



ORIGINAL ARTICLE


Citation: Korzeb, Z., & Niedziółka, P. (2020). Resistance of commercial banks to the crisis caused by the COVID-19 pandemic: the case of Poland. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 15(2), 205–234. doi: 10.24136/eq.2020.010

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Received: 08.05.2020; Revised: 01.06.2020; Accepted: 05.06.2020; Published online: 25.06.2020


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Resistance of commercial banks to the crisis caused by the COVID-19 pandemic: the case of Poland

JEL Classification: G01; G21

Keywords: banking sector; commercial banks; banking crises; COVID-19; multi-dimensional comparative analysis

Abstract

Research background: The analysis allows to assess the impact of the industry structure of the credit portfolio on the resistance of commercial banks to the crisis resulting from the COVID-19 pandemic. It uses two independent methods to measure the impact of the pandemic on industry risk and the methodology allowing to prioritize industries in terms of potential negative effects of the crisis.

Purpose of the article: The aim of the research is to assess the resilience of commercial banks operating in the Polish banking sector to the potential effects caused by the COVID-19 pandemic. The diagnostic features of 13 commercial banks were selected for its implementation.

Methods: Two linear ordering methods were used, namely the Hellwig method and the TOPSIS method. The following were used as the criteria for parametric assessment of the resilience of commercial banks: capital adequacy, liquidity level, profitability of business activity, share in the portfolio of exposures with recognized impairment and the resilience of the bank's credit portfolio to the risk resulting from the exposure in economic sectors. These sectors were classified according to the level of risk associated with the effects of the crisis caused by the COVID-19 pandemic.

Findings & Value added: The study allows to conclude that the largest banks conducting their operations in Poland are the most resistant ones to the consequences of the pandemic. At the same time, the banks most vulnerable due to the crisis were identified. The conclusions can be used, inter alia, in the process of managing the financial system stability risk and contribute to the

discussion on the impact of the pandemic on the condition of commercial banks in emerging markets.

Introduction

The global pandemic COVID-19 has contributed to an unprecedented situation. It has affected the existence of every human being, the way of life of entire communities and the functioning of almost all sectors of the economy. No one was really prepared for the effects of the COVID-19 crisis. After more than a decade of high and stable economic growth, governments had time to build up sufficient reserves to prepare for the next recession. Nevertheless, the need for further assistance programs to alleviate the economic pressure caused by the COVID-19 explosion and the inevitable economic downturn has become a challenge for most countries in the world. Once again, non-standard monetary policy instruments based on quantitative easing (QE) were implemented. The astronomical magnitude of emergency support packages for businesses has again made it clear that the costs of previous financial crises were in fact borne by ordinary taxpayers (Carmassi *et al.*, 2019). Meanwhile, the ability of some countries to carry out large-scale aid programs is becoming limited. The main reason is the high level of debt (Furceri & Zdzienicka, 2012). According to Eurostat data, only three EU Member States: Germany, Sweden and Malta have a more favourable general government gross debt to Gross Domestic Product (GDP) ratio compared to the pre-crisis situation in 2007 (Eurostat, 2020). After the subprime crisis (more on its reasons in: Balcerzak, 2009), supervision authorities tightened capital adequacy regulations and implemented liquidity standards, as well as prepared plans to prevent a repeat of global crises in the financial markets. The stress tests conducted to assess the resilience of credit institutions to specific economic shocks affecting individual countries did not take into account the consequences of the coronavirus-induced recession (EBA, 2019). The banking sector is a critical component of any economy, without which it is impossible to restore the level of economic activity to the pre-pandemic state. Although banks are now better capitalized than in the two previous global crises, namely caused by subprime lending and linked to euro area sovereign debt problems (BIS, 2018), but the COVID-19 pandemic could become one of the most serious challenges they will face. Banks are already the main institutions distributing public aid. The stability of the banking sector is therefore crucial in the context of the crisis affecting individual sectors, such as hotels, restaurants, transport, tourist offices, services, many industries, exhibitions, cultural, leisure and recreational activities, etc. The scope and conditions of financ-

ing provided by banks will become a determinant of the scale of business failure and the level of structural unemployment. With appropriate measures, banks can significantly mitigate the effects of the COVID-19 crisis. However, it should be noted that banks apart from supporting their clients, should also protect the interests of their shareholders. Therefore, their activity must be a reasonable compromise between stimulating the economy and pursuing the interests of the owners in terms of ensuring a satisfactory level of Return on Equity (ROE) at an acceptable cost of risk. The problem remains to find the optimum, while maximizing shareholder value growth and addressing issues of importance to other stakeholders.

The aim of the paper is to assess the resilience of commercial banks operating in the Polish banking sector to potential effects caused by the COVID-19 pandemic. The diagnostic features of 13 commercial banks were selected for its implementation. They were prioritized using multidimensional comparative analysis methods. Two linear ordering methods were used, namely the Hellwig method and the TOPSIS method. The following were used as the criteria for parametric assessment of the resilience of commercial banks: capital adequacy, liquidity level, profitability of business activity, share in the portfolio of exposures with recognized impairment and the resilience of the bank's credit portfolio to the risk resulting from the exposure in economic sectors. These sectors were classified according to the level of risk associated with the effects of the crisis caused by the COVID-19 pandemic.

To the best of our knowledge, this is the first comprehensive review of the Polish banking sector in the context of the threats posed by the COVID-19 pandemic. Our findings can be applied broadly, both as a tool to support decision-making and to evaluate the banking sector, both in Poland and in other countries. The study contains conclusions that contribute to the development of both financial theory and practical application. The analysis allows to assess the impact of the industry structure of the credit portfolio on the resistance of commercial banks to the crisis resulting from the COVID-19 pandemic. It uses two independent methods to measure the impact of the pandemic on industry risk and the methodology allowing to prioritize industries in terms of potential negative effects of the crisis. Banks with the greatest potential negative impact of a pandemic have been identified, which can then be used to construct models aimed at quantifying systemic risk.

The remainder of this article is structured as follows. Section 2 reviews the most significant literature. Section 3 describes the data and methodology employed in the empirical research. Section 4 presents and discusses the results obtained. Section 5 summarises and presents the main conclusions.

Impact of pandemic-driven crises on the banking sector

Related literature

Investigating the effects of the crises related to the propagation of diseases on the banking sector does not commence with the arrival of the COVID-19 pandemic. Such crises usually lead to a massive withdrawal of deposits from banks. The need for ramped up purchases of medicines and food and the precautionary motive are cited as the reason for this. This conclusion was reached, among others, by Leoni (2013), analysing depositor behaviour during the HIV epidemic in developing countries. Lagoarde-Segot and Leoni (2013) created a model indicating the increased risk of banking system failure in a developing country if a pandemic (AIDS or malaria) spreads there.

Goodell (2020) points out that in times of crisis, the banking sector is vulnerable to the risk of a sharp deterioration in the quality of the credit portfolio and a massive withdrawal of deposits. The author questions the validity of the analysis of the crisis caused by the virus in terms of the black swan as understood by Taleb (2007), because it is difficult to prove that this phenomenon was completely unexpected (e.g. from the medical point of view). COVID-19 differs from the classic black swan also in that the situation currently experienced affects different economies at the same time. There is, therefore, no typical pattern of crisis propagation here.

Due to the ongoing COVID-19 crisis and its uncertain duration, as well as the unknown pattern of propagation, relatively little research has been done so far on the impact of the pandemic on the banking sector. The studies mainly relate to individual economies, rarely to regions. An exception to this may be a study by Aldasoro *et al.* (2020) based on data from 118 banks registered in 28 countries, which shows that the first months of the COVID-19 crisis show that the whole banking sector is significantly affected, with well-capitalized and highly profitable banks going through it relatively more smoothly. Credit Default Swap (CDS) spreads have grown up relatively more for banks with higher risk. Taking into account the market criterion, CDS spreads of banks registered in Emerging Markets countries have reported the sharpest spike.

Share prices of banks have been sharply (and more strongly compared to other industries) depreciated. Given this criterion, the capitalization of banks in developed European economies has fallen the most, followed by that of Asian economies, and only in third place in the Emerging Markets countries. The conditions for obtaining financing may deteriorate, which may be magnified by the change of the long term rating outlooks for nega-

tive (especially in case of banks reporting low profitability) and the successive ratings' reductions. Schmieder *et al.* (2020) note that the global banking sector has entered the COVID-19 crisis with an excess of own funds over the Pillar 1 requirement of approximately USD 5 trillion. The scale of lending, which appears to be crucial for economy's recovery, depends on the extent to which capital will be consumed as a result of the crisis and to what extent capital requirements will be liberalized. The above mentioned authors estimate that in a negative scenario the surplus may decrease to approx. USD 800 billion, which creates space for new funding of USD 5 trillion, i.e. approx. 6% of the current balance of credits. In an extreme negative scenario, these figures will be USD 270 billion and USD 1 trillion, respectively.

Research dedicated to the impact of the pandemic on banking sectors in selected countries included an analysis of Nepal (as a small open economy dependent on the economy of India) conducted by Paudel (2020). The author pointed out that the banking sector belongs to the group of industries that suffered the most during the crisis. The situation is aggravated by a drop in confidence in banks, manifested by a dynamically growing scale of deposit withdrawals. Other factors determining the increased systemic risk are: lack of growth prospects for the investment loan portfolio, deteriorating loan repayment, expected augmentation of the cost of financing, materialization of operational risk (high level of absenteeism of bank employees in the low-digitization environment), reduction of asset prices and foreign exchange risk. Dev and Sengupta (2020), analysing the impact of the pandemic on the banking sector in India, come to the conclusion that the risk of destabilization of the banking system in question is amplified by the deterioration of the quality of the credit portfolio. Moody's has also expressed this by changing its rating outlook from stable to negative. The risk is all the more significant because, in contrast to the experience of 2011–2019, currently the assets in the Non Performing Loans (NPL) category (of a significantly larger scale) are much less collateralized. Selvan and Vivek (2020) also, but in a descriptive way, examined the impact of the virus on the banking sector in India. Their study was based on data contained on websites and articles in economic periodicals. The authors concluded that the pandemic will force the process of digitization of banking services to accelerate, will result in a drop of employment due to the reduction of sales through traditional distribution channels of banking products, but at the same time the challenge will remain to adequately protect banking systems against cybercrime. This challenge seems particularly relevant given that 2018 has proven to be a period of unprecedented losses of the banking sector due to cybercrime.

Stiller and Zink (2020), when examining Western European banks, concluded that, on the one hand, the performance of the banking sector will be determined by unfavourable macroeconomic prospects and uncertainty and unpredictability, but, on the other hand, the current situation provides an opportunity to build new business models aimed at intensifying the digitization process. The authors expect a new IT boom in the period immediately following the end of the epidemic. The pandemic also reveals differences in the quality of retail customer service, which may be a premise for changes in individual banks' market shares.

Bryan *et al.* (2020) drew attention to the role of retail banks in the fight against the virus, which indicated three basic and expected courses of action for these institutions. Firstly, it is necessary to intensify the process of digitization of banking services. Secondly, banks should become more involved in the socially beneficial projects, even if they do not currently fit into banking activities (e. g. support for education and health care) in order to change the perception of the bank as an institution with a greater social role. Thirdly, it should be the task of the banks to redefine their existing lending policies and to design processes that take into account the COVID-19 crisis.

Dooseman *et al.* (2020) conclude that from the point of view of the accounting rules COVID-19 is not an event that would determine the need to adjust the banks' financial results post factum (for those institutions that have already published such results). However, it forces a reference to this issue on banks that have not yet published financial statements. This is particularly important from the perspective of the auditor's opinion on the continuation of activity. The authors also draw attention to the need to update the values of parameters determining the amount of expected losses having direct impact on the amount of write-offs, however, they recommend applying the case-by-case approach. In addition to credit risk the most important risk factors for banks in the era of the pandemic are: relaxation of the internal control environment, cyberterrorism and liquidity risk. Due to doubts about the impact of the implementation of government programs supporting the business sector on the reporting of banks the Basel Committee on Banking Supervision (BCBM) has been consulted. In April 2020 BCBM published a list of guidelines in the form of answers to selected questions (BIS, 2020). The aforementioned document includes issues of interpretation of regulations dedicated to the estimation of expected losses and recognition of changes in the economic and financial situation of bank debtors in reporting. In relation to the above Veron (2020) considers that as banks have been allowed to consume the capital buffer previously built up, it would not be advisable at present to liberalize the rules on risk write-offs

as well as to suspend supervisory actions or obligations to maintain certain quantifiable and qualitative standards.

The impact of the pandemic on the banking sector should also be seen from the perspective of financial system stability. The influence of the condition of the banking sector on the stability of the financial system was presented by Niedziółka (2009, pp. 114–118). The Financial Stability Board published a report on 15th April 2020 which shows that the banking system, including systemically important banks, is now better prepared for the crisis than it was in 2008. In particular, it will absorb macroeconomic shocks rather than escalate them. Current actions taken by governments and central banks are aimed at providing liquidity to businesses, in which the banking sector plays a key role. The scale of lending is to be enlarged by such decisions as: interest rate cuts, providing additional liquidity to the banking sector and reduction of obligatory reserve requirements (FSB, 2020). However, McKibbin and Fernando (2020) indicate that in the short term central bank's decisions to reduce interest rates will undoubtedly serve to halt the fall in demand, but since the crisis is multidimensional and is not only related to the fall in demand, so the government should play a key role in its management.

Banking sector in Poland — structure and selected determinants of its condition in times of COVID-19 pandemic

The banking sector in Poland consists of subsectors of commercial banking and cooperative banking. The 13 largest commercial banks together with BGK (state-owned bank) correspond to approx. 85% of the total assets as well as own funds of this segment (KNF, 2020), with the share of the smallest of the above-mentioned banks oscillating around 1% within each criterion.

The cooperative banks segment plays a marginal and strictly local role compared to commercial banks. At the end of 2018, the total own funds of cooperative banks in Poland amounted to PLN 12.1 billion (approx. 7% of the total equity of the commercial bank segment) while the assets accounted for PLN 138.4 billion, i.e. approx. 8.2% of the total assets of the commercial banks segment (KZBS, 2020).

COVID-19 is a crisis which is connected with the outflow of speculative capital from Emerging Markets countries and depreciation of the national currency. It has a measurable impact on the amount of liabilities and current instalments of long-term foreign currency loans (in Poland, especially those denominated in CHF). It can be assumed that the weakening of the exchange rate will result in the deterioration of the payment capacity of

those borrowers who do not have foreign currency inflows and will trigger another wave of court proceedings against banks. In Poland, this type of borrowers' legal actions escalated even before the pandemic and was due to the Court of Justice of the European Union (CJEU) decisions which were favourable to debtors. Banks with foreign currency mortgage loan portfolios will therefore have to establish additional provisions which, in turn, will weaken their competitive position.

Own funds have an impact on the condition of banks, ROE (and thus the attractiveness of the banking sector for investors, which involves the capacity to grasp new funding) and the scale of the conducted credit action. The need to create further buffers on risk-weighted assets makes it necessary to retain profit and sometimes also to limit lending. In order to prevent this during the escalation of the crisis and at the same time to be in line with the principle of building capital during prosperity Polish Financial Stability Committee (FSC) with the support of Financial Supervision Authority on the 16th of March 2020 recommended to the Minister of Finance to repeal the application of the systemic risk buffer. The recommendation was adopted 3 days later and the buffer was repealed by regulation. The FSC also declared that it would consider repealing the O-SII buffer, set on a bank-by-bank basis, given its importance from the banking sector stability point of view. Polish supervisory authorities, following the EBA recommendations, have recommended not to pay dividends, buy back own shares and not to pay variable remuneration (EBA, 2020a). Also, the approach to the estimation of liquidity standards, including in particular Liquidity Coverage Ratio (LCR), is to be made more flexible and the implementation of Recommendation R is to be delayed, thus giving the banks more flexibility in the estimation of write-offs for expected credit losses (Pawlak *et al.*, 2020). In the context of the credit loss allowance and the application of IFRS 9 in the conditions of the so-called “debt service vacation” should mention the position of Polish banking supervision, according to which the rescheduling of loans as a result of a pandemic for borrowers whose debt serviceability has deteriorated only as a result of the pandemic should not result in the reclassification of the respective assets.

Liquidity support for the commercial banking sector also comes from the central bank. The National Bank of Poland (NBP) has intensified its repo operations and plans to purchase Treasury bonds on the secondary market as part of structural open market operations, as well as to introduce a promissory note loan enabling refinancing of the portfolio of loans granted to non-financial entities (Pawlak *et al.*, 2020). It is estimated that the purchase of Treasury securities, which determines the accretion of their prices and contraction of profitability together with the reduction of the

reference rate by the Monetary Policy Council, will result in the loss of profit of the commercial bank sector in Poland by at least 10% (Rudke, 2020). The above actions include, resulting from the European Banking Authority (EBA) recommendation (EBA, 2020b), the announcement of limiting the intensity of supervisory actions by Polish Financial Supervision Authority (so that banks could focus on crisis management) and abandoning stress-testing in 2020 (Szczygielski, 2020). They are elements of a broader program of Polish Financial Supervision Authority called the "Supervisory Pulse Package" (PIN), which aims to strengthen the resilience of the banking sector in the face of the spreading pandemic and create impulses to maintain the scale of bank financing of the economy (Galbierz-Strauch & Gałkowski, 2020).

Research methodology

The sample included 13 largest commercial banks operating in the Polish banking sector (Table 1). The survey covered all banks that published in their annual reports for 2019 information on credit exposures by industry according to the EU CRB-D formula. In the annual reports, commercial banks in Poland present a portfolio structure by section (a section is marked with a single symbol and divides the general population into 21 groups of activities) according to the classification adopted in 2007 (Rada Ministrów, 2007), called PKD 2007. The survey was conducted on a sample of banks whose total assets account for 84.90% of the assets of domestic commercial banks.

The analysis of banks was carried out using linear ordering methods, which are classified as Multiple-Criteria Decision Making (MCDM) techniques that lead to the ranking of banks from the point of view of the adopted ordering criterion. The Hellwig method and the TOPSIS one were used for this purpose.

The construction of Hellwig's synthetic measure (1968) is as follows:

1. normalization of variables (standardization):

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}, \quad (1)$$

where:

- x_{ij} – observation of the j -th variable for the object i ,
- \bar{x}_j – arithmetic mean of observations of the j -th variable,
- s_j – standard deviation of observations of j -th variable.

2. coordinates of the pattern:

$$z_j^+ = \max_i \{z_{ij}\}; \quad (2)$$

3. distances of objects from the pattern:

$$d_i^+ = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^+)^2} \quad (3)$$

4. value of the aggregate variable:

$$q_i = 1 - \frac{d_i^+}{d_0}, \quad (4)$$

whereby typically $q_i \in [0; 1]$;

$\max_i \{q_i\}$ – the best object; $\min_i \{q_i\}$ – the worst object; $d_0 = \bar{d}_0 + 2S_d$;
 $d_0 = \frac{\sum_{i=1}^n d_i^+}{n}$;

$$S_d = \sqrt{\frac{\sum_{i=1}^n (d_i^+ - \bar{d})^2}{n}}. \quad (5)$$

The construction of the TOPSIS of Hwang and Yoon (1981) synthetic measure is as follows:

1. normalization of variables:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, \quad (6)$$

where:

x_{ij} – observation of the j -th variable for i object.

2. coordinates of pattern and anti-pattern:

$$z_j^+ = \max_i \{z_{ij}\}, \quad z_j^- = \max_i \{z_{ij}\}; \quad (7)$$

3. distances of objects from the pattern and anti-pattern:

$$d_i^+ = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^+)^2}, \quad d_i^- = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^-)^2}; \quad (8)$$

4. value of the aggregate variable:

$$q_i = \frac{d_i^-}{(d_i^+ + d_i^-)}, \quad (9)$$

whereby $q_i \in [0; 1]$; $\max_i\{q_i\}$ – the best object; $\min_i\{q_i\}$ – the worst object.

In the first step of a multidimensional comparative analysis, the following diagnostic features were selected: 1) capital adequacy, 2) liquidity level, 3) profitability of operations, 4) the share of exposures with recognized impairment so far and 5) the resilience of the bank's credit portfolio to the risk resulting from its exposure to the most vulnerable sectors of the economy in the context of the crisis caused by the COVID-19 pandemic. The indicators were divided into those whose higher values indicate a better position of the bank due to the examined phenomenon (stimulants — S) and those in which a lower level is desired (destimulants — D) (Table 2). The values of numerical diagnostic characteristics are presented in Table 3 and Table 4.

Resistance of the bank's credit portfolio to the risk resulting from its exposure to sectors of the economy which are the most at risk in the context of the crisis caused by the COVID-19 pandemic (diagnostic feature Z5) was carried out on the basis of the classification of sectors according to risk and thus determination of the portfolio risk of each of the assessed banks. The risk analysis of individual sectors of the economy was determined in two ways:

Option 1 – the expected decline in sales revenue for each section for 2020 has been estimated, taking into account: (i) the duration of the crisis in the strict sense and the percentage decline in revenue (y/y) in that period, (ii) the transition period related to the gradual unfreezing of the economy and the expected decline in sales revenue (y/y) in that period (individually for each section, according to their structure, with, if there are no specific indications, assumed that the decline will be half of that in the crisis in the strict sense), (iii) the period until the end of the year after the end of the transition period and the expected decline in revenue (y/y). In order to estimate the risk of particular sectors of the economy, the following assumptions were made:

- restrictions concerning trade, services, catering, hotel and entertainment activities and closing of borders were announced in Poland on the 13th of March 2020, i.e. in the middle of the eleventh week of the year. It was therefore assumed that the crisis began in the strict sense of the word in the twelfth week of the year,
- on the 4th of May 2020, the process of "de-freezing" of the economy began, which means that the crisis resulting from the restrictions lasted 7 weeks. The "de-freezing" period will not be uniform for each section. It is treated as a process in which individual business areas are gradually restored to their full functionality (full purchasing, production and sales capacity). The length of the "re-freezing" period is defined as a function of the assumed dates of restrictions' abolition (Table 5).

The data sources used in the expert assessment were: i) stock market announcements of companies, ii) press releases, iii) analyses conducted by banks and brokerage houses, iv) analyses prepared by consulting companies, v) analyses of rating agencies, vi) information provided by the European Commission, vii) statements of representatives of individual ministries in Poland, viii) number of card transactions by sector, ix) number of registered vehicles (RS), x) opinions of representatives of chambers of commerce (IB).

The expected COVID-19 risk exposure of particular industries has been estimated on the basis of: i) the duration of the crisis in the strict sense, ii) macro- and microeconomic factors determining the economic and financial situation of particular sectors, iii) export/total sales and import/total costs ratios — the sectors ordered according to deciles (based on data from 2018 (GUS, 2019a, GUS, 2019b), iv) the period of reaching the state of full operational capacity, v) the period until the end of the year after the end of the transition period. The decrease in revenue has been calculated over three main periods: (i) plunge of revenue in the crisis period, (ii) fall of revenue in the recovery period, (iii) diminishment of revenue after the recovery period. The sections were then ranked, taking into account the scale of the drop in sales revenue by decile.

The section risk measure was determined as a weighted average decile of the share of export/ total sales ratio (20%), import/total costs ratios (10%) and the expected depletion of sales revenues in 2020 (70%). It has been recognized that a decrease in sales of its borrowers is of key importance for the risk of the bank's credit portfolio. The scale of export is linked to it and determines the level of sensitivity of the section to changes in foreign markets. The higher weight given to the share of export in relation to import results from the assumption that it is more difficult to find alternative off-takers to suppliers during and immediately after the pandem-

ic. Based on the level of the measure of industry's risk, sections were divided into quartiles and the industry's risk was defined as: (i) low — I quartile, (ii) moderate — II quartile, (iii) significant — III quartile, (iv) high — IV quartile (Table 6). The methodology adopted in Option 1 is based on the policy of reviewing and monitoring the current situation and prospects of borrowers' industries by financial institutions and consulting firms. The resulting risk values were multiplied by the value of banks' on-balance-sheet and off-balance-sheet exposures in particular sectors as of the 31st of December 2019. The result obtained in each bank was then compared to the balance of the credit portfolio at the end of the year.

Option 2 – rates of return on shares of all domestic companies listed on the Warsaw Stock Exchange in the first quarter of 2020 were determined and then medians for particular industries were calculated. The values obtained in this way were used as indicators of potential loss resulting from the bank's existing credit exposures. Then they were multiplied by the value of on-balance sheet and off-balance sheet exposures in particular sectors as of the 31st of December 2019. The result obtained in each bank was then applied to the balance of the credit portfolio at the end of the year and then the potential possibility of impairment of the portfolio in % was calculated. Linear ordering methods require definitions of quantitative weights for the attributes (Ma *et al.*, 1999; Choo & Wedley, 1985; Schoemaker & Waid; 1982). Numerous methods have been suggested in the MCDM literature to determine the weights of diagnostic variables and can be grouped into three categories: 1) subjective, 2) objective and 3) integrated (Korzeb & Samaniego-Medina, 2019). In the conducted research, the weights were determined both from the subjective method and from objective methods based on statistical procedures, according to Olson (2009) and Huang *et al.* (2012):

1) system w_1 – the same weighting was adopted for all variables, that is:

$$w_k = \frac{1}{m}, \quad (10)$$

where:

k – indicator's number ($k = 1, 2, \dots, m$);

- 2) system w_2 – the weights were determined on the basis of the expert method — the highest weights were given to 2 diagnostic features: capital adequacy and liquidity of banks;
- 3) system w_3 – weights were determined on the basis of coefficients of variation:

$$w_{kt} = \frac{|v_{kt}|}{\sum_{k=1}^m |v_{kt}|} , \quad (11)$$

where:

v_{kt} – coefficient of variation ($k = 1, 2, \dots, m$).

A higher weighting factor corresponds to an index whose values have an average higher coefficient of variation.

4) system w_4 – the weights were determined on the basis of correlation coefficients:

$$w_{kt} = \frac{\sum_{i=1}^m |r_{ikt}|}{\sum_{i=1}^m \sum_{k=1}^m |r_{ikt}|} , \quad (12)$$

where:

r_{ikt} – elements of the correlation matrix R between individual variables ($k = 1, 2, \dots, m$) (Roszkowska & Filipowicz-Chomko, 2016).

Table 7 and Table 8 present the values of weighting indicators for every selected variable. It should be noted that statistical approaches are based on information about the characteristics inherent only in the data matrix itself, and in particular use an analysis of the variability of characteristics and an analysis of correlation between characteristics. Its specificity is the mechanical treatment of the problem of weighing, abstracted from the actual position of a given attribute determined by substantive premises.

In order to assess the resilience of commercial banks operating in Polish banking sector to the potential impact of the COVID-19 pandemic, the relative proximity of each bank to the ideal solution was determined and rankings of banks were built using both the Hellwig and TOPSIS method, taking into account 4 weighting procedures and 2 options of the Z5 diagnostic feature. In this way, 16 rankings were obtained, which were used to build the final classification of banks.

Results

The values of the synthetic measure describing the resilience of commercial banks operating in Polish banking sector to the potential impact of the COVID-19 pandemic and the rankings of commercial banks operating in Polish banking sector established on the basis of Hellwig and TOPSIS methods using two variants of loan portfolio resilience and four different weighting procedures are presented in Tables 9-10. Distances of individual

banks from the pattern in the Hellwig method and from the pattern and anti-pattern in the TOPSIS method are presented in Figures 1–4.

Although different assumptions have been made in Option 1 and Option 2 for the Z5 variable the results obtained by both the Hellwig and TOPSIS methods, taking into account 4 different weighting factors, are close to each other and clearly indicate the least resistant banks to potential COVID-19 effects. Banks K and J differ significantly from the others in terms of resistance level. Bank K took last place in all rankings in both options. Bank J was 12 times in the penultimate position. It seems that the most reliable results are the data obtained by both methods: Hellwig and TOPSIS using weighting factors w_2 determined by the expert method, in which the diagnostic features of capital adequacy and ST liquidity are the most important.

The application of 5 diagnostic features: 1) capital adequacy, 2) liquidity level, 3) profitability, 4) share of exposures with recognized impairment and 5) resilience of the bank's credit portfolio to the risk resulting from involvement in the sectors most threatened by the effects of the COVID-19 crisis in the hierarchy of 13 commercial banks by means of 2 linear ordering methods allowed for effective identification of commercial banks which are most threatened ones by the effects of the pandemic.

At the same time, A-F banks are the most resilient. They are the largest commercial banks operating in Poland in terms of total assets, equity and net profit generated. It is also symptomatic that some of these banks are systematically stress-tested by EBA.

Conclusions

The following conclusions can be drawn from the results obtained:

- the largest banks operating in Polish banking sector are the most resilient in the context of the crisis triggered by the COVID-19 pandemic,
- the study has clearly identified two banks most at risk due to the crisis,
- the most sensitive banks to COVID-19 are banks J, K and L with a weak capital position (variable Z1), characterised by low profitability (variable Z3) and worse quality of the credit portfolio than others (variable Z4). Therefore, these banks should take all necessary steps to increase their own funds in order to cover potential losses while observing prudent capital distribution policy. The profit redistribution should be subject to taking into account current uncertainty as to the effects and duration of COVID-19.

At the same time, it can be concluded that the short-term effects of the pandemic crisis will affect the functioning of the banking sector by jump of the value of non-performing loans and write-offs. The need to apply radical measures to mitigate the effects of the crisis on the most affected borrowers through debt restructuring will entail the loss of part of the planned revenues. The deferral of the current interest and capital instalments will have an impact on the distribution of interest income over time. The stress will be laid on magnified volume of working capital loans at the expense of investment loans.

There will be facilitations in financing many industries which recorded high revenue growth during the crisis: production of protective materials: masks, disposable gloves, disinfectant fluids, production of ventilators, production of selected medicines, production of webcams and body temperature measuring devices, courier services, etc. The limitation of direct contact in the bank and recommendations concerning non-cash payments will also encourage the use of electronic channels of access to banking products and services by customer segments that have not been interested in such communication so far. The need to work remotely will reorient the existing employment policy in commercial banks. It turned out that many bank departments do not have to use premises located in the banks' head offices, the ownership or rental of which entailed relatively high costs.

Determinants of the condition of the banking sector after a pandemic will be:

- duration of the pandemic,
- period of reaching the state of full operational capacity,
- current condition of individual economies and, above all, their current level of indebtedness,
- quality and speed of implementation of aid programs by governments,
- scale of bankruptcies,
- level of unemployment and the number of people affected by poverty and financial exclusion,
- size of the fall in production and the level of investment.

The analysis of the stock exchange quotations shows that in the first quarter of 2020 the market value of banks listed on the Warsaw Stock Exchange fell to a lower level than during previous global crises. This may indicate that investors are more concerned about the impact of this crisis on the banking sector, and thus negatively assess the future prospects of banking companies and the possibility of paying dividends in the near future.

A significant proportion of commercial banks do not publish detailed information on their credit exposure to particular sectors of the economy. Meanwhile, the basis of market discipline is that market participants have

up-to-date and reliable information about a particular bank, which enables them to properly assess the economic and financial condition of the company, its results, business activity and risk profile. Transparency of banks is a guarantee of stability and a confidence-building factor for the whole banking sector.

The solutions applied in the study can be used to a wide extent, both as a tool supporting investment decisions, and should provide additional knowledge about the phenomena occurring in Polish banking sector during the crisis caused by the COVID-19 pandemic. The implemented methods may also complement the models used so far by supervisory institutions to monitor stability of the banking sector.

In the applied method there are certain limitations, which include:

- the effects of COVID 19 are ahead of us. The upcoming months will provide data on the situation on the labour market as well as GDP growth and budget deficit. Also, the cash resources of companies will be depleted and then a wave of bankruptcies is expected. This could lead to a further increase in unemployment and an augmentation of NPL exposure in banks' portfolios. That altogether expansive monetary policy will result in the substantial decrease in banks' profits. It therefore appears necessary to periodically review the results obtained taking into consideration the changing environment of the banking sector,
- lack of consideration of legal collateral for loans, their size by sectors of the economy may have an impact on the amount of write-offs created in particular industries,
- the fact that the section level adopted in the analysis is the most aggregated level of Polish Classification of Activity (PKD) taxonomy and includes even a dozen or so sections, which sometimes react completely differently to restrictions introduced in connection with COVID-19. The above mentioned, very aggregated, form of presentation of the portfolio structure makes it difficult to draw unambiguous conclusions and as such is not applied in the banking practice of industry risk management, where the analysis takes place at the class level (four-digit designation). Therefore, in order to improve the accuracy of results, it is necessary to oblige banks to disclose in more detail the structure of the loan portfolio.

As with previous global crises, it is essential to learn lessons from the current situation, as pandemics are unlikely to be repeated in the future. Therefore, the biggest challenge facing the banking sector today is to reorient existing strategies to prepare for similar scenarios in the future. In view of the importance of the banking sector for the economy as a whole, it seems appropriate to consider, when supervisors take the necessary deci-

sions, the potential impact of further unavoidable crises on the stability of the banking sectors and the evolution of the role that commercial banks should play in their activities.

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Annex

Table 1. List of commercial banks analysed in the study¹⁾

Name of the Bank (Alphabetical order)
Alior Bank S.A.
Bank Gospodarstwa Krajowego
Bank Handlowy w Warszawie S.A.
Bank Millennium S.A.
Bank Pocztowy S.A.
Bank Polska Kasa Opieki S.A.
BGŻ BNP Paribas S.A.
Getin Noble Bank S.A.
Idea Bank S.A.
ING Bank Śląski S.A.
mBank S.A.
Powszechna Kasa Oszczędności Bank Polski S.A.
Santander Bank Polska SA

Note: 1) The list is presented in alphabetical order. A different order was applied in the analysis.

Table 2. Selected diagnostic variables

Symbol	Selected diagnostic variables	Description	Variable profile
Z1	Tier1	Capital adequacy	S
		Tier 1 Capital	
Z2	LCR	ST Liquidity	S
		The ratio of coverage of net outflows, which determines the relation of high-quality liquid assets to net outflows (i. e. minus receipts) within 30 days under extreme conditions	
Z3	ROAE	Profitability	S
		Return on average equity	
Z4	NPL	Credit portfolio quality	D
		Share of impaired assets in the portfolio - NPL	
Z5	RES	Resilience of credit portfolio to the COVID-19 crisis	Option 1 – D Option 2 – S
		Calculated on the basis of the risk of banks' portfolios resulting from their exposure to sectors of the economy which are most at risk in the context of the crisis caused by the COVID-19 pandemic, based on: Option 1 - risk estimation of individual sectors of the economy, Option 2 - rates of return of individual sectors of the economy in IQ 2020 on the Warsaw Stock Exchange	

Table 3. The basic characteristic for selected diagnostic variables (Option1)

Specification	Z1	Z2	Z3	Z4	Z5
Max	0.172	1.930	0.116	0.226	9.889
Min	0.007	1.300	-0.215	0.030	6.243
Arithmetic mean	0.133	1.565	0.025	0.081	7.954
Median	0.144	1.560	0.065	0.052	7.650
Standard deviation	0.046	0.174	0.109	0.058	1.079
V(x) variability coeff.	0.349	0.111	4.308	0.707	0.136

Table 4. The basic characteristic for selected diagnostic variables (Option 2)

Specification	Z1	Z2	Z3	Z4	Z5
Max	0.172	1.930	0.116	0.226	0.873
Min	0.007	1.300	-0.215	0.030	0.775
Arithmetic mean	0.133	1.565	0.025	0.081	0.831
Median	0.144	1.560	0.065	0.052	0.836
Standard deviation	0.046	0.174	0.109	0.058	0.028
V(x) variability coeff.	0.349	0.111	4.308	0.707	0.034

Table 5. Determinants of the duration of the “re-freezing” period of economic activity in Poland

Decision/situation	Period (in weeks)
No impact of COVID-19	0
Restriction of production by foreign partners	6
Abolition of restrictions on hotel operations	30
Abolition of restrictions on retail sales and services (non-essential goods) - abroad	10
Abolition of restrictions on retail sales and services (non-essential goods) - in Poland	10
Abolition of restrictions on catering	30
Abolition of restrictions on international tourism and cross-border labour movement (opening of borders)	30
Restoration of consumer demand to pre-crisis levels - in Poland	30
Restoration of consumer demand to pre-crisis levels - abroad	30
Abolition of restrictions on mass events	30

Table 6. Risk measures of individual sections of the Polish economy in the context of COVID-19 impact

	Section	Risk measure	Risk level
A	Agriculture, forestry, fishing	4.50	Moderate
B	Mining	8.10	High
C	Industrial manufacturing	5.80	Moderate
D	Electricity, gas, steam and hot water supply	1.90	Low
E	Water supply; sewerage, waste management; remediation	3.40	Low
F	Construction	4.20	Moderate
G	Trade and repair of motor vehicles	7.70	Significant
H	Transport and storage	7.60	Significant
I	Accommodation and catering	7.80	High
J	Information and communication	3.60	Low
K	Financial and insurance activities	3.80	Moderate
L	Real estate management	5.80	Moderate
M	Professional, scientific and technical activities	5.60	Moderate
N	Administration and support activities	6.50	Significant
O	Public administration and defence, obligatory social security	1.00	Low
P	Education	7.80	High
Q	Health and social care	1.50	Low
R	Culture, entertainment and recreation	7.70	Significant
S	Other service activities	9.70	High

Table 7. Values of weighting indicators (Option 1)

Weights	Z1	Z2	Z3	Z4	Z5
w1	0.200	0.200	0.200	0.200	0.200
w2	0.350	0.350	0.100	0.100	0.100
w3	0.062	0.020	0.768	0.126	0.024
w4	0.106	0.328	-0.133	0.433	0.266

Table 8. Values of weighting indicators (Option 2)

Weights	Z1	Z2	Z3	Z4	Z5
w1	0.200	0.200	0.200	0.200	0.200
w2	0.350	0.350	0.100	0.100	0.100
w3	0.063	0.020	0.782	0.128	0.006
w4	0.376	0.154	0.159	0.079	0.231

Table 9. Overall performance scores and ranks – Option 1

Banks	W1		W2		W3		W4	
	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank
Hellwig method								
Bank A	0.903	1	0.835	4	0.951	2	0.672	4
Bank B	0.879	4	0.811	5	0.924	4	0.659	7
Bank C	0.880	3	0.800	6	0.931	3	0.657	8
Bank D	0.862	7	0.871	2	0.844	7	0.697	2
Bank E	0.893	2	0.762	8	0.994	1	0.671	5
Bank F	0.864	6	0.880	1	0.845	6	0.697	3
Bank G	0.783	8	0.665	11	0.820	8	0.670	6
Bank H	0.878	5	0.869	3	0.855	5	0.710	1
Bank I	0.717	9	0.709	9	0.762	9	0.554	10
Bank J	0.219	12	0.351	12	0.041	12	0.487	11
Bank K	0.060	13	0.098	13	0.002	13	0.320	13
Bank L	0.671	11	0.678	10	0.746	10	0.476	12
Bank M	0.708	10	0.762	7	0.742	11	0.574	9
TOPSIS method								
Bank A	0.517	6	0.391	7	0.938	2	0.410	7
Bank B	0.531	4	0.420	6	0.910	4	0.432	5
Bank C	0.516	5	0.379	9	0.917	3	0.410	6
Bank D	0.715	2	0.680	3	0.829	7	0.636	2
Bank E	0.400	10	0.174	11	0.962	1	0.270	10
Bank F	0.737	1	0.708	2	0.830	6	0.656	1
Bank G	0.475	8	0.457	5	0.796	8	0.469	4

Table 9. Continued

Banks	W1		W2		W3		W4	
	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank
Bank H	0.713	3	0.611	4	0.841	5	0.618	3
Bank I	0.463	7	0.379	8	0.732	9	0.359	9
Bank J	0.107	12	0.377	10	-0.088	12	0.207	11
Bank K	-0.047	13	0.013	13	-0.107	13	-0.015	13
Bank L	0.257	11	0.165	12	0.709	11	0.127	12
Bank M	0.405	9	0.720	1	0.710	10	0.383	8

Table 10. Overall performance scores and ranks – Option 2

Banks	W1		W2		W3		W4	
	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank
Hellwig method								
Bank A	0.541	5	0.400	8	0.940	2	0.667	4
Bank B	0.581	4	0.432	6	0.911	4	0.696	3
Bank C	0.501	7	0.383	10	0.918	3	0.604	6
Bank D	0.747	1	0.688	2	0.829	7	0.815	1
Bank E	0.381	10	0.180	11	0.962	1	0.531	8
Bank F	0.510	6	0.668	3	0.830	6	0.526	9
Bank G	0.439	9	0.457	5	0.797	8	0.386	11
Bank H	0.706	2	0.615	4	0.841	5	0.794	2
Bank I	0.459	8	0.385	9	0.732	9	0.565	7
Bank J	0.229	12	0.410	7	-0.088	12	0.271	12
Bank K	-0.149	13	0.005	13	-0.107	13	-0.220	13
Bank L	0.279	11	0.177	12	0.710	11	0.451	10
Bank M	0.625	3	0.792	1	0.712	10	0.643	5
TOPSIS method								
Bank A	0.912	1	0.836	4	0.951	2	0.926	1
Bank B	0.886	3	0.813	5	0.924	4	0.885	3
Bank C	0.885	4	0.801	6	0.931	3	0.879	6
Bank D	0.865	6	0.872	2	0.844	7	0.881	5
Bank E	0.894	2	0.762	8	0.994	1	0.866	7

Table 10.Continued

Banks	W1		W2		W3		W4	
	Scores	Rank	Scores	Rank	Scores	Rank	Scores	Rank
Bank F	0.865	7	0.880	1	0.845	6	0.882	4
Bank G	0.792	8	0.667	11	0.820	8	0.702	11
Bank H	0.877	5	0.869	3	0.855	5	0.891	2
Bank I	0.718	10	0.710	9	0.762	9	0.754	9
Bank J	0.221	12	0.352	12	0.041	12	0.278	12
Bank K	0.041	13	0.094	13	0.001	13	0.036	13
Bank L	0.676	11	0.680	10	0.746	10	0.748	10
Bank M	0.724	9	0.772	7	0.742	11	0.764	8

Figure 1. Resistance of commercial banks to potential COVID-19 pandemic impacts determined by the Hellwig method taking into account different weighting systems (Option 1)

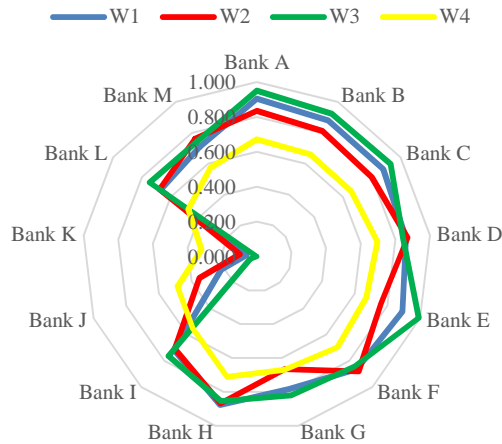


Figure 2. Resistance of commercial banks to potential COVID-19 pandemic impacts as determined by TOPSIS taking into account different weighting systems (Option 1)

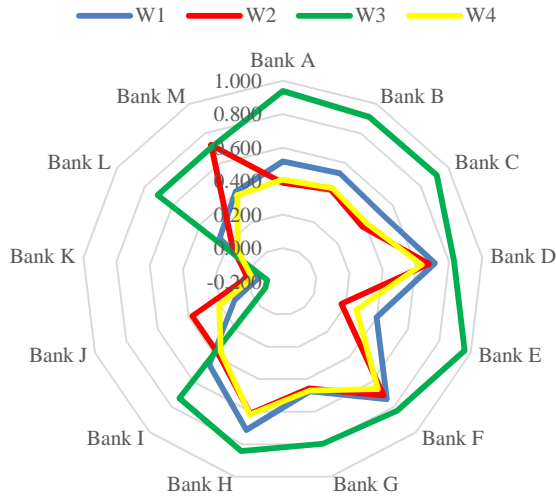


Figure 3. Resistance of commercial banks to potential COVID-19 pandemic impact determined by the Hellwig method taking into account different weighting systems (Option 2)

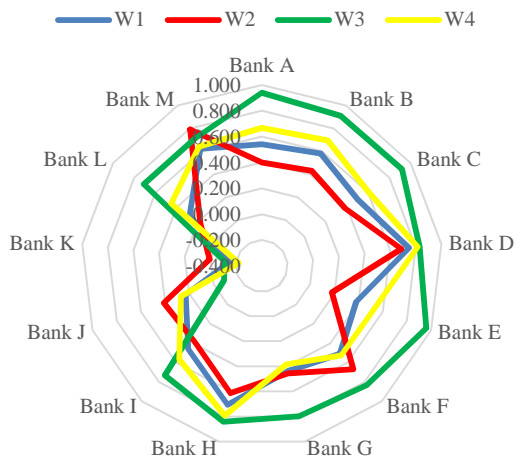


Figure 4. Resistance of commercial banks to potential COVID-19 pandemic impacts as determined by TOPSIS taking into account different weighting systems (Option 2)

