

“Geo-financial stability of the global banking system”

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GEO-FINANCIAL STABILITY OF THE GLOBAL BANKING SYSTEM

Abstract

The development of globalization creates a need for diagnosis of financial stability at the global level. This study aims to analyze the financial stability of the global banking system and identify threats to stability at the level of geographic regions and countries. The study uses the methods of a structured system, comparative and cluster analysis. The empirical study is based on World Bank data for 126 countries for the period 1998–2017. One of the key results of the study is the development of quantitative indicators of the financial stability of the world banking system. These indicators differ from the existing ones due to the predictive nature of the former. The study also proposes criteria of qualitative assessment of the level of financial stability of the world banking system and its individual elements in the form of regional and national banking systems. In addition, appropriate algorithms were developed to calculate the proposed indicators and criteria. The results helped to form clusters of countries in terms of the level of their banking system stability, compile maps of financial stability risks at the global level, and identify countries that are sources of potential threats to financial stability. The empirical part of the study confirms the practical applicability of the proposed analytical tools. The study shows that in 2017, the banking system of Asian countries moved to the high-risk zone. Potential threats to the financial stability of the global banking system come from the European and Asian banking systems, as well as from the Australian banking system.

Keywords

financial stability, banking systems, global risks, financial vulnerability, geofinance

JEL Classification

G21, G28

INTRODUCTION

The global financial crisis of 2008 exposed the disadvantages of the traditional banking regulation instruments, their inability to capture the accumulating systemic risks. The international banking regulatory authorities responded to the global crisis by developing a new concept of financial regulation known as Basel III (BCBS, 2010). Basel III contains new regulatory requirements for the capital adequacy of banks, their structure, the requirements for banks to create protective and countercyclical capital buffers and to introduce a leverage indicator. In addition, Basel III implies more strict supervision of systemically important banks and introduction of an additional capital buffer for them. In 2015, the Financial Stability Board increased the requirements for the financial stability of systemically important banks (Financial Stability Board, 2015).

An analysis of the regulatory requirements of Basel III shows that these requirements are divided into two levels (global and national), and the conditions for their application are differentiated depending on the level of development of countries and their banking systems and do not take into account geo-financial risks. Meanwhile, the need to iden-

tify territorial imbalances in the global banking system is already overdue. So, Borodacheva et al. (2016) directly indicate that it is necessary to study the impact of the crisis on the regions, especially in terms of the functioning of banking institutions. Ugeux (2014) notes that within the framework of financial regulatory reforms, governments tried to create a new regulatory framework that would avoid the use of taxpayers' money to save banks. As a result of uncoordinated efforts, they developed a series of vertical rules not related to each other. This is clearly not enough to prevent financial instability. Therefore, horizontal adjustment is urgently required. Investigating the problem of regulatory fragmentation of modern regulatory requirements, Phua (2019) concludes that this fragmentation is a consequence of the universal standards of Basel, which are calibrated based on data from banks operating internationally. The author believes that these calibrations are not necessarily suitable for Asian banks. In his opinion, a more detailed approach to sizing or a proportionality strategy can serve as reasonable alternatives to make the Basel standards more suitable for specific geographic regions. These statements suggest that in order to further develop the regulatory reform, there is a need to diagnose the geo-financial vulnerability of the global banking system. The desire to solve this problem was the motivation of this study.

1. LITERATURE REVIEW

Numerous studies analyzed by Kahou and Lehar (2017) and Gross et al. (2018) clearly demonstrate that banking stability is fundamental not only for the overall stability of financial systems, but also for the stability of the economy as a whole. And the recent global financial crisis further proves this point. This circumstance prompted the scientific community to focus on the problem of diagnosing and regulating the financial stability of banks not only at the micro and macro levels, but also at the global economic level. At the same time, the majority of studies focus on ways to set particular regulatory requirements for banks that could help reduce the likelihood of new crises.

Analysis of the scientific and professional literature on this issue shows that in order to protect banks from going bankrupt, governments have developed a number of early crisis warning systems and predictive indicator models. However, as some authors note (Behn et al., 2017; Zulkhibri, 2019; Climent et al., 2019), the scope and depth of the recent financial crisis indicate that these methods should be improved in order to become a useful tool for regulators and financial institution managers.

Currently, the majority of publications on the stability of banking systems are aimed at studying the effectiveness of the banking regulation reform known as Basel III. Analyzing the effectiveness of this reform, King (2010) notes that there are many reasons why Basel III requirements alone will not

prevent a new crisis. One of the main reasons, in the author's opinion, is that capital levels are calculated based on past experience, without taking into account the possibility of new events affecting the magnitude of banking risks.

Among the measures proposed by the scholars to increase the effectiveness of banking regulation reform, four key directions can be distinguished. The first direction proposed by many authors (Miles, 2010; Admati, 2016; Thakor, 2018; Gospodarchuk, 2019) consists in the transition to much higher levels of capital requirements for banks. The second direction supposes simplification of bank regulatory requirements (Kupiec, 2016; Herring, 2016; Nguyen, 2019). The third direction is related to the requirements to limit the debt of banks (King, 2010; Haldane & Madouros, 2012; Schoenmaker & Wiertz, 2015; Schoenmaker & Wiertz, 2016). The fourth direction consists in complementing the vertical rules of banking regulation with horizontal rules that take into account territorial imbalances (Borodacheva et al., 2016; Phua, 2019).

So far, the fourth direction remains the least studied, therefore, it is of particular scientific interest. The key research trends of this direction include comparative analysis of the functioning of the banking systems of different countries and identification of threats to financial stability at the global level.

An example of such research is the work of Radulescu et al. (2017). The authors used multi-criteria analysis to compare the banking systems of 28

EU member states. According to the results of the analysis, banking systems of Portugal and Greece scored last in their banking system rankings.

Ruza et al. (2019) developed a new indicator (CI) of the sustainability of banking systems in developed countries. Using this indicator, they empirically assessed the stability of a group of countries with more developed economies and two European countries that were receiving financial support. The analysis revealed significant differences in the stability of the banking systems of these countries and identified Canada and the United States as the most sustainable countries. The authors conclude that the analysis of financial stability using the indicator (CI) allows for better identification of potential weaknesses in the stability of banking systems.

Naceur et al. (2019) used a database of almost 100 countries around the world to estimate the impact of the level of financial development of countries on financial stability. The authors concluded that financial development led to financial stability for the duration of 1-2 years. In addition, while access to financial resources was deemed destabilizing for developed countries, it appears to be stabilizing for developing countries and low-income countries. According to the authors, both results are important for financial regulation.

Continuing this topic, Hernandez et al. (2020) conducted a comparative analysis of banks from developed and developing countries of Americas. The results show that in developed countries of Americas, the largest banks from the United States make the largest contribution to the aggregate portfolio risk, while banks from Canada carry the least risk. In developing countries of Americas, Brazilian banks carry the highest risk in terms of aggregate portfolio risk, while banks in Peru and one bank in Colombia carry the lowest risk. Portfolios of banks from developing countries in Americas offer greater diversification potential and lower overall portfolio allocation risk.

Ter-Mkrtchyan and Franklin (2020) examined how the level of development and political stability of countries, the quality of regulation and the rule of law could affect the efficiency of the financial system. Having analyzed the data from 139

countries, they found that political stability and the rule of law affected the depth and effectiveness of the financial system serving as indirect indicators of its effectiveness.

Summarizing the research results on the topic shows that at the moment the studies focus mainly on a comparative analysis of the financial stability of banking systems in developed and developing countries. Accordingly, they do not offer analytical tools for a comparative analysis of the stability of banking systems within geographic areas and identification of geo-financial threats to the stability of the global banking system.

2. AIMS

This study aims to analyze the financial stability of the global banking system and identify threats to stability in geographic regions and countries.

3. METHODS

3.1. Selection of indicators for the quantitative assessment of the financial stability of the global banking system and its structural elements: geo- and national banking systems

Currently, there exist two methodological approaches to the diagnosis of financial stability of banking systems: universal and risk-oriented.

Within the universal approach, sensitivity to external shocks and the effects of “infection” are investigated. This methodological approach allows drawing the conclusion about the financial stability of banking systems based on the compliance of the achieved values of financial indicators with the established criteria. These criteria are usually developed using one of the following methods:

- 1) average values for previous periods;
- 2) threshold values of prudential standards established by the banking supervisory authorities applied at the aggregated level;

- 3) trigger points;
- 4) cross-country comparisons;
- 5) criteria derived from econometric studies.

The following basic concepts are used within the framework of the risk-oriented approach: the concept of structural changes (Bhattacharya et al., 2015); the concept of default (Aspachs et al., 2007); the concept of regulatory (economic) capital (BCBS, 2004); the concept of leverage (King, 2010); and the debt limitation concept (Trichet, 2011).

In many cases, the financial stability of a bank is assessed using a ratio of a certain value indicator to the size of the risks taken. Of all the possible options, the ratio of profitability to risk (IPR) looks the most favorable. At the same time, taking into account the main goal of the banks' activities makes the profit/risk ratio more preferable.

Using the IPR ratio in assessing the financial stability of banking systems, in comparison with the available diagnostic tools, has the following advantages:

- first, the IPR ratio is a very common indicator used in investment analysis;
- second, the ratio of profitability to risk shows the availability of additional (on top of bank's own capital) sources of funds to cover risks; and
- third, it indicates the effectiveness of a bank.

However, despite these advantages, the calculation of the IPR ratio in relation to banks is not practiced due to both the complexity of determining the magnitude of banking risks and limited access of external users to all the information necessary for these calculations. Thus, the practical use of the IPR indicator to assess the financial stability of banking systems comes down to finding a simplified option for determining profit and risks based on publicly available information.

Given the imperfection of regulatory capital concepts, it is proposed to use the concept of effective risks to assess financial stability at the global level. According to this concept (G. Gospodarchuk & S. Gospodarchuk, 2017),

the ratio of profitability and risk (IPR) should be applied as indicators of the financial stability of the global banking system and its structural elements. It is advisable to use the profit of banking systems as an indicator of profitability, and the value of their risky assets as an indicator of risk. The idea of using this indicator is that if there is a profit, banks will be able to use it to cover the assumed unaccounted risks, which, ultimately, will allow them to maintain stability in the future.

IPR indicators cannot be calculated directly from statistics, as data on profitability and risk of organizations are available for a very small number of countries. In this research, formulas (1-7) for calculating IPR from the World Bank data were developed. The IPR is calculated as follows:

1. Determining the assets of the banking system for each country:

$$A = K \cdot Q, \quad (1)$$

where A – assets of the banking system of the country, US dollars; K – assets to GDP ratio for the banking system of the country (from statistical data); and Q – GDP of the country at current prices (from statistical data), US dollars.

2. Determining the profit of the banking system for each country:

$$P = A \cdot ROA, \quad (2)$$

where P – profit of the banking system of the country, US dollars; A – assets of the banking system of the country (calculated), US dollars; and ROA – return on assets of the banking system of the country (from statistical data).

3. Determining the equity capital of the banking system for each country:

$$C = P / ROE, \quad (3)$$

where C – equity capital of the banking system of the country, US dollars; P – profit of the banking system of the country (calculated), US dollars; and ROE – return on equity of the banking system of the country (from statistical data).

4. Determining the risk-weighted assets of the banking system for each country:

$$R = C / N, \quad (4)$$

where R – risk-weighted assets of the banking system of the country, US dollars; C – equity capital of the banking system of the country (calculated), US dollars; and N – regulatory capital to risk-weighted assets of the banking system of the country (from statistical data).

5. Determining the financial stability index of the banking system for each country:

$$IPR = P / R, \quad (5)$$

where IPR – index of financial stability of the banking system of the country; P – profit of the banking system of the country (calculated), US dollars; and R – risk-weighted assets of the banking system of the country (calculated), US dollars.

6. Determining the financial stability index for groups of banking systems and for the global banking system, using aggregate values:

$$IPRc, IPRg = \sum_{i=1}^n P_i / \sum_{i=1}^n R_i, \quad (6)$$

where n – number of countries used in the calculation; P_i – profit of the banking system of the i -th country (calculated), US dollars; and R_i – risk-weighted assets of the banking system of the i -th country (calculated), US dollars.

7. Also, the financial stability index for groups of banking systems and for the global banking system can be calculated using the weighted average formula (where assets are used as weights). It gives similar but not exactly equal results¹:

$$IPRc, IPRg = \sum_{i=1}^n (IPR_i \cdot A_i) / \sum_{i=1}^n A_i, \quad (7)$$

where n – number of countries used in the calculation; $IPRc$ – financial stability index of the country group; $IPRg$ – financial stability index of the global banking system; IPR_i – financial stability index of

the banking system of the i -th country (calculated); A_i – financial stability index of the banking system of the i -th country (calculated), US dollars.

3.2. Development of criteria for qualitative assessment of the level of financial sustainability of the global banking system and its structural elements: geo- and national banking systems

To qualitatively characterize the financial stability of banking systems, it is proposed to use special criteria that allow determining the level of financial stability by the actual values of the indicators (Table 1). It is proposed to use five quality characteristics of financial stability: high, good, satisfactory, low, and unstable.

Table 1. Qualitative assessment criteria of financial sustainability

Source: Authors.

Financial stability levels	Values of financial stability criteria (IPR , $IPRc$, $IPRg$)
High	$(IPR, IPRc, IPRg) \geq 4.5\%$
Good	$3\% \leq (IPR, IPRc, IPRg) < 4.5\%$
Satisfactory	$1.5\% \leq (IPR, IPRc, IPRg) < 3\%$
Low	$0\% \leq (IPR, IPRc, IPRg) < 1.5\%$
Unstable	$(IPR, IPRc, IPRg) < 0\%$

Ranges of financial sustainability were formed with a step equal to 1.5%. The step size was chosen based on the following considerations. Statistical data from the World Bank² was used to determine the IPR values for the period 1998–2017. Next, after eliminating the extreme values of this indicator, the value of the maximum positive IPR value of the countries was determined and this interval was divided into three equal parts. As a result, the lower limit of satisfactory financial stability was 1.5%, which corresponds to the median value of IPR.

The resulting five intervals were then combined into risk zones: risk-free, neutral and risky (Table 2). The following values were assigned to the risk-free zone: $(IPR, IPRc, IPRg) \geq 3.0\%$, neutral zone:

¹ This formula is only for reference, actually formula (6) was used.

² <https://data.worldbank.org/>

Table 2. Risk zones

Source: Authors.

Risk zones	Financial stability level	Values of financial stability criteria (<i>IPR</i> , <i>IPRc</i> , <i>IPRg</i>)
Risk-free zone	Excellent: (<i>IPR</i> , <i>IPRc</i> , <i>IPRg</i>) $\geq 4.5\%$ Good: $3\% \leq (\text{IPR}, \text{IPRc}, \text{IPRg}) < 4.5\%$	(<i>IPR</i> , <i>IPRc</i> , <i>IPRg</i>) $\geq 3.0\%$
Neutral zone	Satisfactory: $1.5\% \leq (\text{IPR}, \text{IPRc}, \text{IPRg}) < 3\%$	$1.5\% \leq (\text{IPR}, \text{IPRc}, \text{IPRg}) < 3.0\%$
Risk zone	Low: $0\% \leq (\text{IPR}, \text{IPRc}, \text{IPRg}) < 1.5\%$ Unstable: (<i>IPR</i> , <i>IPRc</i> , <i>IPRg</i>) $< 0\%$	(<i>IPR</i> , <i>IPRc</i> , <i>IPRg</i>) $< 1.5\%$

$1.5\% \leq (\text{IPR}, \text{IPRc}, \text{IPRg}) < 3\%$, and risk zone: (*IPR*, *IPRc*, *IPRg*) $< 1.5\%$. Unstable level of financial stability (*IPR*, *IPRc*, *IPRg*) < 0 occurs in the absence of profit or the presence of losses. This level will reflect the presence of crisis in banking systems.

The qualitative characteristic of the stability of the global banking system and its structural elements is of great importance, since it adds multifunctionality to the multilevel system of stability indicators. It can be used not only to determine the institutional threats to financial stability at the global level, but also to formulate quantitatively expressed strategic goals of global and geo-financial prudential policies.

4. RESULTS

The data for empirical research was obtained by analyzing indicators on the state of national banking systems of 180 countries for the period 1998–2017. 2018 and 2019 were excluded from the analysis due to the lack of data on a number of indicators used in the calculation of *IPRg*, *IPRc*, and *IPR* indices. Several countries were excluded from the analysis for the same reason. Next, the following

geo-zones were identified for the structural analysis of the global banking system: European Union, Europe, Asia, Africa, North America, South America, Australia. The list of countries included in each geo-zone is presented in Table 3.

The sustainability indicators of the global banking system (*IPRg*), its geo-subsystems (*IPRc*) and national banking systems (*IPR*) were calculated using the proposed algorithm (1-7) and the classification of countries by geo-zones (Table 3). The results of these calculations are provided in Table 4 and in Figure 1.

Data analysis shows that during 1998–2017 the level of sustainability of the global banking system varied depending on the presence of crisis situations on a global scale. At the same time, the Asian 1998 crisis had more pronounced negative consequences than the financial crisis of 2008. The 2014 crisis was geo-local in nature and, therefore, did not have a significant impact on the level of sustainability of the global banking system. An analysis of the dynamics of the *IPR* index shows that after the 2008 crisis, the stability of the global banking system tends to increase. This is largely due to the reform of banking regulation, known as

Table 3. Sample countries

Region	Countries
European Union	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain
Europe	Albania, Belarus, Bosnia and Herzegovina, Iceland, Macedonia, Moldova, Norway, Russia, Serbia, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and all EU countries
Asia	Azerbaijan, Armenia, Bahrain, Bhutan, Cambodia, China, Georgia, Hong Kong, India, Indonesia, Israel, Japan, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Macao, Malaysia, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, South Korea, Tajikistan, Thailand, United Arab Emirates, Vietnam, Yemen
Africa	Algeria, Burundi, Cameroon, Central African Republic, Chad, Egypt, Equatorial Guinea, Gabon, Ghana, Kenya, Lesotho, Madagascar, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Republic of the Congo, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Tunisia, Uganda, Zambia, Rwanda
North America	Costa Rica, Dominican Republic, El Salvador, Grenada, Guatemala, Honduras, Mexico, Panama, Trinidad and Tobago, USA
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela
Australia	Brunei, Australia, New Zealand, Samoa, Vanuatu

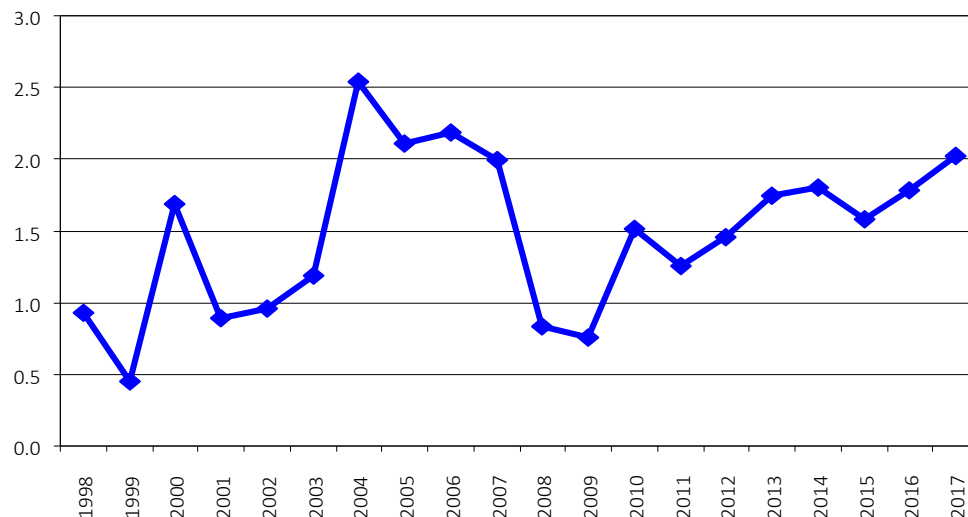


Figure 1. Financial stability index of the global banking system (PR)

Basel II and Basel III. Additionally, an increase in the financial stability of the global banking system by the end of the analyzed period was affected by the decline in the share of countries and the share of assets of their banking systems located in the risk zone (Figure 2).

However, by the end of 2017, the level of sustainability of the global banking system still remained below the pre-crisis 2006. This demonstrates the

need to further improve the regulatory framework for financial regulation at the global level.

The dynamics of the financial stability of the global banking system was the result of a change in the financial stability of its geo-subsystems, which was multidirectional by nature. Figures 3-6 show graphs characterizing the dynamics of the financial stability of geo-banking systems against the global trend of this indicator.

Table 4. Indicators of financial sustainability of the global banking system (IPRg) and geo-subsystems (IPRc)

Source: Authors.

Year	World	European Union	Europe	Asia	Africa	North America	South America	Australia
1998	0.9299	2.4001	1.6047	-1.3365	0.7797	2.6800	0.6539	1.5883
1999	0.4461	1.1464	1.4186	-2.2800	1.7085	3.2090	1.2453	0.8878
2000	1.6884	1.2776	1.7246	0.9988	1.8011	2.5791	0.7072	1.3759
2001	0.8952	0.9982	1.0481	0.1197	1.5091	2.4220	1.5402	-1.1804
2002	0.9603	0.4916	0.8293	-0.8147	1.0515	2.6359	3.1728	1.2067
2003	1.1902	0.6288	0.9743	-0.6433	0.9742	2.8574	3.1295	1.7940
2004	2.5355	1.8381	2.5499	2.3217	3.4269	2.5700	3.3817	1.5981
2005	2.1066	2.1092	2.2767	1.3013	3.1455	2.4772	4.0798	4.2381
2006	2.1822	2.0313	2.2713	1.5849	3.5996	2.4414	4.2143	3.2815
2007	1.9968	1.6185	1.8998	2.0164	3.9452	1.6683	5.1602	2.4382
2008	0.8364	-0.0140	0.0871	2.7099	3.4491	0.3040	1.5389	1.9469
2009	0.7548	0.3389	0.3753	0.7380	0.0785	0.3800	4.2456	1.6294
2010	1.5123	0.5239	0.6079	2.3320	1.0340	1.3234	3.9872	1.9032
2011	1.2596	-0.7054	-0.2250	2.1146	2.7351	1.6151	3.1901	2.0472
2012	1.4610	-0.4247	-0.1702	2.3420	3.5339	1.8489	3.0358	2.0169
2013	1.7446	-0.2790	0.2408	2.4794	3.2429	1.9893	2.4579	2.0185
2014	1.8057	0.0773	0.4817	2.4441	3.1437	1.9137	3.2812	2.3354
2015	1.5860	0.6442	0.4435	3.0260	3.3067	1.8788	1.5092	2.4370
2016	1.7783	0.5289	0.7123	2.0375	3.1759	1.9079	4.2931	2.2381
2017	2.0243	1.8605	1.9732	1.4764	3.7829	2.0426	4.1220	2.6656

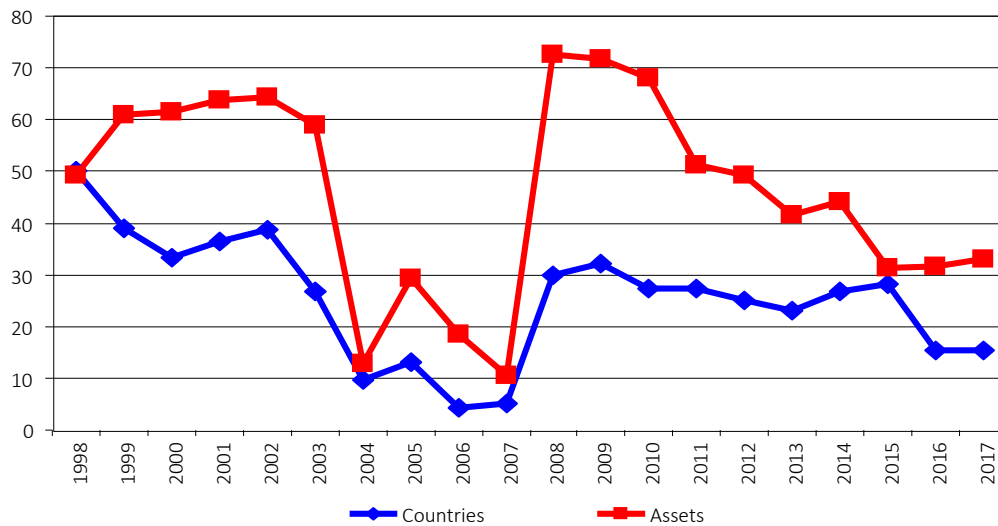


Figure 2. Percentage of countries in the risk zone and percentage of banking assets in the risk zone

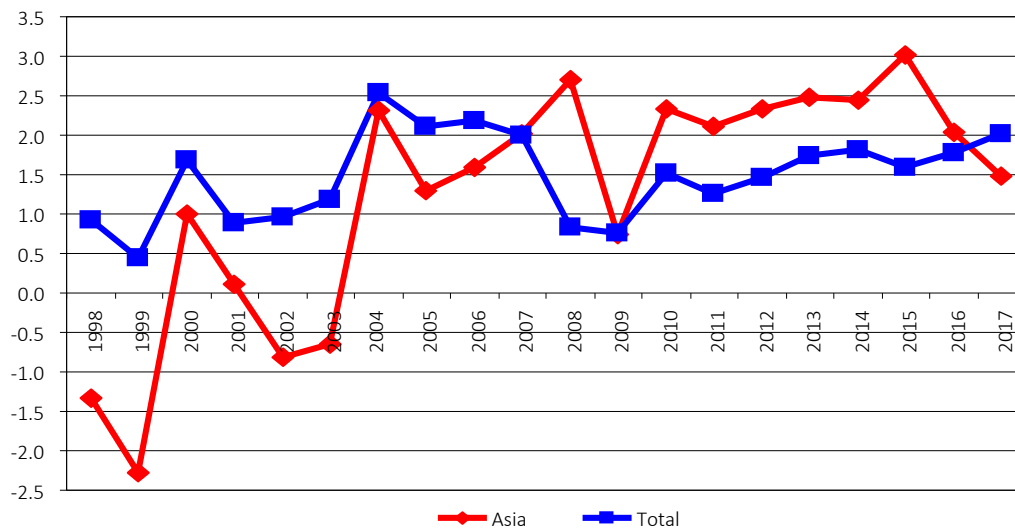


Figure 3. Financial stability index of banking systems of the World and Asia

The analysis of graphs (Figures 3-6) gives the following results:

- during the 1998–1999 crisis, the Asian banking system was unstable. During this period, the IPRc index was below zero. As the crisis was overcome, the stability of the Asian banking system began to improve. Since 2007, the stability of the Asian banking system had been above the global level, but in 2017 it took a sharp decline;
- the dynamics of the stability of the banking systems of the EU and Europe were synchronous, but opposite to the dynamics of the stability of the Asian banking system. In 2017, the stability of the European banking system was almost on par with the global level;
- the stability of the banking systems of Africa and Australia in 2005–2017 exceeded the global level. The only exception was in 2009. This year, due to the 2008 crisis, the African banking system stability was 0.6763 p.p. below the global level;
- a distinctive feature of the stability dynamics of the banking systems of North America and

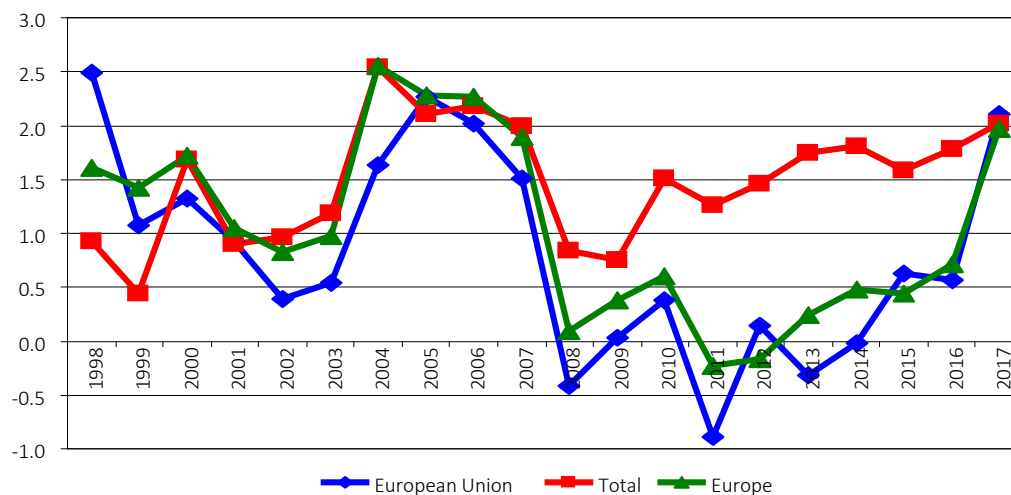


Figure 4. Financial stability index of the banking systems of the World, the EU, and Europe

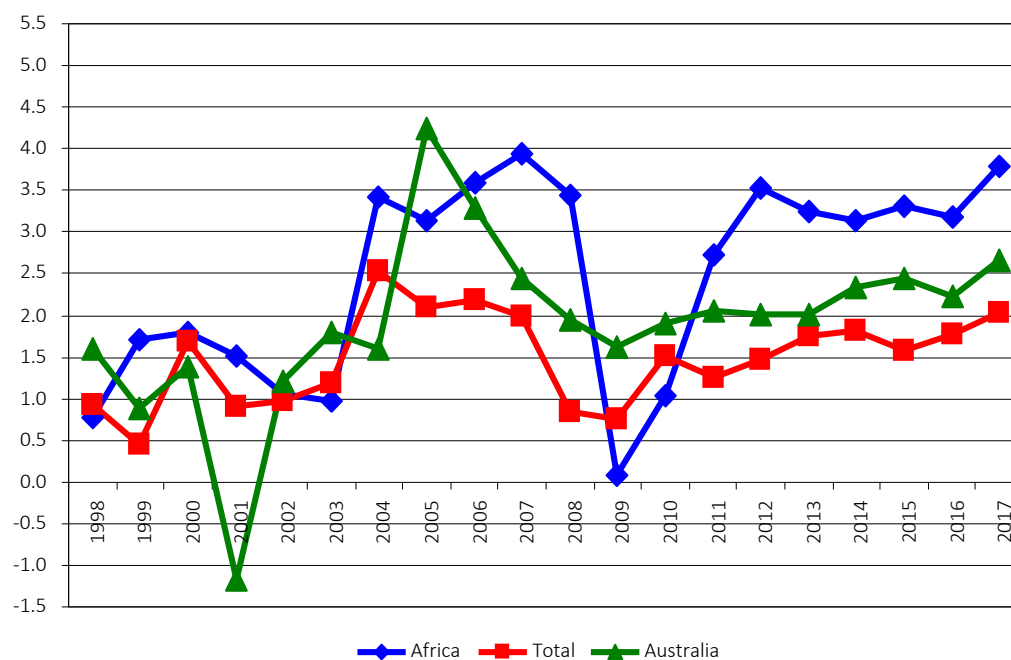


Figure 5. Financial stability index of banking systems of the World, Africa, and Australia

South America was its level of volatility. At the same time, starting from 2005, the level of stability of North America's banking system practically coincided with that of the global banking system.

According to the analysis of the financial stability of banking systems, a risk map was developed for the financial stability of geo-banking systems for the period 2007–2017 (Table 5). The risk map for the finan-

cial stability of geo-banking systems was compiled as follows. The entire global banking system was divided into geo-banking systems in accordance with Table 3. In addition, annual financial stability indices (IPRc) for the period from 1998 to 2017 were calculated for each geobanking system using formula (6). The obtained index values (IPRc) were compared with the financial stability criteria (Table 1) and the regional banking systems were distributed by risk zones.

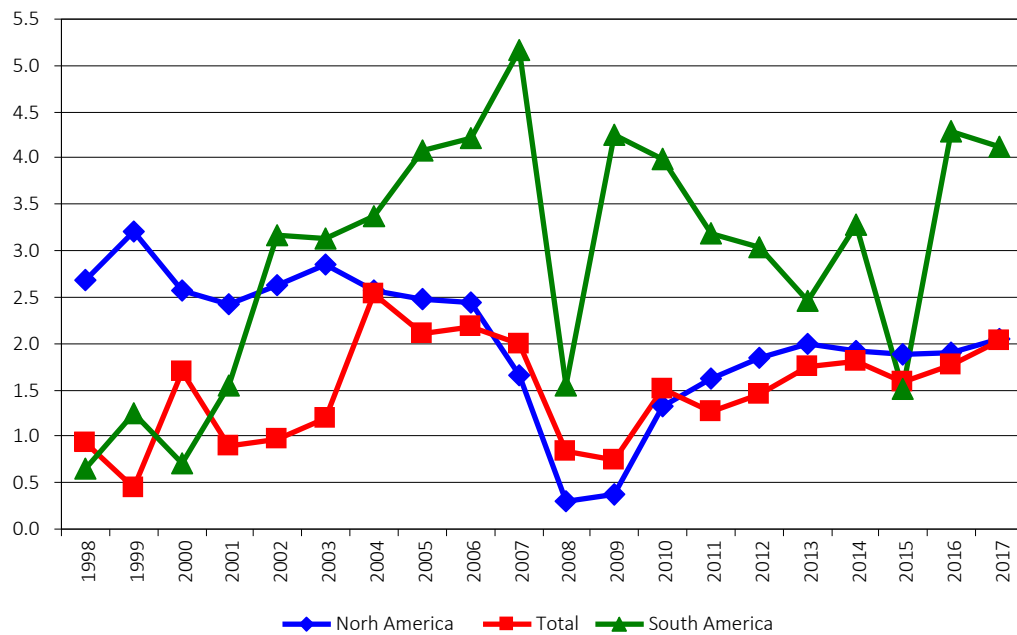


Figure 6. Financial stability index of banking systems of the World, North America, and South America

Table 5. Risk map of financial stability of geo-banking systems in 1998–2017

Source: Authors.

Year	Risk-free zone	Neutral zone	Risk zone
1998	(empty)	European Union, Europe, North America, Australia	Africa, South America, Asia
1999	North America	Africa	European Union, Europe, Asia, South America, Australia
2000	(empty)	Europe, Africa, North America	European Union, Asia, South America, Australia
2001	(empty)	Africa, North America, South America	European Union, Europe, Asia, Australia
2002	South America	North America	European Union, Europe, Asia, Africa, Australia
2003	South America	North America, Australia	European Union, Europe, Asia, Africa
2004	Africa, South America	European Union, Europe, Asia, North America, Australia	(empty)
2005	Africa, South America, Australia	European Union, Europe, North America	Asia
2006	Africa, South America, Australia	European Union, Europe, Asia, North America	(empty)
2007	Africa, South America	European Union, Europe, Asia, North America, Australia	(empty)
2008	Africa	Asia, South America, Australia	European Union, Europe, North America
2009	South America	Australia	European Union, Europe, Asia, Africa, North America
2010	South America	Asia, Australia	European Union, Europe, Africa, North America
2011	South America	Asia, Africa, North America, Australia	European Union, Europe
2012	Africa, South America	Asia, North America, Australia	European Union, Europe
2013	Africa	Asia, North America, South America, Australia	European Union, Europe
2014	Africa, South America	Asia, North America, Australia	European Union, Europe
2015	Asia, Africa	North America, South America, Australia	European Union, Europe
2016	Africa South, America	Asia, North America, Australia	European Union, Europe
2017	Africa, South America	European Union, Europe, North America, Australia	Asia

Analysis of the data in Table 5 allows us to state the following:

- Geo-banking systems located in the epicenter of crises or close to it are more sensitive to crises;
- During the entire analyzed period, the banking system of Australia remained the most stable. Having overcome the 1998 crisis, it entered the risk-free zone and remained there until the end of the analyzed period. The South American banking system showed similar results;
- Africa's banking system demonstrated its ability to quickly overcome the effects of crises, and North America's banking system responded only to the 2008 financial crisis.

Based on the analysis of the financial stability of banking systems, the financial stability risk map of national banking systems for 2007 and 2017 was also developed. To create this map, the financial stability indices (IPR) for each national banking system for the corresponding period were calculated. The calculation period was limited by two extreme points of the eleven-year period, since this range is sufficient to illustrate the risk map method. The obtained index values were compared with the criteria of financial stability (Table 2), and risk zones for each banking system were identified. The results of the analysis are presented in Table 6.

Table 6 shows that in 2017, 22 countries from the analyzed sample showed quite high indicators on the level of financial stability of their banking systems. At the same time, the following countries turned out to be leaders in the financial stability of national banking systems: Argentina (5.55), Swaziland (6.40), Uganda (5.60), Estonia (5.92), and Sweden (4.48). A sufficiently large number of countries, however, did not overcome the effects of the 2008 crisis and failed to restore the stability of their banking systems to the pre-crisis level. In 2017, the worst financial stability indicators were registered in the banking systems of India (−0.32), Kazakhstan (−0.84), Vanuatu (−6.11), Greece (−0.57), and Ukraine (−0.06).

For a more in-depth analysis of the global risks of financial sustainability of the global banking system, the risk maps of geo- and national banking systems in 2017 (Table 7) were compared. This comparison revealed the sources of instability of the global banking system at the geo- and national levels for the near future.

Table 7 shows that potential threats to the financial stability of the global banking system come from the European and Asian banking systems, as well as the Australian banking system. At the same time, the largest number of risks (by the number of countries) falls on the Asian banking system. The results of the analysis of threats to the financial stability of the global banking system indicate the need for central banks in Germany, Greece, Albania,

Table 6. Distribution of countries by the level of financial stability of their banking systems

Source: Authors.

Zone	Financial stability level	Countries as of 2007	Countries as of 2017
Risk-free zone	Excellent	Brazil, Ecuador, Paraguay, Peru, Kenya, Swaziland, Uganda, Armenia, Indonesia, Albania, Moldova, Turkey	Argentina, Swaziland, Uganda, Estonia, Sweden
	Good	Colombia, Costa Rica, Guatemala, Mexico, Lesotho, Kazakhstan, Saudi Arabia, United Arab Emirates, Bulgaria, Czech Republic, Iceland, Latvia, Luxembourg, Macedonia, Russia	Brazil, Colombia, El Salvador, Mexico, Paraguay, Peru, Kenya, Lesotho, Georgia, Indonesia, Czech Republic, Denmark, Hungary, Moldova, Netherlands, Turkey
Neutral zone	Satisfactory	Argentina, El Salvador, Honduras, Panama, USA, Mauritius, Georgia, Hong Kong, India, Israel, Japan, Malaysia, Philippines, Singapore, Australia, Austria, Belarus, Bosnia and Herzegovina, Croatia, Denmark, Estonia, Germany, Greece, Hungary, Ireland, Malta, Slovenia, Spain, Sweden	Costa Rica, Ecuador, Guatemala, Honduras, Panama, USA, Mauritius, Hong Kong, Israel, Malaysia, Philippines, Saudi Arabia, Singapore, Thailand, United Arab Emirates, Australia, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, France, Iceland, Ireland, Latvia, Luxembourg, Macedonia, Malta, Russia, Slovakia, Slovenia
Risk zone	Low	Thailand, Belgium, France, Netherlands	Armenia, Japan, Albania, Germany, Cyprus, Spain
	Unstable		India, Kazakhstan, Vanuatu, Greece, Ukraine

Table 7. Geo- and national banking systems containing threats to the stability of the global banking system in the near future

Source: Authors.

Region	Countries
European union	Germany, Greece, Cyprus, Spain
Europe	Albania, Ukraine
Asia	Japan, Armenia, Kazakhstan, India
Africa	—
North America	—
South America	—
Australia	Vanuatu

Spain, Ukraine, Japan, Armenia, Kazakhstan, India, and Vanuatu to develop and implement plans for financial rehabilitation of their banking systems. These plans should be specifically focused on improving financial stability expressed in IPR indicators and the roadmap for achieving these goals. The results of the analysis point to the need to further improve financial regulation of banking systems in those countries that contain potential threats to the stability of the global banking system. The research also confirms the conclusion of Phua (2019) on the necessity to consider specific features of geographic regions in Basel III standards.

5. DISCUSSION

This study aimed to solve the problem of interlevel analysis of financial stability of banking systems by creating a unified system of indicators. This system was created using a risk-based approach, which, according to Allen and Gale (2000), is currently used as a predominant method for the analysis of financial stability. Unlike the existing methods developed by scholars within the risk-oriented approach, this study used the ratio of profitability to risk. The profit of banking systems was taken as an indicator of profitability, and the value of their risk assets as an indicator of risk. The idea of using this indicator is that if there are profits in the banking system, they can be used to cover the assumed unaccounted risks, which could help the system to maintain its stability in the future. Thus, unlike the existing indicators, the indicators developed in this study are predictive in nature.

The stability of banks is usually determined by assessing risks of individual banks and aggregating them. Applying this method to groups of banks turns out to be excessively labor-intensive. This study

managed to overcome this difficulty by developing a method for calculating the amount of banks' risk assets using published statistics on the banking system. The method is quite simple and easy to use.

The results of the interlevel analysis of the financial stability of banking systems only partially coincide with the results of studies conducted by other scholars (Radulescu et al., 2017; Ruza et al., 2019). This is due to the fact that the proposed algorithm for calculating IPR_g, IPR_c, and IPR indicators is based on data for 126 countries. This ensures that the results of the current analysis are more objective than those based on data for developed or developing countries only, or data for a single geographical area.

Along with the system for quantitative evaluation of financial stability of banking systems, criteria for qualitative evaluation of their financial stability have been developed. These criteria were derived from the analysis of initial data for the period 1998–2017. It is logical to assume that the values of these criteria may change as new input data becomes available. This study did not consider the frequency with which these criteria were revised. It is believed that this problem can be the subject of further research.

The financial stability risk maps developed in this study can be used to identify not only existing but also potential threats to the stability of the global banking system. These threats arise when countries with low levels of financial stability of banking systems emerge and show tendency to grow within relatively favorable geographical zones. Of particular interest, however, are the criteria for identifying critical points of transition of national threats to threats at the level of a geographic zone. It is believed that identifying these critical points can become a topic for further research.

CONCLUSION

As a result of the study, a multilevel system of indicators of the financial stability of the global banking system has been proposed, which allows diagnosing its state and dynamics both on a global scale and at the level of its structural elements: geo- and national banking systems. In contrast to the existing indicators, the indicators proposed in this study are predictive in nature, since they allow estimating the level of coverage of unforeseen risks by the amount of generated profit. An algorithm for calculating these indicators was also developed using publicly available information on the state of national banking systems, which covers a fairly long period of time (19 years). At the same time, criteria for qualitative assessment of the financial sustainability of the global banking system and its elements were developed. Based on these criteria, risk zones for the sustainability of the global banking system were formed, and criteria that allow distributing geo- and national banking systems by risk zones were defined. An analytical toolkit in the form of a risk map of geo- and national banking systems was also developed. Risk maps help identify the sources of financial vulnerability of the global banking system, both at the global and at the geo- and national levels. Along with this, they serve as analytical tools for differentiating regulatory tools depending on the scale and depth of the imbalances identified. Thus, this study improves the methodology for diagnosing and regulating financial stability at the global level.

The empirical part of the study proved the practical applicability of the proposed analytical tools and revealed the sources of financial instability. The study showed that the dynamics of financial stability of the global banking system was the result of changes in the financial stability of its geo-subsystems, which reacted differently to the crises of 1998–2017. After the global 2008 crisis, the stability of the global banking system tends to improve. However, in 2017 the level of its stability still remained below the pre-crisis level (2006). In 2017, only the Asian banking system was at risk. Potential threats to the financial stability of the global banking system in the near future come from the European and Asian banking systems, as well as from the banking system of Australia. At the same time, the greatest number of potential risks (by the number of countries) comes from the banking system of Asia. This indicates the need for further improvement of the financial regulation of the banking systems in those countries that contain potential threats to the stability of the global banking system.

AUTHOR CONTRIBUTIONS

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