries in the country and abroad	Germany
	Value of domestic payment transactions Total Assets/GDP Private sector loans/GDP Deposits to private sector/GDP Interbank market share	Pakistan
	Placement with banks Deposits and balances from banks Loans to financial concerns	Hong Kong
	Private sector loans Business loans Local services and nonprofit organizations loans Government loans	Australia
	Loans to households and non-financial corporations Agriculture loans	New Zealand
Weighting	Total assets take 20%	Canada, Australia
	Total assets take 25%	The UK, New Zealand
	Total assets take 30%	Ukraine
	Total assets take 50%	Hong Kong
Non-indicator-based methods	The contribution methods: Methods that assess the vulnerability of individual banks (MES, SRISK, ΔCoVaR-Bank); methods assessing the vulnerability of the financial system (SEM, ΔCoVaR-System)	Sweden, Canada
	The network method (analyzing the bi-lateral interbank positions using large exposures data)	Hong Kong

Kolodizieva (2016), Lavreniuk (2016), Buriak, Lyeonov, and Vasylieva (2016), Zherdetska (2017), Bura (2019), Malakhova and Klimovych (2018), Onyschenko and Rimko (2016), Lesyk (2018) and others.

The PISIB-2014 methodology was criticized by many scholars who stated that it did not sufficiently take into account many important realities and risks of the current Ukrainian financial system related to the activities of systemically important banks.

In particular, it was proposed to include criteria such as trust in society, social responsibility, and foreign capital dependence; use additional indicators such as the volume of non-guaranteed deposits, the volume of loans to legal entities and individuals; funds raised from individuals; the number of bank staff and others. Many comments on the methodology concerned the distribution of weights between criteria and indicators, especially regarding the overweight of the size criterion (70%); the need to set a threshold of systemic importance instead of an arithmetic mean; the identification of actual and potentially systemically important banks; the use of non-indicator valuation techniques such as network analysis techniques, as well as increasing the transparency of the identification and operation of systemically important banks.

The results of the empirical work indicated the main sources of systemic risk in the Ukrainian banking system. The largest banks have a lower level of financial leverage and a larger gap between foreign currency assets and liabilities than the average in the system (Zherdetska, 2017). Additional requirements for D-SIBs Tier 1 capital are estimated at 22% of risk-weighted assets, which implies

their significant capitalization (Lavreniuk, 2016). The financial stability indicators of the banking system in 2016, the level of which was critically different from the thresholds, included the indicator of the D-SIB financial stability, the level of riskiness of the D-SIB credit portfolios and the share of state capital in banks (Lesyk, 2018).

The following preventive measures have been proposed to increase the financial stability of D-SIB: constant monitoring of the viability of business models, stress testing using network analysis, limiting the size of systemically important banks, waiving state guarantees of deposits of state banks, partial or full privatization of state banks.

State ownership in the financial sector is a relevant issue not only for Ukraine. There is ongoing debate in the scientific and professional community about the advantages and disadvantages of government ownership of banks and government control of finance. On the one hand, an optimistic approach emphasizes the positive role of state-owned banks in the long-term lending policy in underdeveloped economies, where state-owned banks contribute to financial development for economic growth. On the other hand, the pessimistic approach indicates that state control over finances politicizes the redistribution of resources and reduces economic efficiency. Public property in the financial sector is widespread worldwide. On average, forty percent of the ten largest banks in the country were owned by the government at the end of the 20th century (Saffar & Boubakri, 2017, p. 7). Nevertheless, many empirical studies prove that the government ownership of banks is especially common in poor countries, in countries with poorly defined property rights, underdeveloped financial systems and slow economic growth (Saffar & Boubakri, 2017; La Porta, Lopez-de-Silanes, & Shleifer, 2000; Ferrari, Mare, & Skamnelos, 2017; Igan, Moussawi, Tieman, Zdzienicka, Dell'Ariccia, & Mauro, 2019). The countries where the government stake remained high displayed slower private investment and credit growth, as well as a deterioration in financial depth, efficiency, and competition, and less improvement in financial stability (Druhov, 2019; Saffar, & Boubakri, 2017).

The complexity of assessing the systemic importance of Ukrainian banks also lies in the opacity of their business models (Heorhiadi, Druhov, Vilhutska, Bets, Stoianovskyi, & Folwarski, 2018). To evaluate possibilities of replacing a bank in the market, it is necessary to have clear knowledge of its specialization, the types of products and services it offers and a niche in the market. R. Kornyliuk, & A. Kornyliuk (2018) identified five basic business models of the Ukrainian banking system, among which two specific models are the so-called FR-CL model (transformation of proceeds of retail into corporate loans to related parties) and the frozen banks model (this model is also called a "zombie bank", low business activity).

2. METHODS AND DATA

This paper examines the upgraded methodology for identifying D-SIB approved in Ukraine for its compliance with the recommendations of international banking bodies and internal features of the financial and economic development of Ukraine.

To provide a comparative analysis of previous (PISIB-2014) and updated (PISIB-2019) versions of the NBU methodology and its correspondence to Ukrainian realities, the study uses general and special methods of investigation, such as analysis and synthesis, generalization and systematization, the dialectical approach, and statistical indicator-based methods, which are recommended both by the Basel Committee and NBU to assess systemic risk.

According to PISIB-2019, the National Bank calculates the bank's share in the total value of the relevant indicator in the banking system according to the following formula:

$$I = \frac{I_b}{I_s}, \tag{1}$$

where I is the share of bank indicator I_b in the total value of the correspondent indicator in banking system I_s.

At the first stage, the National Bank calculates the systemic importance indicator of bank SI_1 according to the following formula:

$$SI_1 = \sum_{j=1}^{9} I_j \cdot w_j \cdot 10,000, \tag{2}$$

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where I_j is the share of the j-th bank's indicator, w_j – weights of the j-th indicator.

At the second stage, the National Bank calculates the systemic importance indicator of a bank as follows:

$$SI_2 = \frac{D_b}{D_s} \cdot 1,000, \quad (3)$$

where D_b – deposits of individuals in the bank guaranteed under the deposit guarantee system, D_s – total deposits of individuals guaranteed under the deposit guarantee system in the banking system.

To test the transparency of the updated methodology, systemically important banks of Ukraine were identified based on available data from the National Bank of Ukraine at the beginning of 2019.

To determine the influence of the state monopoly in the Ukrainian banking market on the systemic risk growth, the minus one bank Z-score approach was used. This method was proposed by Li, Tripe, and Malone (2017) to identify four largest New Zealand banks as systemically important. It is based on the aggregate bank risk measure Z-score and minus one bank Z-score, which defines a Leave-One-Out contribution to systemic risk.

Z-score is estimated according to the following formula:

$$Z = \frac{E(ROA) + EQ/TA}{\sigma(ROA)}, \quad (4)$$

where $E(ROA)$ is the expected value of ROA, $\sigma(ROA)$ – standard deviation of ROA, EQ/TA – equity-to-asset ratio.

Minus one bank Z-score catches the contribution of the considered bank to systemic risk by the difference between the performance of a banking system and the performance of the system when excluding that bank. Minus one bank Z-score is expected to be lower than the aggregated Z-score, which indicates higher risks.

To construct an aggregated Z-score and minus one bank Z-score, the statistical quarterly data of the National Bank of Ukraine were used concerning the financial statements of Ukrainian banks for the analyzed period from 2007 to 2017. The analysis identified 40 banks presented in the banking market during this period. These are four state-owned banks, 15 banks with foreign capital, and 21 banks with private Ukrainian capital.

3. RESULTS

It is important for national authorities to follow three principles while developing their own methodology for assessing D-SIBs: international practice, relevance to domestic features and transparency. The principles can serve as criteria for evaluating the quality of the established methodology. Table 2 shows main changes in the updated PISIB-2019 methodology compared to the previous one.

Consider the correlation between the assessment methodology innovations and the changes that have taken place in the economy and the financial system of Ukraine over the last five years.

The capacity of the Ukrainian banking market is relatively small and decreased sharply over the past few years. Total assets (liabilities) of the banking sector, which amounted to USD 160 billion at the beginning of 2014, decreased to USD 84 billion (beginning of 2020). The revaluation of the hryvnia equivalent of assets in foreign currency by banks after the hryvnia devaluation led to an increase in contributions to foreign currency loan reserves, which in turn necessitated the immediate replenishment of banks' capital.

In 2014–2020, after clearing the banking system of Ukraine, when the number of banks in the market decreased from 180 to 75, the concentration level of the banking system increased from low concentrated to moderately concentrated, and on deposits of individuals approached high concentration. Such changes in the structure of the banking system justify the reduction of the size criterion in the updated methodology from 70% to 30%.

At the beginning of 2020, the ratio of GDP to banking sector assets has almost halved compared to the beginning of 2014, from 83.2% to 50.1%, and loans to individuals – from 21.3% to 5.7%. The ra-

Table 2. Comparison of Basel Committee's D-SIB and 2014 and 2019 revised versions of the NBU's assessment methodologies

Sources: Compiled by authors based on BCBS and NBU (2019).

BCBS			Criteria	PISIB-2014		PISIB-2019	
Criteria	Indicators	Weight		Indicators	Weight	Indicators	Weight
Size	Total assets	25.00%	Size	Total assets	35.00%	Total assets	30.00%
				Deposits (except interbank)	35.00%		
Interconnectedness	Intra-financial system assets	8.33%	Interconnectedness	Funds raised from other banks	7.50%	Funds raised from resident banks	7.50%
	Intra-financial system liabilities	8.33%				Funds posted in resident banks	7.50%
	Debt securities outstanding	8.33%		Fund placed in other banks	7.50%	Liabilities of non-residents to the bank	7.50%
						Bank liabilities to non-residents	7.50%
Substitutability	Private sector deposits	8.33%	Direction of activity	Agriculture, industry and construction loans	15.00%	Deposits (except interbank)	10.00%
	Private sector loans	8.33%				Loans (except interbank)	10.00%
	Value of domestic payment transactions	8.33%				Annual transactions using electronic cards issued by the Bank	10.00%
						Annual initial payments in the electronic payment system	10.00%
Complexity	Value of OTC derivatives(notional)	8.33%					
	Cross-jurisdictional liabilities	8.33%					
	Cross-border claims	8.33%					

tio of loans to GDP, that is, the financial depth of the economy, has sharply decreased in recent years: at the beginning of 2020, this figure was 35%. For comparison, in 2014, this figure was at the level of 67%. Moreover, in the Eurozone, for example, this figure is more than 100%, in Turkey – 80%, and in Japan – 180%. The sectoral structure of issued loans is dominated by loans to the wholesale and retail trade, i.e. to industries with low added value. Increased lending to the real sector is still not a priority for the banking sector. Therefore, in this context, the removal of the credit indicator of the real sector of the economy, which in the old method had a weight of fifteen percent, is quite justified.

At the same time, the introduction of indicators characterizing the scope of banking, the volume of non-cash payments and new financial technologies' criterion areas of activity, brings this criterion closer to that recommended by the Basel Committee, which contains similar indicators. The introduction of the latter two indicators is especially relevant in view of the doubling of the share of non-cash transactions using electronic payments issued by Ukrainian banks in five years, which increased from 2% in 2014 to 50% in 2019 in the total structure.

In times of banking crises, foreign banks can transfer instability from foreign countries into the

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host banking system. In the updated methodology of a criterion for assessing the degree of financial relationships, the National Bank has singled out the separate assessment of relationships with non-resident banks and doubled the weight of the criterion of interconnection from 15 to 30 percent. Although over the last five years the number of banks with foreign capital has decreased from 51 in early 2005 to 35 in 2019, their share in the total number of institutions has increased from 27% to 48%, and during this period the share of banks with 100% foreign capital increased from 9% to 30% in the total number of banking institutions.

Besides updating the system of indicators in the new PISIB-2019 methodology, the algorithm for determining a bank as systemically important was changed. The comparison with the arithmetic mean of the systemic importance indicator, which has lost its relevance, in particular due to a sharp change in the structure of the banking system, was replaced by the recommended EBA comparison with the minimum systemic importance limit, which was adopted at 275 basis points. The second stage of the assessment was also introduced, which takes into account the social importance of banks that have more than one percent of total government guaranteed public deposits. This part of the methodology corresponds to the importance of monitoring trust in the banking system, as many researchers have noted.

Although the new methodology for assessing systemically important banks is in line with those recommended by international banking institutions, it still does not contain the fourth criterion for assessing complexity, primarily due to the undeveloped derivatives and debt securities market in Ukraine.

The methodological approach should be transparent, as this may be related to ever-rising expectations of bank investors and the general public. This means that the scores of assessing banks' systemic importance can be verified and subject to public scrutiny. Therefore, the indicators chosen should be mostly based on publicly available data. In different countries, the framework for identifying D-SIBs varies in the transparency of their identification methodologies. Increasing the financial sector transparency for clients and financial service providers has been identified as one of the main objectives of The 2025 Financial Sector Development Strategy of Ukraine. Tables 3 and 4 present the assessment of the systemic importance of Ukrainian banks by the PISIB-2019, based on open data on the values of indicators or their substitutes.

The valuation results were almost the same as those published by the National Bank of Ukraine (Table 4), with the exception of several foreign banks (see Table 4), which is mainly related to the second stage of the assessment.

Despite its positive features, the updated methodology does not fully capture the current systemic risk factors of the banking system of Ukraine. First and foremost, the risks are associated with the current state monopoly on the banking market. In state-owned banks, 64% of the banking system's assets, 63% of its authorized capital, almost 60% of

Table 3. Indicators and corresponding proxies to test the NBU assessment methodology

Sources: Compiled by authors (2019).

Indicators	Proxy	Weight
Stage 1		
Total assets	Total assets	30%
Funds posted in resident banks	Funds in other banks	15%
Liabilities of non-residents to the bank		
Funds raised from resident banks	Bank's funds	15%
Bank liabilities to non-residents		
Deposits (except interbank)	Clients' funds	10%
Loans (except interbank)	Loans and debts of clients	10%
Annual transactions using electronic cards issued by the Bank	Payment cards (in circulation)	10%
Annual initial payments in the electronic payment system	Payment cards (active)	10%
Stage 2		
Deposits guaranteed under the deposit guarantee system	Funds of individuals	100%

Table 4. Testing results of the NBU assessment methodology (as of January 1, 2019)

Sources: Authors' estimation (2019).

No.	Bank	Stage 1 score	Stage 2 score	Stage 1result	Stage 2 result
1	PrivatBank	2266	3486	+	+
2	Oschadbank	1414	1863	+	+
3	Alfa-Bank + Ukrsotsbank	907	669	+	+
4	Ukreximbank	839	515	+	+
5	Sberbank	699	110	+	+
6	Ukrgasbank	538	414	+	+
7	Raiffeisen Bank Aval	459	460	+	+
8	Ukrsibbank	403	299	+	+
9	FUIB	339	340	+	+
10	Credit Agricole Bank	212	132	–	+
11	OTP Bank	183	221	–	+
12	Tascombank + Universal Bank	181	241	–	+
13	Bank Pivdennyi	173	166	–	+
14	Prominvestbank	143	241	–	+
15	Kredobank	139	113	–	+
16	ProCredit Bank	116	109	–	+

individuals' investments at the beginning of 2019, the basic infrastructure of the banking system, i.e. most ATMs and active electronic cards, are concentrated. Simultaneously, the monopoly of state-owned banks leads to an increase in moral hazard due to their privileged position in the market in the form of refinancing and capitalization by the state and weak risk management, since experience shows that the state is not a successful manager. Thus, PrivatBank has the largest share of non-performing loans – more than 80%. The law on corporate governance in state-owned banks has not yet been adopted. Besides, state-owned banks in Ukraine are the major purchasers of government bonds, which in fact means financing the budget deficit and negatively affects macroeconomic stability due to increased inflation risks.

The selected sample of 40 banks holds more than 80% of total assets. The dynamics of return on assets of the sample of banks almost coincides with that for the whole banking system of Ukraine (Figure 1), except the depth of loss 2014–2015, when almost more than a third of banks were withdrawn from the market. These facts confirm the representativeness of the sample.

Sources: Compiled by authors.

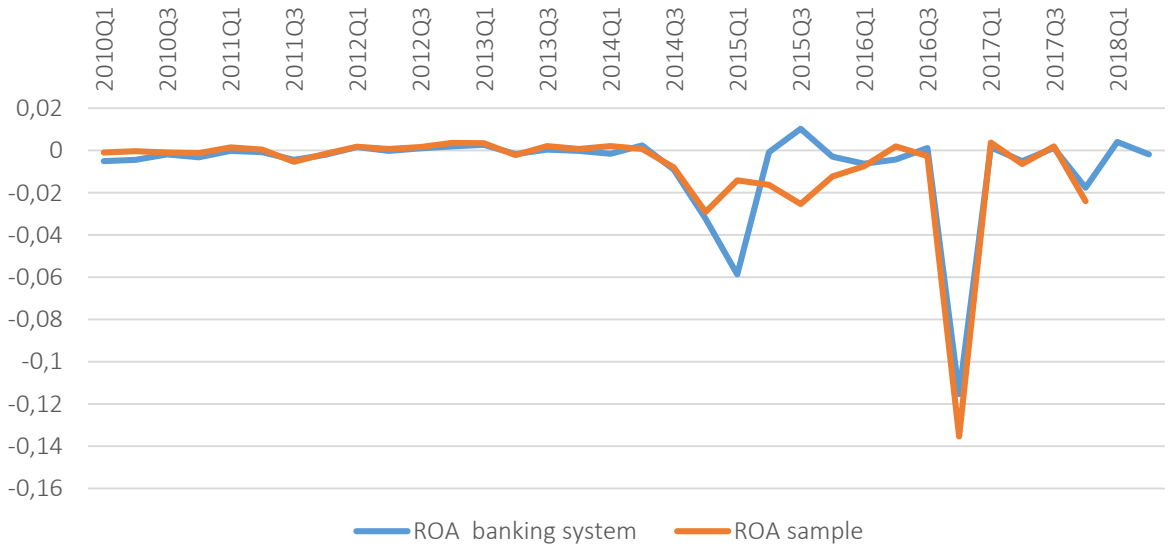

Figure 1. Return on assets over the period of 2010–2017

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Sources: Authors' estimation (2019).

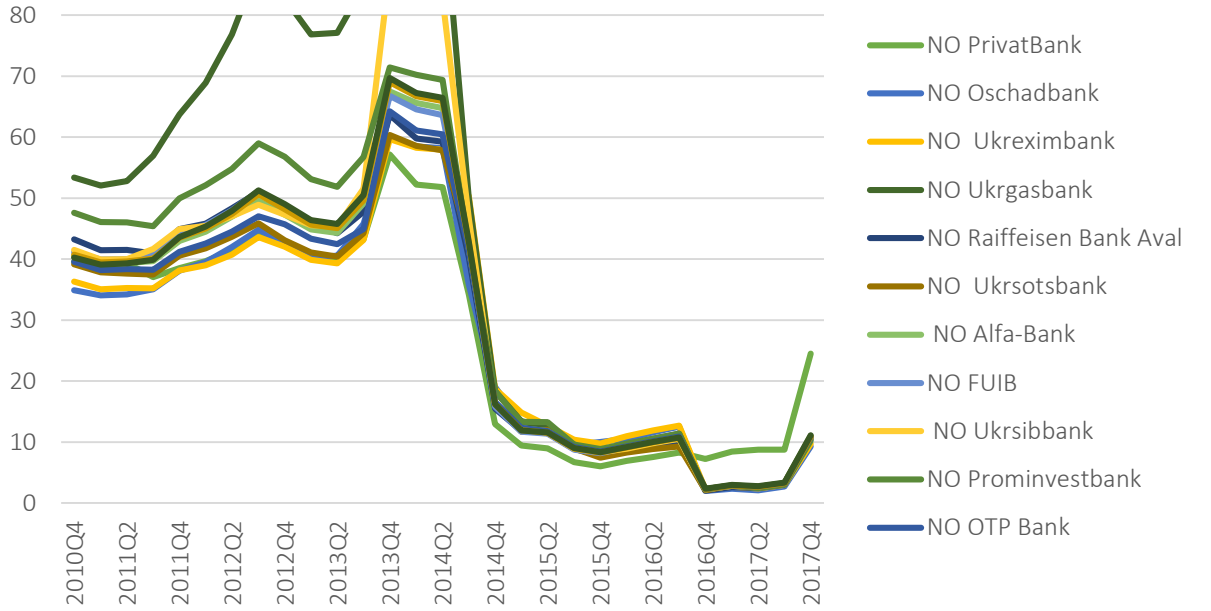

Figure 2. Trends in aggregated Z-scores and minus one bank Z-scores for Ukrainian banks, calculated using Approach 1

Based on existing approaches, minus one bank Z-scores of 12 Ukrainians banks and aggregated Z-scores are calculated for the sample using two main approaches (Li, 2018).

Approach 1: Moving mean and standard deviation of ROA over the previous 16 quarters (or four years) are computed and combined with the current period value of the equity-to-asset ratio (see Figure 2).

Sources: Authors' estimation (2019).

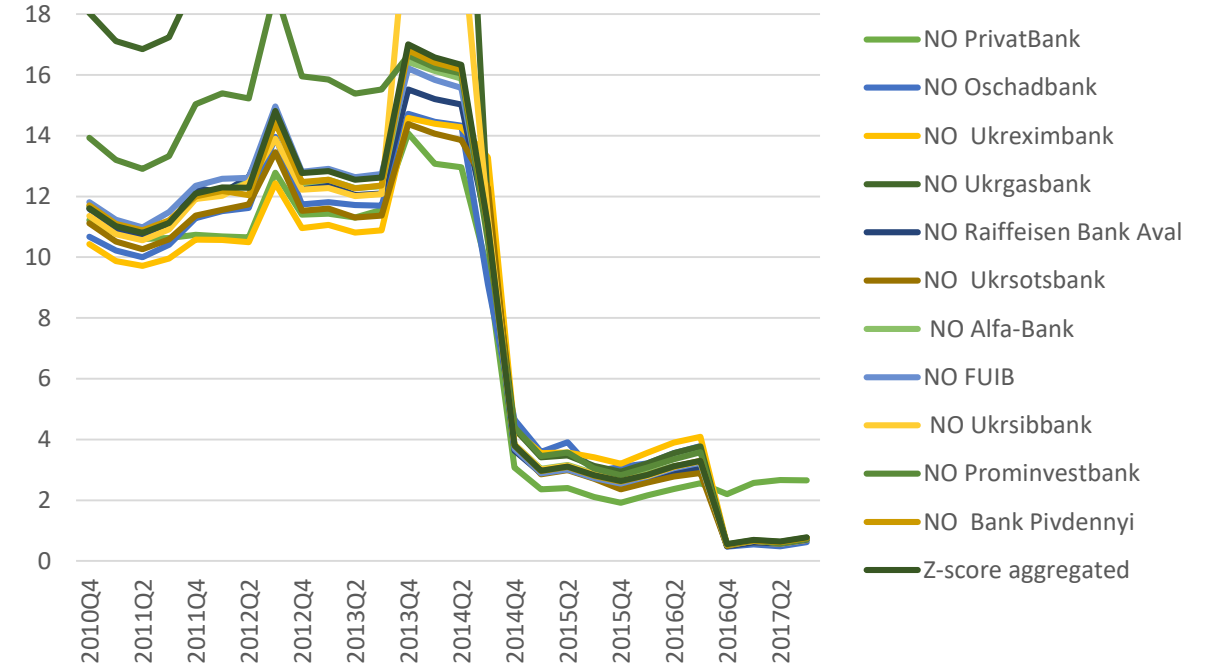

Figure 3. Trends in aggregated Z-scores and minus one bank Z-scores for Ukrainian banks, calculated using Approach 2.

Table 5. Aggregated Z-scores and minus one bank Z-scores for Ukrainian banks for 2015–2017

Sources: Authors' estimation (2019).

	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1	2017Q2	2017Q3
NO PrivatBank	9.44	8.95	6.72	6.03	6.93	7.55	8.28	7.24	8.44	8.75	8.76
NO Oschadbank	13.02	12.82	9.53	10.04	10.56	11.58	12.55	2.00	2.36	2.10	2.69
NO Ukreximbank	14.85	12.68	10.35	9.73	10.95	11.92	12.70	2.27	2.63	2.41	2.96
NO Ukrgasbank	13.43	12.36	9.30	8.62	9.59	10.53	11.39	2.20	2.84	2.61	3.21
NO Raiffeisen Bank Aval	11.86	11.46	8.84	7.86	8.62	9.44	10.09	2.04	2.61	2.45	3.01
NOUkrsotsbank	11.70	12.00	8.98	7.44	8.28	8.84	9.29	2.09	2.85	2.61	3.24
NO Alfa-Bank	12.27	11.77	9.13	8.41	9.27	10.06	10.51	2.31	2.93	2.69	3.29
NO FUIB	11.71	11.37	8.77	8.17	9.04	9.90	10.64	2.23	2.82	2.58	3.16
NO Ukrsibbank	12.14	11.56	8.93	8.35	8.93	9.80	10.55	2.23	2.82	2.58	3.15
NO Prominvestbank	13.30	13.25	9.60	8.83	9.74	10.51	11.39	2.23	2.85	2.46	3.04
NO OTP Bank	12.35	11.82	9.18	8.46	9.27	10.13	10.88	2.27	2.87	2.64	3.21
NO Bank Pivdennyi	11.97	11.56	8.96	8.27	9.10	9.95	10.71	2.28	2.88	2.65	3.23
Z-score aggregated	11.87	11.58	9.03	8.33	9.15	10.00	10.75	2.36	2.98	2.74	3.33

Approach 2: The range between the maximum and minimum values of ROA over previous 16 quarters (or four years) is used as a volatility measure and combined with the moving mean of ROA over previous 16 quarters (or four years) and current period value of the equity-to-asset ratio (see Figure 3).

Due to biased distributions of the data series, more realistic values of the minus one bank Z-scores are obtained using Approach 2.

Although approaches 1 and 2 derive different patterns of graphs, they generally agree on the trends of the minus one bank Z-score time-varying rows over the sample periods.

The minus one bank Z-score approach made it possible to compare the contribution of the banks considered to systemic risk in terms of achieving the banking goals during 2010–2017 (see Figure 1).

First, the analysis has not confirmed the list of CSRs determined by the NBU on basic 2014 methodology. It is shown that during 2015–2016, the largest contribution to systemic risk was made by PrivatBank. Besides, the D-SIB list includes banks with foreign capital, such as Raiffeisen Bank Aval, Ukrsibbank, and Ukrsotsbank, and banks with Ukrainian capital, such as FUIB and Bank Pivdennyi. In contrast, Prominvestbank, Oschadbank and Ukreximbank are not identified as systemically important during this period.

Second, the study revealed the loss of the leading role of PrivatBank in ensuring the banking stability after the transition to state ownership since 2016, as well as the equalization of the systemic risk contribution of banks with state, foreign and domestic capital.

CONCLUSION

The features of the Ukrainian banking system differ from other countries. Therefore, the selected indicators of the D-SIM framework should be closely related to the domestic financial system and economy. This is in line with the Basel Recommendations, which allow for a degree of autonomy of the national authority to reflect domestic characteristics.

The transparency testing results show that the new PISIB-2019 methodology can be verified based on publicly available data. The valuation results were practically the same as those published by the National Bank of Ukraine.

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Systemic risk is a phenomenon that may arise from different sources and spread through various channels. Although the new PISIB-2019 methodology for assessing D-SIB is in line with those recommended by international banking institutions, it does not fully capture the current systemic risk factors, such as rapid shrinking of the banking sector during 2015–2018, current state monopoly on the banking market and the lack of clear business strategy for banks.

The methodology for assessing Ukrainian systemically important banks should be complemented by non-index-based tools that are developed and actively implemented in different countries. In Ukraine, financial soundness measures as an assessment of the ability of systemically important banks to fulfil their target functions should be added.

A Z-index has been discovered that combines the positive characteristics of the static asset return ratio and the bankruptcy probability and can be used in the Ukrainian D-SIB assessment methodology as an indicator of the performance of systemically important banks, primarily state-owned banks.

AUTHOR CONTRIBUTIONS

Conceptualization: Oleksandra Hirna, Vira Druhova, Lidiia Dudynets, Olha Vernei.
Data curation: Oleksandra Hirna, Vira Druhova, Lidiia Dudynets, Dariusz Wawrzyniak.
Funding acquisition: Lidiia Dudynets, Olha Vernei.
Investigation: Oleksandra Hirna.
Methodology: Vira Druhova, Dariusz Wawrzyniak.
Project administration: Dariusz Wawrzyniak.
Resources: Oleksandra Hirna.
Software: Oleksandra Hirna, Vira Druhova, Lidiia Dudynets, Olha Vernei.
Supervision: Dariusz Wawrzyniak.

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