Polityki Europejskie, Finanse i Marketing
27 (76) 2022
DOI 10.22630/PEFIM.2022.27.76.6

Received: 21.11.2021
Accepted: 30.05.2022

Piotr Misztal
Marcin Łupiński
Jan Kochanowski University in Kielce

ARE POLISH BANKS STABLE? A SYSTEMIC RISK ANALYSIS

The financial crisis that began in 2007 pointed out deficiencies in policy-makers' responses to systemic risk. It turned out that not only individual bank insolvencies but also spillovers from negative externalities among entities can cause serious threats to the financial sector. During the last 10 years, many international and national initiatives were taken to strengthen the soundness of the financial system, introducing a macroprudential perspective to financial supervision. However, the recent COVID-19 pandemic resulted in a serious negative shock for many economies and their financial sectors. In this paper, using the network model we try to analyse how these recent unexpected developments affected the Polish banking sector with systemic risk. To analyse Polish bank stability we developed a formal stress-testing framework based on the network model that allowed systemic risk identification, modelling and measurement. We tried to integrate analysis of time and the cross-sectional nature of systemic risk.

Keywords: financial stability, systemic risk, network model, banking system
JEL codes: G21, G23, G32

Introduction and research motivation

The financial crisis that began in 2007 pointed out deficiencies in policy-makers' responses to systemic risk. It turned out that not only individual bank insolvencies but also spillovers from negative externalities among entities can cause serious threat to the financial sector. During the last 10 years many international (e.g. G-20 Financial Stability Committee recommendations) and national initiatives (e.g. Polish financial supervisory regulations) were taken to strengthen the soundness of the financial system, introducing a macroprudential perspective to financial supervision. However, the recent COVID-19 pandemic resulted in a serious negative shock for many economies and their financial sectors.

In this paper, using the network model we try to analyse how these recent unexpected developments affected the Polish banking sector. Considering the complex characteristics of systemic risk we looked at its key sources:

- Selected real economy sectors severely hit by negative shocks;
- Decision-makers' reaction to unexpected developments: expansionary domestic monetary and fiscal policy being a catalyst of a credit and consumption boom;
- Opaque and oligopolistic interconnections between local large financial institutions that amplify externalities stemming from excessive leverage and procyclical business models;

- Integration of small open economy with global financial markets and deregulation of cross-border capital movements allowing transmission of foreign macroeconomic policy shock;
- Banks' similar responses to the external shocks (one-approach-fits-all).

To analyse the stability of Polish banks, we developed a formal stress-testing framework based on a network model that allowed systemic risk identification, modelling and measurement. We tried to integrate analysis of time and the cross-sectional nature of systemic risk:

- Time dimension: addressing the evolution of system-wide risk over time by considering risk stemming from banking sector procyclicality, amplifications of credit action, asset price bubbles, excessive leverage and maturity mismatches;
- Cross-sectional dimension: addressing distribution of risk in the financial system at a certain point of time by analysing risk concentration caused by the similarity of banking sector institution exposure to non-financial enterprises and the direct balance and off-balance sheet interlinkages among banks.

We also needed to close some statistical data gaps ensuring access to accurate and reliable financial and prudential statistics of the Polish banking sector and Polish financial markets. We used the individual supervisory data taken from the National Bank of Poland/Financial Supervisory Commission dashboard.

We hope that our approach can be applied for proactive Polish banking sector systemic risk detection and measurement and then used by decision-makers to intervene as early as possible to reduce the impact of potential distress on the Polish financial system.

The article was divided into six parts. In the first part were presented different, theoretical concepts of systemic risk. In the second part we made a review of the recent literature on systemic risk analysis. Then we described the data used in the research. In the next part we presented the formal framework (network model) used for the analysis. The fifth part is devoted to description of the gained results, and the last part presents conclusions.

Systemic risk definitions and concepts

Systemic risk can be defined in both a narrow and broad sense as the risk of experiencing systemic events in a strong way. Basically, the spectrum of systemic risk covers second-round effect on an individual institution or market to the risk of a systemic crisis affecting most or the entire financial system. The geographic scope of systemic risk can be regional, national or international. A key component of this definition of systemic risk, the systemic event, consists of two important components: shocks and propagation mechanisms. According to the terminology of financial theory, shocks can be idiosyncratic or systematic. In an extreme sense, idiosyncratic shocks are those that initially affect only the condition of one financial institution or only the price of one asset, while systematic shocks affect the entire economy, e.g. all financial institutions together.

Another dimension of the concept of systemic risk is the impact of systemic events in the financial sector on the real sector, and more specifically on production and general welfare. A horizontal view of the concept of systemic risk can be distinguished, in which the emphasis is only on events in the financial sector (through the bankruptcy of financial intermediaries or a financial market crash). From a vertical view of systemic risk, the impact of a systemic event on production is assessed to calculate the severity of such an

event. The real effects play a role in many of the articles discussed below. In this article, the analysis focuses on the horizontal dimension of systemic risk (De Bandt and Hartmann, 2000).

The literature on systemic risk assessment in the banking sector can be divided into three categories. The first category focuses on how balance linkages can amplify the magnitude of shocks and influence the direction of propagation across borders. The second category uses abundant market data and uses information from credit spreads and stock or other asset prices to measure system risk premiums and correlate shocks across markets.

Table 1. Systemic events in the financial system

Type of initial shocks	**Single systemic events (affect only one institution or one market in the second round effect)**		**Wide systemic events (affect many institutions or markets in the second round effect)**	
	Weak (no failure or crash)	Strong (failure of one institution or crash of one market)	Weak (no failure or crash)	Strong (failure of one institution or crash of one market)
Narrow shock that propagates				
- **Idiosyncratic shock**	✓	✓Contagion	✓	✓Contagion leading to a systemic crisis
- **Limited systematic shock**	✓	✓Contagion	✓	✓Contagion leading to a systemic crisis
Wide systematic shock			✓	✓Systemic crisis

✓ means that the combination of events defined by the cell is a systemic event. The shaded area describes cases of systemic events in the narrow sense. Systemic events in the broad sense also include the cells with ✓ in the last row.

Source: (De Bandt and Hartmann, 2000).

Ultimately, the third category is one of perspective and based on simulations to better understand how certain types of shocks can develop into more serious systemic events. All three types of analysis take into account risks from the side of assets and liabilities, bank balance sheets, as well as risks that arise from interactions between the two parties (Cerutti, Claessens and McGuirev, 2012).

Literature review

We start by pointing out literature that defines key issues analysed in the research: financial stability and systemic risk. Smaga (2013) described financial stability as the feature of the financial system that can fulfil its crucial functions: financial intermediation, asset pricing and capital/risk allocation. The second most important phenomenon analysed in our survey, systemic risk, can be defined as the risk that internal and external shocks can destabilize the whole financial system (Bongini, Nieri, and Pelagatti, 2015). In the strict sense, systemic risk materialization can be perceived as the process in which financial problems of a single financial institution result in negative externalities for the whole financial system or/and the real economy (Bluhm and Krahnen, 2014; Tarashev, Tsatsaronis, and Borio, 2016; Vallascas and Keasey, 2012).

To analyse systemic risk many researchers use different econometric and statistic methods. Some of them (e.g. Adrian and Brunnermeier, 2008; Adrian and Brunnermeier, 2016; Brunnermeier, Dong, and Palia, 2012; Castro and Ferrari, 2014; López-Espinosa et al. 2013; Weiß and Mühlnickel, 2014) within the CoVaR framework tried to capture marginal contribution of individual financial entities to the general risk of the financial system. This approach compares cumulated system-wide losses caused by systemically important institutions or their group failure and the financial output of the system being in the normal condition.

An alternative idea of systemic risk analysis uses information included in financial market data. The Systemic Expected Shortfall (SES) model described and applied in the papers of Acharya et al. (2009), Acharya et al. (2017), Jonghe, Diepstraten, and Schepens (2015) tries to capture the expected value of individual institution undercapitalization when the systemic risk spillover occurs and when the whole financial system is undercapitalized. There is also a formalized SRISK framework (Laeven, Ratnovski, and Tong, 2014) based on the Systemic Expected Shortfall model that measures systemic risk with the capital shortfall of a particular financial institution caused by severe market negative shock, focusing on the key institution's parameters such as its size, leverage and interconnectedness. Moreover Banulescu and Dumitrescu (2015) in their Component Expected Shortfall (CES) procedure extended the SES approach to directly measure the contribution of an individual institution to the system-wide systemic risk.

To analyse Polish banks' stability we use a network model that allows tracing the impact of the contagion effect on the whole banking sector. Detailed description of this model can be found in the works of Arinaminpathy, Kapadia, and May (2012), Caccioli, Catanach, and Farmer (2012) Krause and Giansante (2012) and He and Chen (2016).

Data

In the research we used micro and macroprudential data gathered within the National Bank of Poland/Financial Supervision Commission databases. Our area of interest covered:

- FINREP package (balance sheet and off-balance sheet data);
- COREP package (capital requirements and capital structure);
- EU Large Exposures (ELE) statistics (>= 10% of institution capital criterion);
- Domestic Large Exposures (DLE) statistics (>= 120.000 EUR criterion).

Based on the statistical history of individual Polish banks we prepared a set of quarterly time series:

- Measures of interconnections: interlinkages among institutions (especially systemically important ones), sectors and countries;
- Indicators of institutions and sectors with cross-border dependencies and cross-border investment flows;
- Measures of common exposures and funding concentrations;
- Time series of leverage;
- Measures of financial market risks;
- Bank balance sheets data and ratio;
- Data on banks' collateral practices;
- Measures of maturity mismatches and financial imbalances.

The time span used for calibration covered the years 2013-2017. For analysis we used data from 2018-2020 including the data depicting the massive economic shock at the beginning of 2020 caused by the COVID19 pandemic.

Polish bank characteristics

The development of the modern Polish banking sector can be dated back to the 1990's. During last 30 years it has undergone substantial transformation, focusing on asset accumulation and consolidation. Finally, at the end of 2019 it consisted of 30 commercial banks, 538 cooperative banks and 32 branches of credit institutions. At the end of 2019 Polish banking sector assets totalled almost $525 billion and the relative size of the banking industry reached 88.3% of Polish GDP. The Polish banking sector is also highly concentrated, with the 5 and 10 biggest local banks making up 50% and 70% of total banking sector assets, respectively.

Table 2. Polish largest bank assets compared with assets of the biggest banks worldwide

	Country	Assets 31 Dec 2019 ($ billion)
Industrial and Commercial Bank of China	China	**4,307,501**
China Construction Bank Corporation	China	3,638,950
Agricultural Bank of China	China	3,559,125
Bank of China	China	3,257,474
Mitsubishi UFJ Financial Group	Japan	3,096,332
HSBC Holdings	US	2,715,152
JP Morgan Chase & Co	US	2,687,379
Bank of America	US	2,434,079
BNP Paribas	France	**2,432,261**
…	…	…
PKO Bank Polski	PL	**81,843**
Bank Pekao	PL	**50,442**
Santnder Bank Polska (Banco Santander)	PL/SP	**46,695**

Source: National Bank of Poland and The Banker database.

However, in the context of systemic risk analysis it is worth noting that the world's biggest banks are much larger than Polish banks. At the end of 2019 the world's largest bank (Industrial and Commercial Bank of China) was more than 50 times larger than Poland's biggest bank (PKO Bank Polski) (Table 2).

Research framework

The framework used in this survey was initially developed in 2011 and 2012 to analyse the stability of the Polish banking sector after the financial crisis that began in 2007. The heart of this system consists of the 20 biggest Polish banks' balance sheet model, associated with the Risk Weighed Assets (RWA) model, credit loss model and liquidity risk model. The impact on banks from the side of the most important risks (credit and market risks) was embedded in the satellite models. The framework is fed with scenarios prepared with separated financial, founding and macro generators. To evaluate consequences of the systemic risk spillovers within the Polish banking sector we used a

network model. The iterative character of systemic risk is simulated with a feedback module.

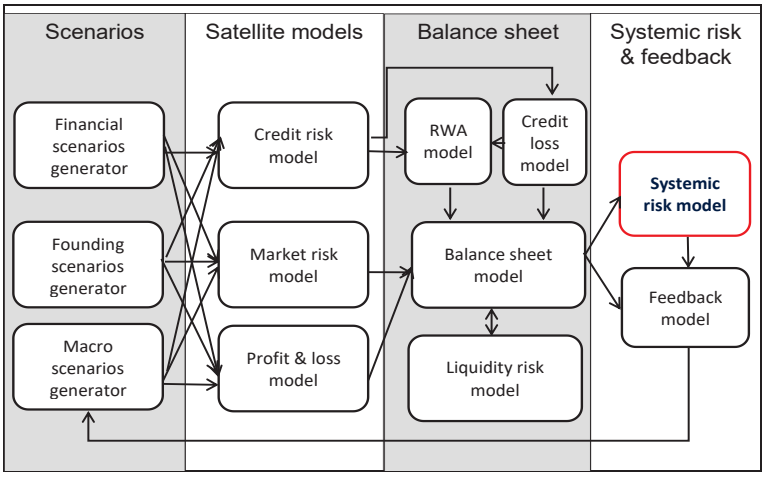

Figure 1. The framework used in the research
Source: Author's own study

The network model

The network model of systemic risk used in the research allows for modelling direct relations among banking sector entities, resulting from financial instrument exposure and the structure of capital. The model is iterative; in each period it consists of a certain number of bank entities (network nodes). A particular financial entity's balance sheet at a specific period of time consists of:

- Assets: external assets and interbank assets;
- Liabilities: aggregated equity capital, external liabilities and interbank liabilities.

In each period of time, external assets are replenished with net external income and interbank assets with interbank net receivables. On the liability side, external liabilities are with external net due liabilities and interbank liabilities with interbank net due liabilities outflows.

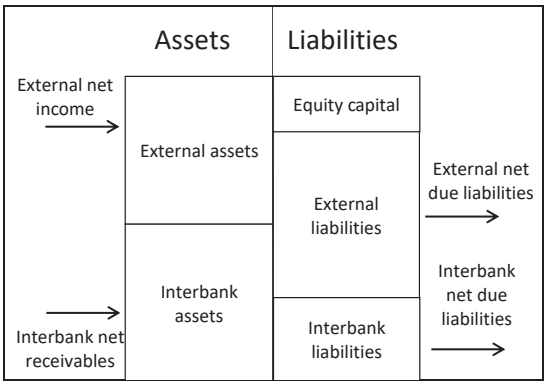

Figure 2. Individual banks' balance sheets used in the network model
Source: Author's own study

The interdependencies between two particular banks from the Polish sector (eg. A.B.) in each period of time (t) are modelled with flows of capital (C) within capital channels and liabilities (L) within liabilities channels.

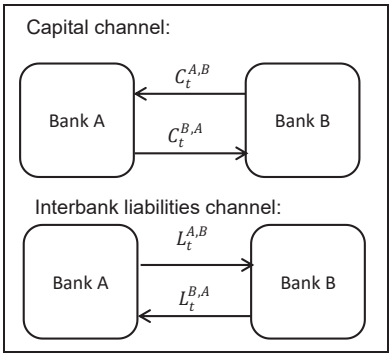

Figure 3. Individual banks' balance sheets used in the network model
Source: Author's own study

The model is solved with an iterative Fictious Default Algorithm (FDA). It starts with computation of initial net due liabilities of the initial group of banks and the system "clearing vector" and, possibly, identification of insolvent banks. Then, for each step (period of time t):

- net due liabilities of surveyed banks (taking into account solvency of other institutions) are computed; if all banks' liabilities are covered with current income/capital cushion, the algorithm is stopped.
- in the case where some insolvent institutions are identified, the clearing vector is computed and all connected institutions, which lost their solvency due to lack of payments from counterparties, are identified; if the propagation of first-order defaults doesn't imply bankruptcies of the banks, the algorithm is stopped at this stage; if it does, net due liabilities of surveyed banks are computed and the procedure is repeated.

The Fictious Default Algorithm stops when there is a lack of defaults in a certain step or all entities from the banking sector have defaulted. The iteration number, in which a particular bank was found insolvent, can be interpreted as its measure of vulnerability to systemic risk. The institutions that were found bankrupt in the first round can be perceived as fundamentally/exogenously insolvent.

Results

The empirical study started with three different scenarios: 1) baseline, 2) scenario including moderate financial, founding and macro shocks, and 3) scenario including severe financial, founding and macro shocks. The satellite models were applied to compute credit, market and liquidity risk reactions to the alternative paths. In the last stage, a network model with FDA procedure was used to identify the number of banks and their uncovered losses. The gained results were analysed in two dimensions:

- the number of banks that defaulted in each period;
- the share of defaulted bank assets in total banking sector assets.

The first approach allows to identify systemically important institutions that are prone to financial distress. The second one can be perceived as the measure of systemic

risk spillovers. Below we present both perspectives of analysis for moderate and severe shock scenarios. In the baseline we didn't detect any default in the Polish banking sector.

a. Moderate negative scenario

Moderate negative shocks impacted the Polish banking sector in the 3rd quarter of 2020, resulting in 10 defaulted banks. None of them was among the systemically important institutions (their assets accounted for approx. 5% of the total Polish banking sector).

The defaulted banks' assets share in the time series shows that the combination of a moderate negative scenario with the COVID19 shock substantially increased the number of affected banks. The number of defaulted banks soared from 6 to 10 and the share of their assets almost doubled from 3% to 5,25%.

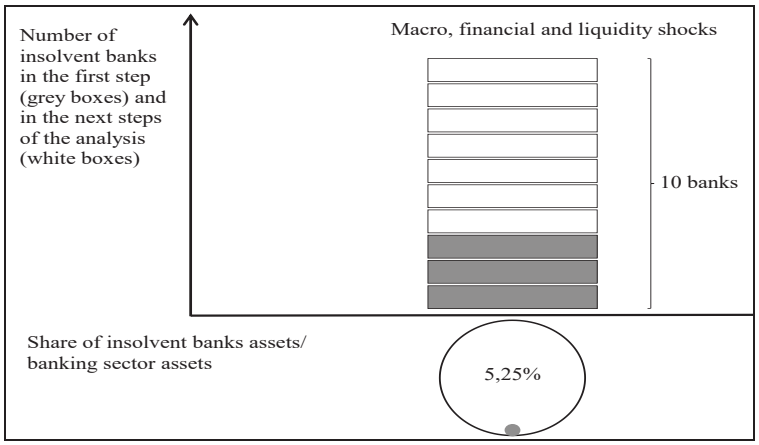

Figure 4. Moderate negative shock scenario: number of defaulted banks and their asset share in the 3rd quarter 2020

Source: Author's own computations

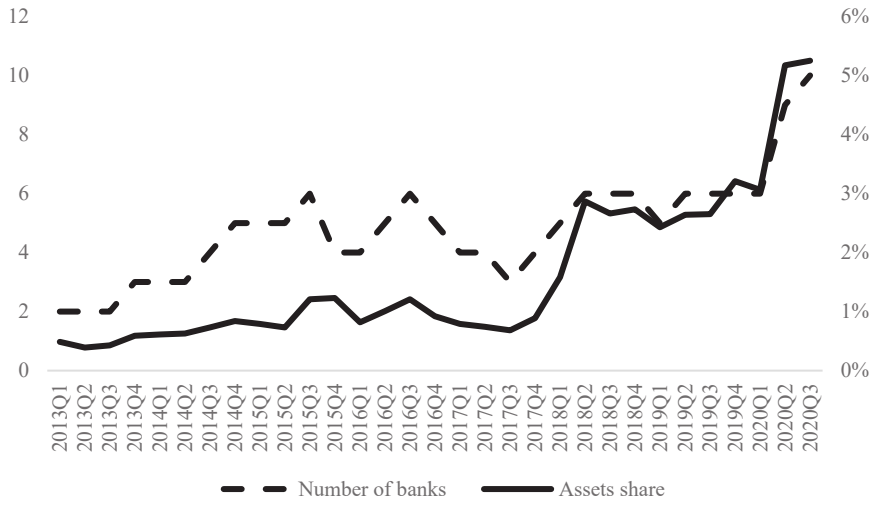

Figure 5. Moderate negative scenario: number of defaulted banks and their asset share, 2013- 2020

Source: Author's own computations

b. Severe negative scenario

The severe negative scenario added momentum to the risk impact on the Polish banking sector. Compared with the moderate scenario, nine additional insolvent banks were detected. Moreover, the share of defaulted banks' assets in the post-COVID19 environment increased to almost 8%. Despite the difficult situation of the Polish banking sector in this scenario, no systemically important institutions have failed.

Substantial negative shocks brought additional instability to the Polish banks. The number of insolvent banks increased from 11 to 17, and their asset share almost tripled from 3% to almost 8%.

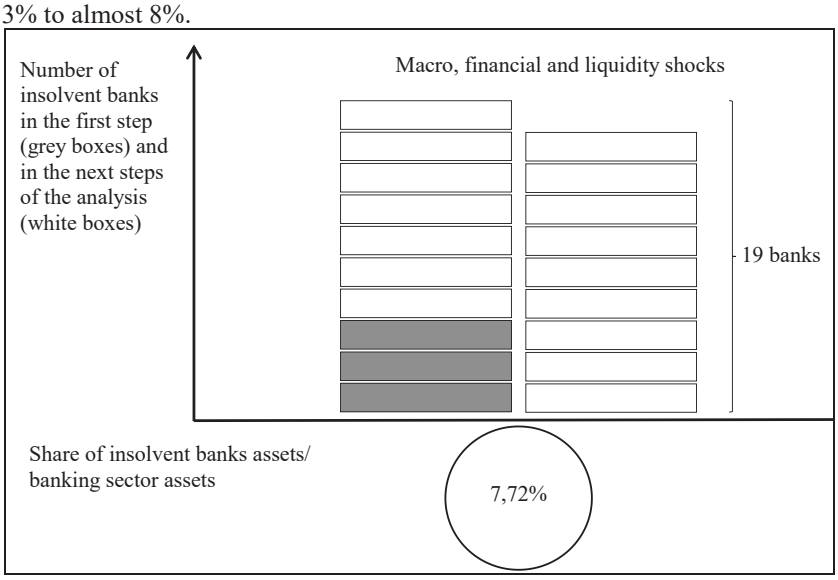

Figure 6. Moderate negative scenario: number of defaulted banks and their asset share in the 3rd quarter 2020

Source: Author's own computations

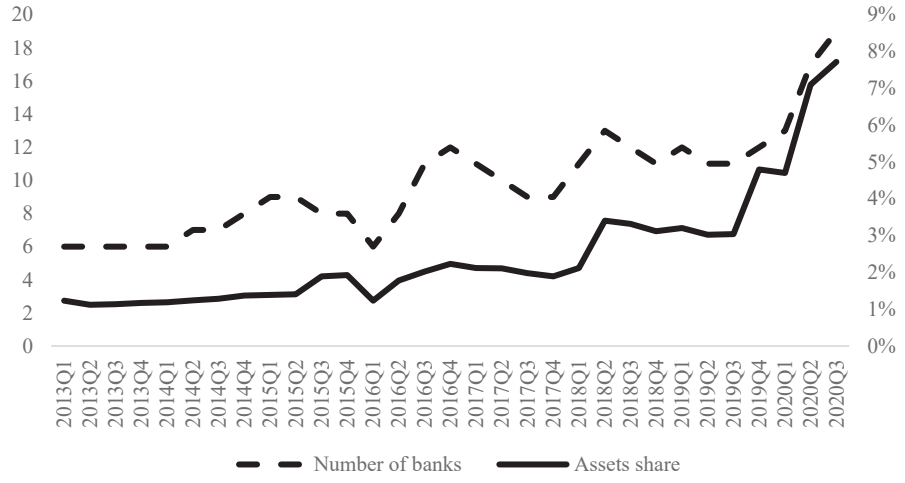

Figure 7. Moderate negative shock scenario: number of defaulted banks and their asset share, 2013-2020

Source: Author's own computations

Conclusions

Due to its traditional business model the Polish banking sector is generally immune to endogenous and exogenous sources of systemic risk. The relatively low value of interbank loans, balanced structure of assets (with extremely small share of structured instruments like ABS, MBS, etc.), adequate level of leverage and high liquidity are strong pillars of the Polish banking sector stability. However, the COVID-19 pandemic generated new sources of negative shocks originating mainly in the real economy. The 2020 "new normal" substantially increased domestic banks' insolvency risk.

The results of the analysis based on the systemic risk network model, using data up to the third quarter of 2020, allow us to conclude that, in the case where post-COVID19 is combined with:

- moderate real economy shock associated with financial and liquidity distress, 10 Polish banks would be insolvent (5,25% of the Polish banking sector's assets),
- severe real economy shock associated with financial and liquidity distress, 19 Polish banks would be insolvent (7,72% of the Polish banking sector's assets).

Generally, the COVID19 pandemic seems to be a catalyst of insolvency risk for institutions with poor credit risk management procedures (revealed before the pandemic). However, it is worth emphasizing once again that none of Poland's systemically important institutions is exposed to the risk of insolvency.

The dynamics of the recent economic and financial condition could also allow the authors to draw other conclusions. The empirical exercise described in this paper can be perceived as research in progress. The proposed framework can be used to cyclically assess systemic risk propagation in the Polish banking sector.

References

Acharya, V. V. (2009): A Theory of Systemic Risk and Design of Prudential Bank Regulation, Journal of Financial Stability vol. 5(3), pp. 224–255.

Acharya, V. V., L. H. Pedersen, T. Philippon and M. Richardson (2010): Measuring Systemic Risk, NYU Stern Working Papers.

Acharya, V. V., L. H. Pedersen, T. Philippon and M. Richardson (2017): Measuring Systemic Risk, Review of Financial Studies vol. 30(1), pp. 2–47.

Acharya, V. V., R. F. Engle and M. Richardson (2012): Capital Shortfall: A New Approach to Ranking and Regulating Systemic Risks, The American Economic Review vol. 102(3), pp.59–64.

Adrian, T. and M. K. Brunnermeier (2008): CoVaR., Federal Reserve Bank of New York Staff Reports 348.

Adrian, T. and M. K. Brunnermeier (2016): CoVaR, American Economic Review vol. 106(7), pp. 1705–1741.

Banulescu, G.-D. and E.-I. Dumitrescu (2015): Which are the SIFIs?: A Component Expected Shortfall Approach to Systemic Risk, Journal of Banking & Finance vol. 50, pp. 575–588.

Benoit, S., J.-E. Colliard, C. Hurlin and C. Pérignon (2017): Where the Risks Lie: A Survey on Systemic Risk, Review of Finance vol. 21(1), pp. 109–152.

Bluhm, M. and J. P. Krahnen (2014): Systemic Risk in an Interconnected Banking System with Endogenous Asset Markets, Journal of Financial Stability vol. 13, pp. 75–94.

Bongini, P., L. Nieri and M. Pelagatti (2015): The Importance of Being Systemically Important Financial Institutions, Journal of Banking & Finance vol. 50, pp. 562–574.

Brunnermeier, M. K., G. Dong and D. Palia (2012): Banks' Non-Interest Income and Systemic Risk, Paper presented at the AFA 2012 Chicago Meeting.

Caccioli, F., T. A. Catanach and J. D.Farmer (2012): Heterogeneity, Correlations and Financial Contagion, Advances in Complex Systems 15 Suppl. No. 2

Castro, C. and S. Ferrari (2014): Measuring and Testing for the Systemically Important Financial Institutions, Journal of Empirical Finance vol. 25, pp. 1–14.
Cerutti, E. S. Claessens and P. McGuirev (2012): Systemic Risks in Global Banking: What Can Available Data Tell Us and What More Data Are Needed?, BIS Working Papers No 376, pp. 1-22.
De Bandt, O. and P. Hartmann (2000): Systemic Risk: A Survey, ECB Working Paper No 35, pp. 12.
Financial Stability Board (2014): Structural Banking Reforms. Cross-border consistencies and global financial stability implications: Report to G20 Leaders for the November 2014 Summit.
Gravelle, T. and F. Li (2013): Measuring Systemic Importance of Financial Institutions: An Extreme Value Theory Approach, Journal of Banking & Finance vol. 37(7), pp. 2196–2209.
He, F. and X. Chen (2016): Credit Networks and Systemic Risk of Chinese Local Financing Platforms: Too Central or Too Big to Fail?, Physica A: Statistical Mechanics and Its Applications vol. 461, pp. 158–170.
Knot, K. H. W. and H. Van Voorden (2013): Systemically Important Banks – Possible Options for Policy Makers, in: A.Dombret and O.Lucius(eds.) Stability of the Financial System. Illusion or Feasible Concept?. Edward Elgar Publishing, Cheltenham, pp. 288–309.
Krause, A. and S. Giansante (2012): Interbank Lending and the Spread of Bank Failures: A Network Model of Systemic Risk, Journal of Economic Behavior & Organization vol. 83(3), pp. 583–608.
Laeven, L., L. Ratnovski and H. Tong (2014): Bank size and systemic risk, International Monetary Fund Staff Discussion Note 14/04
Laeven, L., L. Ratnovski and H. Tong (2016): Bank Size, Capital, and Systemic Risk: Some International Evidence, Journal of Banking & Finance 69 Suppl. 1, S25–S34.
López-Espinosa, G., A. Moreno, A. Rubia and L. Valderrama (2012): Short-Term Wholesale Funding and Systemic Risk: A Global CoVaR Approach, Journal of Banking & Finance vol. 36(12), pp. 3150–3162.
López-Espinosa, G., A. Rubia, L. Valderrama and M. Antón (2013): Good for One, Bad for All: Determinants of Individual versus Systemic Risk, Journal of Financial Stability vol. 9(3), pp. 287–299.
Smaga, P. (2013): Assessing Involvement of Central Banks in Financial Stability, Center for Financial Stability Policy Paper.
Tarashev, N., K. Tsatsaronis and C. Borio (2016): Risk Attribution Using the Shapley Value: Methodology and Policy Applications, Review of Finance vol. 20(3), pp. 1189–1213.
Vallascas, F. and K. Keasey (2012): Bank Resilience to Systemic Shocks and the Stability of Banking Systems: Small Is Beautiful, Journal of International Money and Finance vol. 31(6), pp. 1745–1776.
Vanhoose, D. D. (2011): Systemic risks and macroprudential bank regulation: A critical appraisal, Networks Financial Institute at Indiana State University Policy Brief 2011-PB-04
Vlahović, A. (2014): Challenges to the Implementation of a New Framework for Safeguarding Financial Stability, Journal of Central Banking Theory and Practice vol. 3(3), pp. 19–52.
Völz, M. and M. Wedow (2011): Market Discipline and Too-Big-To-Fail in the CDS Market: Does Banks' Size Reduce Market Discipline?, Journal of Empirical Finance vol. 18(2), pp. 195–210
Weiß, G. N. F. and J. Mühlnickel (2014): Why Do Some Insurers Become Systemically Relevant?, Journal of Financial Stability vol. 13, pp. 95–117.

Czy polskie banki są stabilne? Analiza ryzyka systemowego

Streszczenie

Kryzys finansowy 2007+ ujawnił braki w reakcji decydentów politycznych na ryzyko systemowe. Okazało się, że nie tylko upadki poszczególnych banków, ale także negatywne efekty zewnętrzne wśród podmiotów mogą spowodować poważne zagrożenie dla sektora finansowego. W ciągu ostatnich 10 lat podjęto wiele międzynarodowych i krajowych inicjatyw mających na celu wzmocnienie stabilności systemu finansowego, wprowadzając perspektywę makroostrożnościową do nadzoru finansowego. Jednak ostatnie pandemie COVID19 okazały się poważnym negatywnym

szokiem dla wielu gospodarek i ich sektorów finansowych. W niniejszym artykule, wykorzystując model sieciowy, staramy się przeanalizować, w jaki sposób te nieoczekiwane wydarzenia wpłynęły na polski sektor bankowy z ryzykiem systemowym. W celu analizy stabilności polskich banków opracowaliśmy formalne ramy testów warunków skrajnych oparte na modelu sieciowym, które umożliwiły identyfikację, modelowanie i pomiar ryzyka systemowego. Staraliśmy się zintegrować analizę czasu i przekrojowego charakteru ryzyka systemowego.

Słowa kluczowe: stabilność finansowa, ryzyko systemowe, model sieci
Kody JEL: G21, G23, G32

Information about authors

Dr hab. Piotr Misztal, prof. UJK,
Jan Kochanowski University in Kielceul. Żeromskiego 5, 25-369 Kielce
e-mail: piotr.misztal@ujk.edu.pl
ORCID: 0000-0003-2609-3439

Dr hab. Marcin Łupiński, prof. UJK,
Uniwersytet Jana Kochanowskiego w Kielcach, Narodowy Bank Polski w Warszawie
e-mail: marcin.lipinski.edu.pl
ORCID: 0000-0002-8632-8087