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# Multidimensional analysis of the banking sector stability in the Eurozone countries. Effects in the context of risk

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**Abstract**
The aim of this article is to analyse the stability of the banking sector of the Eurozone countries in light of the turbulence in the contemporary global economy. This aim is achieved through the considering current changes and tendencies in the economy, the importance of stability, measures of stability, and empirical analysis of the main indicators of financial stability. The study ends with final conclusions as to the further analysis.
The research hypothesis is based on the statement that the banking system of the Eurozone countries, regardless of high risk and turbulence in the global economy, remains stable.
Research methodology is based on scholarly literature review, and the empirical analysis used the system of measures and selected indicators adopted by the International Monetary Fund within the scope of the stability analysis of the banking sector of the Eurozone.
The originality of the study stems from the time this topic is addressed, due to the highly unfavourable and turbulent situation in the global economy. The added value is the identification of indicators and measures, which demonstrate the tendency for further deterioration (however, the analysis involves indicators that are still acceptable) under the current economic and geopolitical circumstances in the world.
**Keywords:** crisis, Eurozone, financial fragility, risk, stability, banking sector.

## Wielowymiarowa analiza stabilności sektora bankowego krajów strefy euro. Skutki w kontekście ryzyka

**Streszczenie**

Celem artykułu jest analiza stabilności sektora bankowego krajów strefy euro na tle turbulencji współczesnej gospodarki światowej. Realizację celu oparto na omówieniu aktualnych zmian i tendencji w gospodarce, istoty stabilności, miar stabilności oraz na empirycznej analizie głównych wskaźników stabilności finansowej. Całość opracowania zamykają wnioski końcowe do dalszej analizy.

Za hipotezę badawczą przyjęto stwierdzenie, że system bankowy krajów strefy euro, pomimo wielu zagrożeń i turbulencji w gospodarce światowej, pozostaje nadal stabilny.

Metodologia badań została oparta na badaniach literatury przedmiotu, zaś w analizie empirycznej wykorzystano system miar i wybranych wskaźników przyjętych przez Międzynarodowy Fundusz Walutowy w zakresie analizy stabilności sektora bankowego krajów strefy euro.

Oryginalność opracowania wynika z czasu, w którym podjęto temat, z uwagi na bardzo niekorzystną i turbulentną sytuację w gospodarce światowej. Wartością dodaną jest wskazanie tych miar i wskaźników, które na moment analizy wykazują tendencję do dalszego pogorszenia (choć przyjmują jeszcze wartości akceptowalne) w aktualnej sytuacji gospodarczej i geopolitycznej na świecie.

**Słowa kluczowe:** kryzys, strefa euro, niestabilność finansowa, ryzyko, stabilność, sektor bankowy.

The history of international finance demonstrates that instability has been an intrinsic quality of the financial systems. These systems move from stability to instability and crisis. The source of financial instability is a complex confluence of causes and factors originating from the financial system itself and its surrounding.

Nowadays, the world financial system is functioning under the conditions of high instability. This applies to the broadly defined connections between the financial and real spheres of the economy, operations of financial institutions, standing of financial markets, market valuation of financial instruments, as well as the world of public finance.

**The aim of this article** is to analyse the stability of the banking sector of the Eurozone countries in light of the turbulence in the contemporary global economy. This aim will be achieved through the considering current changes and tendencies in the economy, the importance of stability, measures of stability, and empirical analysis of the main indicators of financial stability. The study ends with final conclusions as to the further analysis.

## EU banking system in a turbulent environment

The modern global economy is undergoing profound structural and market changes. The world economy has experienced shocks in recent years. However, such accumulation has not yet occurred. The instability of international economies, uncertainty in the financial markets, the still unfinished effects[1] of the financial crises of 2008 and 2013, the current armed conflict in Ukraine, the danger of a new armed conflict in the Middle East

[1] The Eurozone suffered particular problems, when several peripheral countries, especially Greece and Ireland, fell into a debt trap.

area, rising global inflation – the risk of stagflation and the risk of economic slowdown, the impending energy crisis, integrity-related problems in the EU, a rapidly growing China, with a huge trade surplus and huge foreign exchange asset reserves (forming a disproportion compared to other national economies), the deepening dispute between the West and China, the still experienced effects of the COVID-19 pandemic, disrupted supply chains and changes in the political world – these are the main phenomena that are currently very strongly affecting and destabilising the national economies and have a significant impact on the stability of the banking sector, in terms of risk. On the background of the aforementioned phenomena, the liquidity of global financial markets is declining, prompting banking and non-banking financial institutions to seek new forms of competition that take into account the problem of risk.

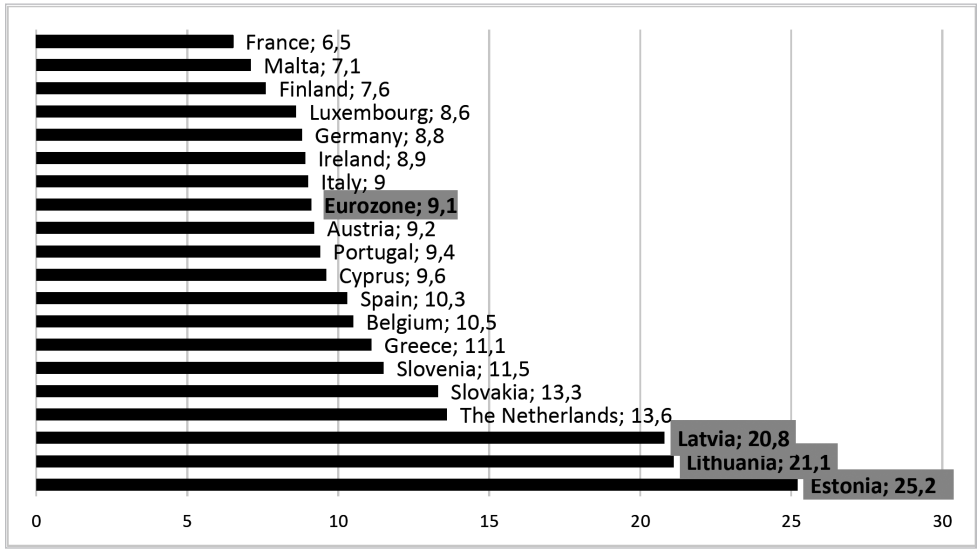
For example, in Germany, inflation was only 7.9% in August 2022, equaling the highest level since 1952. In Lithuania, inflation of 22.4% is the highest since August 1996. Czechia, with a 17.2% increase in averaged prices, reached maximums since 1993. For comparing: CPI in Poland hit a more than 25-year high of 16.1% in August 2022. Inflation in Poland is still behind the following countries: Moldova, Estonia, Ukraine, Lithuania, Latvia, Belarus, Bulgaria, Czechia, and North Macedonia[2] (see: Frączyk 2022).

The European Central Bank is in a difficult position. It was unresponsive and delayed interest rate increases for a long time, arguing that inflation was temporary. Now it needs to raise the cost of money fast and hard. Nevertheless, the ability of central banks to raise interest rates is being increasingly constrained due to the decline in liquidity caused by volatility, credit, and the momentum of economic growth in key Eurozone countries is slowing. The ECB will be forced to raise rates further, despite the fact that global economic conditions are deteriorating, and a rate hike could push the Eurozone economy into recession, while the scale of the energy crisis in Europe remains an additional risk, and it is unknown.

HICP inflation in the Eurozone was at an all-time high in August 2022: 9.1% per year – see *Figure 1* and *Table 1*. The European Central Bank's main interest rate rose to 1.25%, it means an increase of 0.75 percentage points. Such high increase has not been seen in the ECB's history. The ECB has lowered its forecast for Eurozone GDP growth for 2023 by 1.2 percentage points to 0.9%. Eurozone GDP growth will reach 3.1% this year, before forecasted slowing to 0.9% in 2023, and 1.9% the following year, according to European Central Bank projections. At the same time, the ECB raised its inflation forecasts. It currently expects annual HICP inflation in the Eurozone of 8.1% in 2022, 5.5% in 2023 and 2.3% in 2024 (Eurostat WWW, 2022a,b).

[2] Countries in order from highest to lowest inflation.

**Figure 1: HICP inflation in Eurozone countries, August 2022, %**




Source: Eurostat 2022b.

**Table 1: Inflation in Eurozone countries, %**

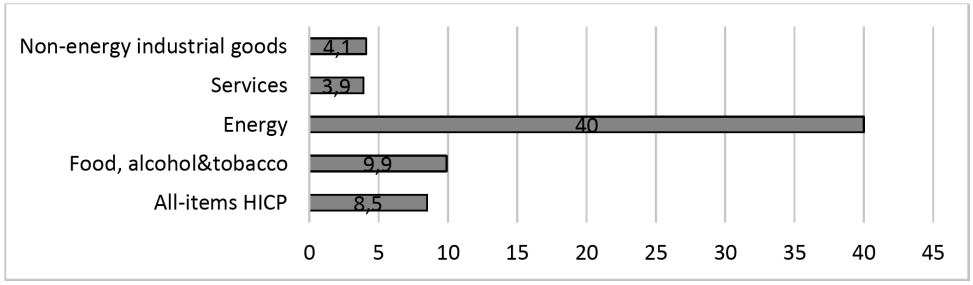
| | Annual rate | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Jul 21** | **Feb 22** | **Mar 22** | **Apr 22** | **May 22** | **Jun 22** | **Sep 22** |
| Belgium | 1.4 | 9.5 | 9.3 | 9.3 | 9.9 | 10.5 | 10.5 |
| Germany | 3.1 | 5.5 | 7.6 | 7.8 | 8.7 | 8.2 | 8.8 |
| Estonia | 4.9 | 11.6 | 14.8 | 19.1 | 20.1 | 22.0 | 25.2 |
| Ireland | 2.2 | 5.7 | 6.9 | 7.3 | 8.3 | 9.6 | 8.9 |
| Greece | 0.7 | 6.3 | 8.0 | 9.1 | 10.5 | 11.6 | 11.1 |
| Spain | 2.9 | 7.6 | 9.8 | 8.3 | 8.5 | 10.0 | 10.3 |
| France | 1.5 | 4.2 | 5.1 | 5.4 | 5.8 | 6.5 | 6.5 |
| Italy | 1.0 | 6.2 | 6.8 | 6.3 | 7.3 | 8.5 | 9.0 |
| Cyprus | 2.7 | 5.8 | 6.2 | 8.6 | 8.8 | 9.0 | 9.6 |
| Latvia | 2.8 | 8.8 | 11.5 | 13.1 | 16.8 | 19.2 | 21.1 |
| Lithuania | 4.3 | 14.0 | 15.6 | 16.6 | 18.5 | 20.5 | 20.8 |
| Luxembourg | 3.3 | 7.8 | 7.9 | 9.0 | 9.1 | 10.3 | 8.6 |
| Malta | 0.3 | 4.2 | 4.5 | 5.4 | 5.8 | 6.1 | 7.1 |
| Netherlands | 1.4 | 7.3 | 11.7 | 11.2 | 10.2 | 9.9 | 13.6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Austria | 2.8 | 5.5 | 6.6 | 7.1 | 7.7 | 8.7 | 9.2 |
| Portugal | 1.1 | 4.4 | 5.5 | 7.4 | 8.1 | 9.0 | 9.4 |
| Slovenia | 2.0 | 7.0 | 6.0 | 7.4 | 8.7 | 10.8 | 11.5 |
| Slovakia | 2.9 | 8.3 | 9.6 | 10.9 | 11.8 | 12.6 | 13.3 |
| Finland | 1.8 | 4.4 | 5.8 | 5.8 | 7.1 | 8.1 | 7.6 |

Sources: Eurostat WWW, 2022a,b.

Inflation was initially driven by post-pandemic supply bottlenecks, yet at the moment the situation in Ukraine is the main culprit. It resulted in energy, metals and food price increase. While high energy prices remain a major inflationary factor, the prices of processed food and services have also risen sharply, suggesting that inflation is becoming more widespread. This is mainly behind the gigantic increases in energy prices, amounting to almost 40% per year. Food is getting more expensive at a rate of less than 10% (see: *Figure 2*).

**Figure 2: Euro area annual inflation, July 2022, %**




Source: Eurostat 2022a.

The issue of the money printing "spreading" around the economy is important in the analysis of inflation. The mass of money grew faster than the economy. In case of additional money printing in Eurozone, there are clear differences in inflation between countries. The high price growth in the Baltic states and low one in Germany or France may be explained by the highest investment rate in Lithuania, Latvia and Estonia compared to the Eurozone as an entirety. Simply speaking, "cheap money" in proportion to the size of the economy there affected those economies the most, therefore it rebounded when prices started increasing after the pandemic.

Such highly turbulent economic and geopolitical environment means that new risks are consequently affecting the EU's banking system. This is because we are currently facing a unique combination of rising geopolitical risks, the rise of global protectionism, the threat of total war and the stiffening of monetary policy.

## Stability of the banking system – prediction of the issue in the literature

Stability of the banking system is a state, in which it performs its functions continuously and efficiently, even in case of unexpected and adverse disturbances of significant magnitude and low probability of occurrence.

A stable banking system is one that:

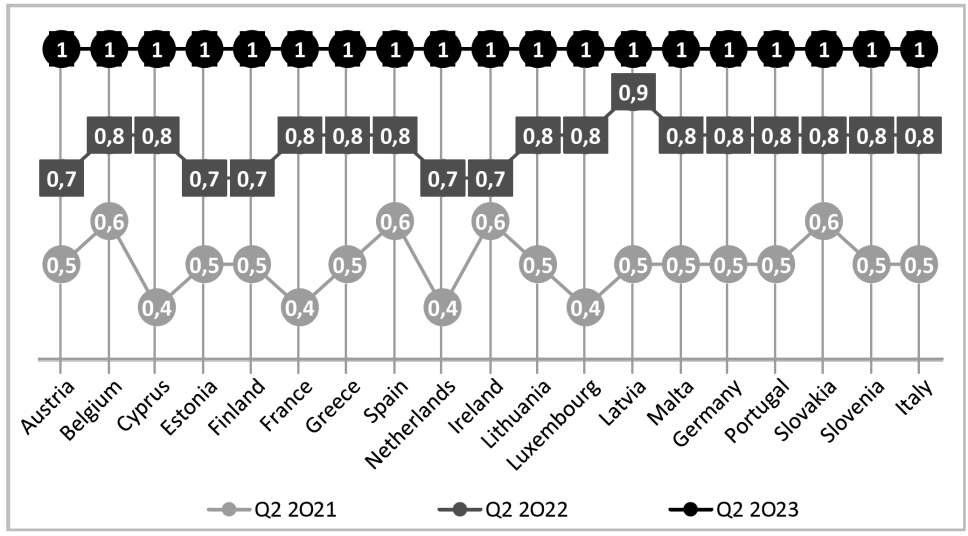
- does not permanently demonstrate liquidity or insolvency (Masiukiewicz 2011: p.18);
- performs its functions continuously and effectively, even in the event of unexpected disruptions on a significant scale (NBP 2011a: p. 3);
- is able to withstand shocks without succumbing to growing risks that adversely affect the allocation of savings, the ability to invest them and the functioning of payments in the economy (Jurkowska-Zeidler 2008: p. 168).

The *Figure 3* demonstrates the global uncertainty index for euro area countries. In 2021 was marked a slight increase of 0.1–0.2 points in the index compared to the previous year. In 2022, a sharp increase (0.7–0.9 points) was recorded in the index. A maximum uncertainty of 1.0 points according to the forecasts is to be recorded from 2023 onwards, when a significant escalation is predicted in the range of: (1) – (12).

Source literature provides various definitions of stability and the lack thereof. One contradicts the other. Therefore, as we define stability, the lack of factors to specify it will testify to instability (Hall 2010; Legrain 2010). The definition of financial stability is best demonstrated on the basis of the approaches of A. Crockett (1996) and T. Paddoa-Schioppa (2002). For the first author, instability is simply the lack of stability. By describing the stability of the financial system, he analyses the stability of its two most important components – financial institutions and financial markets. Financial institutions are stable when they can fulfil their contractual obligations uninterruptedly, without obstacles and having to seek help outside, while the stability of financial markets is equivalent to the stability of asset prices (Crockett 1996: p. 2). According to the other author, the financial system is characterised by stability if it is capable of withstanding shocks without allowing the occurrence of cumulative processes adversely affecting the allocation of savings in investments and making payments in the economy (Paddoa-Schioppa 2002: p. 20).

Similarly, literature provides for a very simplified approach to financial stability, defining it as the condition of a banking system not affected by financial crises (Fidrmuc, Schardax 2000: p. 92). Between the state of financial stability and crisis, as already mentioned, there may be the state of financial instability (Tymoigne 2012; Borio, White 2004).

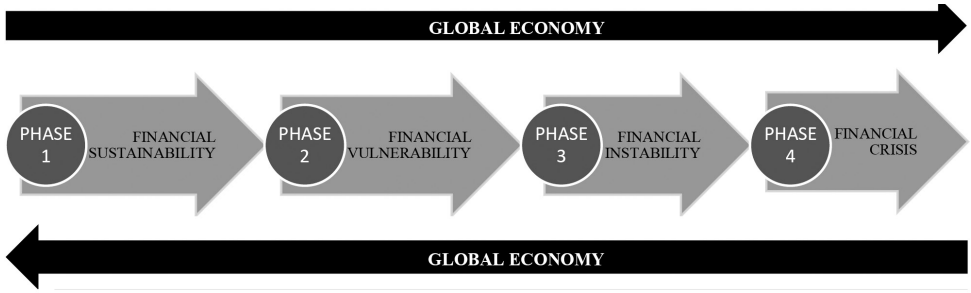
**Figure 3: World Uncertainty Index[3] for the Eurozone 2021-2023 (*forecast) for Q2.**




Source: author's own elaboration based on: https://fred.stlouisfed.org/series/WUIEUROPE (26.09.2022)

Literature also provides for the approach that stability is different from crisis in terms of *financial fragility* and *financial instability* (see: *Figure 4*).

**Figure 4: Financial fragility and instability.**




Source: own elaboration based on publication: Mitręga-Niestrój 2014: p. 11.

The state of financial fragility means that the banking system is characterised by increased vulnerability to risks. However, the system is capable of fulfilling its functions, while this fragility begins to interrupt the process of providing banking services in the state of instability.

Yet another definition is specified by J. Chant (see: Schinasi 2004: p. 13), who defines financial instability as conditions on financial markets, which are or may be detrimental to

[3] The World Uncertainty Index quantifies uncertainty based on the frequency of the word in the Economist Intelligence Unit's quarterly country reports.

the economic situation through their impact on the functioning of the financial system. According to another author, E. Ph. Davis (2003: p. 2), financial instability simply involves the increased risk of financial crisis.

R. Ferguson contends that financial instability is characterised by three essential properties:

- firstly, prices of several important classes of financial assets significantly deviate from the foundations;
- secondly, the functioning of the market and availability of loans and credits on the national level and, most likely, on the international level, are disturbed to a large extent;
- thirdly, it is probable that aggregated expenditure will deviate below or above the production capacity of the economy (Ferguson 2003).

With reference to the above-mentioned definitions, we can talk about the macro- and microeconomic characteristics necessary to consider a given system stable. Properties of macroeconomic importance include sound economy-wide fundamentals, consistency of fiscal and monetary policy instruments, as well as financial liberalisation. On the other hand, microeconomic properties include: legal system, accounting rules, market structure, supervision and control, as well as financial safety net (Capiga et al. 2010: p. 11). A prerequisite for the stability of the banking system is the stability of key financial institutions, especially banks, which constitute the most developed and largest segment of the banking market (NBP 2011b: p.12). The stability of the banking system is expressed in the ability of the system to maintain liquidity and of individual units to cover losses and risks from their own funds, and to maintain solvency (Jaworski, Zawadzka 2001: p. 203), with the level of stability being assessed differently by the bank's board of directors or the central bank, differently by supervisory authorities, and still differently by customers or shareholders (see: *Table 2*).

**Table 2: Stability of the bank in the assessment of the environment.**

| Entity evaluating the stability of the banking system | Description of stability |
|---|---|
| **Central bank** | Equity in the amount required by law, compliance with prudential standards. |
| **Shareholders** | Growing dividend value, good image of the bank and its competitiveness. |
| **Bank management** | Positive evaluation of financial statements, positive assessment of profit levels, balance sheet total and capital. |
| **Depositors** | High bank rating, guarantee of interest payout and return of invested money funds, possibility to withdraw the deposit before maturity. |
| **Borrowers** | Regularity in meeting financial needs, minimum procedures and formalities. |

Source: Żukowska 2007: p. 89.

Financial stability depends on the institutional conditions of the banking system and the economic and financial situation of individual banks (Dattels et al. 2010). The stability of the banking system is affected by the actions of the institutions of the legal and financial environment of banks, as well as the banks themselves as independent entities. Supporting financial stability is the responsibility of the central bank, supervisory institutions, the deposit guarantee scheme or the credit information bureau. Their efforts are directed at limiting the frequency and scale of disruptions in the banking system and mitigating the consequences when they occur, since the spread of banking sector problems could ultimately be the cause of a nation-wide economic crisis. A stable banking system is characterised by credibility, understood as customer confidence in individual bank and the banking sector as an entirety, as well as transparency, which contributes to reducing information asymmetry and uncertainty in financial markets. This allows investors to assess risks more accurately and make a more optimal decision. The banking system is stable when the troubles of individual banks do not translate into the operation of the banking system as a whole, i.e. they do not negatively affect the performance of its tasks (NBP 2000: p.7). However, it is important to remember that a stable banking system does not mean that all banks are financially stable. In turn, an unstable banking system does not preclude the existence of stable banking institutions that will prove resilient to a crisis situation.

The modern global banking system, as a result of the turbulence described above, operates under conditions of severe instability. It deals broadly with the relationship between the financial and real spheres of the economy, the activities of financial institutions, the situation in banking markets, the market valuation of financial instruments, and the world of public finance. The financial instability of the modern global economy – as evidenced by the observation of the changes taking place in it – seems to confirm H. Minsky's hypothesis that the world, characterised by the existence of a large financial sector and an extraordinary pressure to create new investment instruments, generates instability itself. Stability naturally leads to instability. The more stable the world is and the longer it maintains stability, the more unstable it becomes when the next crisis arrives (Tymoigne 2012).

F.S. Mishkin argues that financial instability occurs, when shocks in the financial system disrupt the flow of information, so that the financial system cannot perform its capital flow functions (Mishkin 1999: p. 6). He points out that one of the primary factors in financial instability is problems in the banking sector. Thus, the instability of the banking system is affected by the condition of the banking sector and the condition of banking institutions (Reinhart, Rogoff 2009). These entities are particularly vulnerable to the risk of destabilisation, which is due to the characteristics of banking institutions, the specifics of their operations and the characteristic structure of their balance sheets (Niedziółka 2011: p.79).

The recognition of the banking sector as the most important channel for the transfer of impulses determining the risk of financial destabilisation indicates the existence of the phenomenon of banking sector instability. The banking system, by collecting and allocating savings, transforming risk and information, and ensuring the functioning of

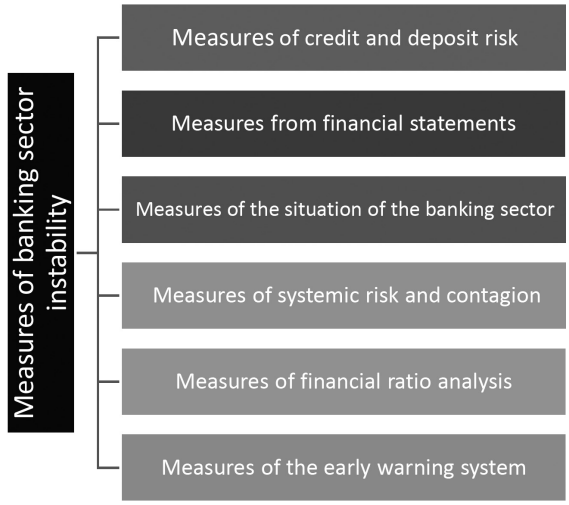
the payment system, plays a special role in the economy. Banks constantly interact with other segments of the economy, and are linked to the macroeconomic environment and foreign countries, therefore they should conduct their operational and investment activities in a way promoting economic development. However, it should be remembered that there is a strong feedback loop between the development of the economy and the development of the banking system, which means that the basis for the development of any economy is the stable development of the banking system (Żukowska 2007: p. 83), which should become the overriding goal of regulators and supervisory institutions. The financial stability of the banking system is important for the smooth operation of the entire economy, as both quantitative and qualitative changes have been taking place in the banking system over the past several years (Reinhart, Rogoff 2009).

## Indicators of banking sector stability

The level of stability of the bank and the banking system as a whole is determined by selected **indicators** adopted by the International Monetary Fund (see: *Figure 5*), which include:

- capital adequacy (*Total Capital Ratio* – TCR, *Capital Adequacy Ratio* – CAR, *Capital to Risk-Weighted Assets Ratio* – CRAR) – provides a buffer to protect the bank against unforeseen losses;[4]

**Figure 5: Measures of banking sector instability**




Source: author's own elaboration

[4] It is the ratio of the size of a bank's equity (*Tier 1* and *Tier 2* common funds) to its risk-weighted assets. Is a state in which the level of risk taken by the group in connection with the development of business activities, can be covered by the capital held; own funds and core funds to risk-weighted assets, non-performing loans less provisions to capital.

- quality and structure of assets (QSA) – non-performing loans to total loans, structure of loans to the non-banking sector;
- profitability (P) – return on assets, return on core funds, interest income and non-interest income to assets, operating expenses to banking profit;
- liquidity (L) – liquid assets to assets and liquid assets to current liabilities;
- sensitivity to foreign exchange risk (SFER) – net open foreign exchange positions to capitals;
- aggregate indices (AI) – relating to the magnitude of credit risk, developed on the basis of the value of the risk of individual banks, the macro coverage of which can be subject of generalisation, thus, it is illustrating the condition of the entire banking sector (e.g., Credit Default Swap indices);
- MES ratio – is a measure of the impact of an individual bank's situation on systemic risk; it is measured as a percentage of bank's total assets, and therefore the marginal expected loss shortfall; the higher the value of the MES ratio (the higher the level of systemic risk);
- SRISK indicator – the total systemic risk in the banking sector in a given period is equal to the sum of (positive) values of SRISK***i*** for all ***i***, that is, the sum of the risks of individual banks; the higher the value of the SRISK indicator (the higher the level of systemic risk);
- indexes: Markit and iTraxx Financial – estimated on the basis of CDS (Credit Default Swap) instruments;[5]
- indicators of lending activity (IFLA) – the ratio of the volume of loan receivables to the bank's total assets;
- deposit activity ratios (DAR) – the share of deposits in the total liabilities of banks; it characterises the structure of funding sources;
- measures, based on data included in the financial statements of individual banking institutions (MSF);
- indicators depicting the situation in the banking sector (e.g., LIBOR-OIS spread);
- indexes showing the size of systemic risk in the banking sector (IRS) – systemic risk is the risk of such a disruption in the banking system operation that, if materialised, disrupts the operations of the banking system and the national economy as an entirety;[6]
- indicators of the early warning system of instability in the banking sector – WSWO (systemic risk assessment, intensity of credit risk, security of financial institutions, health of the banking system);
- financial health indexes in assessing banking sector fragility – Bloomberg FCI (BFCIUS), Bloomberg European FCI (BFCIEU), BECIUS+, CFCILEVL, KCFSI, GF FSI, GFSI;

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5 *iTraxx Financial* is the name of a set of indices relating to CDS operating in the European market, Australia, Japan and continental Asia. They reflect the cost of insuring against the insolvency of financial institutions, indicating the assessment of credit risk by the financial institutions themselves.

6 Sources of systemic risk can include, for example, excessively fast credit growth, high leverage of financial institutions, households or companies, or highly concentrated links between financial institutions.

- class econometric models: RBC (Real Business Cycle), Diamond-Dybvig, DSGE (Dynamic Stochastic General Equilibrium), OLG (Overlapping Generation), FHGE (Finite Horizon General Equilibrium), SVAR (Structural Vector Autoregressive), Bartram-Brown-Hund;
- profitability ratios (PR) as measures of assessing the intensity of volatility in the banking sector, which illustrate the efficiency of the bank's operations.

Excessive declines in the rates of return for most of the world's leading banks or banks in selected regions of the globe may be indicative of increasing volatility, profitability indicators are interrelated. The most general indicator is ROE (Return on Equity), which stands at the top of the "pyramid". It can be calculated by multiplying ROA (Return on Assets) by the Assets/Equity ratio, which results directly from the Du Pont model. High ROA tends to characterise smaller banks – local and national banks – reflecting the lower cost of their capital and the higher profitability of their lending. Large banks, on the other hand, obtain lower index values due to the higher cost of capital used. Banks' equity accounts for a relatively small share of liabilities. Thus, only a portion of the institution's assets are financed by secure, non-refundable sources of funding. This is due to the high leverage used by banks. Thus, the return on equity is correspondingly higher than the return on assets (ROA).

ROE is also compared with the inflation rate. A lower ROE than the inflation rate means the bank is decapitalised. In developed market economy, it is assumed that for banking institutions, a ratio of 16–18 (with no or negligible inflation) is attractive and signifies the good condition of the entity.

## Methods, research and results

The purpose of this research is to analyse the stability of the banking sector of the Eurozone countries with the consideration of the turbulence of the contemporary global economy. The stability of the banking system will be examined with 13 core measures and indicators: TCR, CRAR, QSA, P, L, MES, SRISK, Markit, iTraxx, IFA, DAR, PR-ROE, PR-ROA. In addition, the analysis is based on literature research. As the impending crisis will primarily affect Europe, therefore the 19 largest banks in Eurozone countries will be analysed in terms of their total asset size: Austria – Erste Group Bank (EGB), Belgium – Argenta Bank (AB), Cyprus – Bank of Cyprus (BC), Estonia – LHV (LHV), Finland – OP Corporate Bank PLC (OPCB), France – BNP Paribas (BNPP), Greece – National Bank of Greece (NBG), Spain – Banco Santander Central Hispano (BSCH), the Netherlands – ING (ING), Ireland – Bank of Ireland (BI), Lithuania – Šiaulių Bankas (SB), Luxembourg – Deutsche Bank Luxembourg SA (DBL), Latvia – Swedbank Latvia (SL), Malta – Bank of Valletta (BV), Germany – Deutche Bank AG (DBAG), Portugal – Banco Comercial Português (BCP), Slovakia – Slovenská sporiteľňa (SS) (Erste Bank), Slovenia – Nova Ljubljanska Banka (NLB), and Italy – Unicredit SpA (USPA). These institutions continue to be ranked as the largest systemically important banks for these EU countries.

The empirical study includes: source data from the banks' annual financial statements, published statistical data from the central banks' yearbooks and reports, empirical data from the World Bank, International Monetary Fund, Basel Committee on Banking Supervision, statistical offices – Eurostat and news agencies, namely Bloomberg and Reuters. The inclusion of such range of data is necessitated by selected indicators and measures to quantify the stability of the banking system.

The analysis covered the three-year period from 2021 to 2023 (forecasting). The choice of such short time interval is necessitated by the fact that during the previous period (2013–2020) the analysed banks remained stable in terms of the studied measures and indicators. Slight deviations (if they occurred sporadically) were a consequence of the following risks in the Eurozone: political problems, debt serviceability of Eurozone countries, sustainability, banks' implementation of non-performing loan (NPL) strategies, easing of credit standards, valuation adjustments in financial markets, consequences of Brexit, geopolitical uncertainty and risks related to climate change. The preceding years, together with 2021, generally were a period of stability, 2022 from Q4 has been a period of increasing imbalances, 2023 will be the first year of projected severe volatility. After 2024, further declines in finance are predicted; however, their magnitude cannot be precisely estimated at this point due to the difficulty in determining the magnitude and severity of turbulence in the global economy in 2024.

The following relations were applied to the calculations:

**(1)** Balance sheet total of the bank *i* for *i=1,2,3.....n*

$$\boldsymbol{D_i + C_i = \sum_{j=1}^{n} Xi,j}$$

where:

$D_i$ – all liabilities,

$C_i$ – the bank's equity valued at the current market price,

$X_{i,j}$ – assets of the bank concerned and valued at the current market price.

**(2)** The *MES* ratio was considered as a percentage of the bank's total assets ***i*** in the calculations.

$$\boldsymbol{MES_i^q = \mathrm{E}\,(L_i |\, \mathrm{L} > VaR^q)}$$

where:

$L_i$ – potential loss on the bank's assets ***i***,

$L$ – losses of the entire banking sector,

$VaR^q$ – value of the maximum potential loss on the bank's assets ***i*** over a specified period of time ***i*** with the specific probability of occurrence ***q***,

$E\,(L_i \mid \mathrm{L} > VaR^q)$ – the final projected capital shortfall to occur in the banking sector as a result of the occurrence of the bank's loss *i* provided that the losses of the entire sector exceed *the* $VaR$, i.e. when a crisis occurs.

*MES* as a capital shortfall in the bank ***i*** in period ***t*** will occur, when:

$$k\,(D_i + C_i) - C_i > 0 \text{ , i.e.: } k > C_i \mid \sum_{j=1}^{k} Xi, j$$

where: $k$ – nominal capital adequacy ratio, i.e. the ratio of equity to total assets of the bank.

**(3)** $\boldsymbol{SRISK}$ – equal to the expected size of the shortfall in the bank's required equity capital $\boldsymbol{i}$ in crisis conditions. This model uses the measure of systemic risk.

$$\boldsymbol{SRISK_i = E\,(k\,(\,D_i + C_i\,) - C_i \mid crisis) = kD_i + k\,(1 - LRMES_i\,)\,C_i - (1 - LRMES_i)\,C_i}$$

$$\boldsymbol{= kD_i - (1 - k)\,(1 - LRMES_i)\,C_i}$$

where:

E – expected size of the shortfall in the bank's required equity capital and $\boldsymbol{i}$ in crisis conditions.

k – nominal capital adequacy ratio, i.e. the ratio of equity to total assets,

$D_i$ – all liabilities of the bank $\boldsymbol{i}$,

$C_i$ – the bank's equity valued $\boldsymbol{i}$ at the current market valuation,

$LRMES_i$ – *long-run marginal expected shortfall* is the expected percentage decline in the value of the bank's equity $\boldsymbol{i}$ in crisis conditions at a specific time $\boldsymbol{t}$.

**(4) TCR**, which is the ratio of the size of a bank's own funds and to its risk-weighted assets and off-balance-sheet liabilities:

$$\mathbf{W1} = \frac{\boldsymbol{ktier1 + ktier11 - k\,deduction}}{\boldsymbol{r\,cred}} \geq 8\%\ \boldsymbol{r\,cred = r_{bs} + r_{obs}}$$

where:

W 1 – credit side solvency ratio,

$ktier1$ – core funds,

$ktier11$ – matching funds,

$k\,deduction$ – items reducing total funds,

$r\,cred$ – credit risk exposure,

$r_{bs}$ – credit risk exposure from balance sheet items,

$r_{obs}$ – credit risk exposure from off-balance sheet items.

$$\mathbf{(5)\ W11} = \frac{\boldsymbol{ktier1 + ktier11 - k\,deduction + ktier111}}{\boldsymbol{r\,cred + 12.5\,r\,market}} \geq 8\%$$

where:

$ktier111$ – Category III funds,

$r\,market$ – exposure to market risk.

$$\mathbf{(6)\ W111} = \frac{\boldsymbol{ktier1 + ktier11 - k\,deduction + ktier111}}{\boldsymbol{r\,cred + 12.5\,(r\,market + r\,oper)}} \geq 8\%$$

where:

$r\,oper$ – operational risk exposure.

$$(7)\ \textbf{Solvency ratio} = \frac{enhanced\ Tier\ 1 + Tier\ 2\ capital}{capital\ requirements}$$

$$(8)\ \textbf{Tier I Capital Ratio} = \frac{core\ Tier\ 1\ funds}{risk-weighted\ assets}$$

$$(9)\ \textbf{Bank lending activity ratio} = \frac{total\ loans}{total\ assets}$$

$$(10)\ \textbf{Bank's deposit activity ratio} = \frac{total\ deposits}{total\ liabilities}$$

$$(11)\ \textbf{Loans/deposits ratio} = \frac{total\ loans}{total\ deposits}$$

$$(12)\ \textbf{ROA} = \frac{net\ profit}{total\ assets}$$

$$(13)\ \textbf{ROE} = \frac{net\ profit}{equity}$$

In 2021, the MES ratio for all the banks under analysis was at an acceptable level, averaging between 1.1% and 2.3%. The ratio increased in Q3–Q4 2022, especially for the following banks: BC, OPCB, BNPP, BSCH, NLB, USPA. A significant progression of this indicator is predicted for 2023, especially for the following banks: BC, NLB, USPA. This means that the amount of the marginal expected capital shortfall in the conditions of the financial crisis caused by the capital shortfall in the above-mentioned banks was 20%, 30%, 30% of their balance sheet totals, respectively.

Similarly to the MES indicator, the SRISK indicator did not show any significant deviations in the examined banks in 2021, which translates to the low level of systemic risk. From Q2 2022 onwards, its value started to increase in all the examined banks, especially in: LHV, SL, SS, BV, DBAG, BCP. This means the total percentage capital shortfall for these banks on the order of: 30%, 35%, 40%, 38%, 35%, 43% of their balance sheet totals, respectively. Therefore, this indicator demonstrates the high level of systemic risk in these banks. The 2023 forecast for this indicator is unfavourable for all the examined banks, it demonstrates a significant increase in systemic risk. This is particularly true for the following banks: LHV, OPCB, BV, USPA, SS, BCP, DBAG, SL, SB, BI, where the growth range is 40%, 45%, 50%, 43%, 51%, 41%, 40%, 48%, 49%, 45%, respectively. This situation predicts difficulties for these institutions. The analysis of the MES and SRISK indicators aimed at examining system risk leads to a conclusion that they are highly informative and predictive. Therefore, they should be included in modern early warning systems.

For the Markit and iTraxx Financial indices issued (the research was based on such assumption) after 2016 with maturities of 5 and 10 years, it was adopted that they would cover the period before and during the forecasted 2023 crisis. From 2022 onwards, their values began to rise. In 2021, these indices were below 100 basis points on average. From Q4 2022, increases are recorded at 165,555 to 189,432 basis points. In 2023, increases of

387,612 basis points are predicted. Therefore, the examined indices demonstrate a significant increase in credit risk among the analysed banks and an increase in its volatility.

IFA-DAR (LTD – *Loan-To-Deposit Ratio*). The ratio of loans to the banks' balance sheet total in 2021 was relatively low. The increase in loans occurred (%) in Q2 2022, which is attributable to the impoverishment of the population in the Eurozone due to skyrocketing inflation. Certain banks increased the amount of loan receivables in relation to their total assets.

There is marked an increase in the loan portfolio of the examined banks, but it also confirmed the earlier thesis as regards the impoverishment of EU societies. The largest loan receivables were recorded by the following banks: BC, BNPP, BSCH, ING, BI, SB, SL, BV, BV, SS, NLB, DBAG. Growth at a similar level to 2022 is also projected for 2023. These increases demonstrate added volatility risk at the banks under examination.

The ratio of deposits to total liabilities of the examined banks adopted the highest values in 2021. From Q3 2022 onwards, this ratio decreases significantly, which marks the banks reducing the share of deposits in their funding mix. Declines were recorded by all the banks covered by the analysis, in particular: OPCB, BNPP, DBL, BV, DBAG, SS, NLB. As it can be concluded from the analysis, the LTD ratio exceeded 100% as for all the banks, which means that the volume of loan receivables exceeded the total of accepted deposits in these banks. Simultaneously, the banks had to fund a part of their loan receivables from other sources, which in practice testifies to a significant increase in their risk of financial instability. As loans increased, non-performing loans (bad loans) increased also. In practice, this translated into a deterioration of the loan portfolio of the banks, which, in turn, presented a higher risk of instability for them and, consistently, instability for the banking sector at large.

Profit is the basic figure that determines the financial health of a business. By Q2 2022, the examined banks had recorded increased net profits. For the purposes of the analysis, the size of this growth was not taken into account but the fact of the growth itself. The forecast for Q4 2022 and the entire year of 2023 demonstrates drastic declines in the banks' net profits. The following banks will suffer the largest losses: BC, SB, SL, BV, SS, NLB. This indicates a serious deterioration in the financial health of these banks within just one financial year.

The banks' profitability is in detail expressed by two ratios: ROE and ROA. The research demonstrates that the ROA values of the banks examined at the time of the analysis, i.e. Q2 2022, are positive. The projected declines are related to the entire 2023 year, when banks can start to see negative returns by the month. This will particularly affect the following banks: AB, SB, EGB, NBG (decreases 50%, 62%, 69%, 72%, respectively), in which assets will be reduced due to the lower resilience of the economies to the crisis (including the size of GDP), where these banks operate in relation to the other banks in the group under study. The return on assets of individual banks and, consistently, the entire banking sector of the Eurozone countries will therefore be decreasing.

Analysing the changes in ROE for the adopted research period, it is evident that for the years 2021–2022, the value of the examined indicator exceeded 10% in the case of the

majority banks. It means that the net profit of the Eurozone banks represented at least 10% of their equity value. This good trend can start to deteriorate by the month in the projected Q4 2022 and throughout 2023, which marks even further deterioration in the banks' return on equity. At the end of 2023, significant declines in ROE values are already recorded for the following banks: BCP, DBAG, SS, NLB, NBA, USPA – negative values.

In terms of TCR until 2022, the Eurozone banks had met the requirements set by the Basel Committee on Banking Supervision. The TCR ratio was above the established threshold value of 8%. Therefore, the banks adopted themselves to the prudential regulations imposed on them. The following banks had the highest values for this indicator: BNPP, ING.

For the CRAR ratio – in compliance with the New Capital Accord, the banks should maintain this ratio at no less than 4%. Similarly as for the TCR, this indicator had exceeded the set threshold by Q4 2022. Therefore, the banks adapted themselves to the regulations imposed on them also in relation to this indicator. The highest values of this indicator were recorded by the following banks: BSCH, NBG, BC. However, it should be borne in mind that capital adequacy ratios alone, even if within the threshold values, do not guarantee the safety and stability of the banks and, consistently, of the entire banking sector of the Eurozone countries. The lower the value of these indicators, the higher the risk of instability in the banking sector.

The design of a market-based early warning system should also include the assessment of confidence in the banking sector. While assessing this level, the verification of two indicators was adopted for the purpose of the analysis: LIBOR-OIS spread and TED spread. An increased LIBOR-OIS spread indicates irregularities in the functioning of the banking sector and an elevated risk of instability. Whith the increased size of the spread between LIBOR and the OIS, the cost of funding interbank loans grows. This indicator had remained stable at 10 basis points until Q1 2022, but it had increased afterwards. It is predicted to be very high for 2023: 282 basis points. The growth of TED[7] indicator is also unfavourable, and it indicates a decline in the confidence of financial institutions in banks. Until Q2, the ratio had been at a low level in the group of the banks subject to analysis, and was 20 basis points on average. Afterwards, the value of this indicator is projected to deteriorate at a rolling rate – 5 basis points by the end of 2023 on average. Both LIBOR-OIS and TED already foreshadow irregularities in the functioning of the banking sector in the Eurozone countries.

## Conclusions

The aim of this article was to analyse the stability of the banking sector of the Eurozone countries in light of the turbulence in the contemporary global economy. This aim was achieved through the considering current changes and tendencies in the economy, the importance of stability, measures of stability, and empirical analysis of the main indicators of financial stability of the banking sector.

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[7] It indicates the level of confidence of financial institutions in the solvency of banks.

The research hypothesis, based on the statement that the banking system of the Eurozone countries, regardless of high risk and turbulence in the global economy, remains stable, was verified positively. This confirms the circumstances, in which the banks of the Eurozone countries found themselves during the analysed period. The banking performance deteriorated as the COVID-19 pandemic escalated and the first symptoms of the energy crisis occurred.

The research demonstrates that an early warning system for monitoring the economic and financial health of the banking sector remains an important element for analysing the fragility of the banking system. The selection of indicators used for the research proves to have been suitable and meaningful. In author's opinion, it represents the basic set of measures which should be included in a modern early warning system. It is important to emphasise that today's early warning system should be quick and effective in assessing the financial health of the banking sector. In the author's opinion, the proposed system meets such requirements.

The empirical verification of the indicators selected in the analysis leads to the following **conclusions**:

1) The proposed indicators can be divided into those that can be referred to as informational and predictive (here we can distinguish e.g.: MES, SRISK, Markit iTraxx, ROA, ROE, LTD), as well as those that are purely informational – deposit and loan activities.
2) An early warning system structured in such manner should become an important component of the system, to complement the already existing tools for assessing the central banks' response to the instability of the banking sector.
3) Additionally, effective early warning system should be characterised by very early and quick identification of instability sources. For this purpose, the proposed information and forecasting indicators should be used.
4) Today's banks operating in volatile and risky environment need to respond to risks flexibly. They need to be equipped with effective analytical tools, taking this volatility into account and mitigating it in risk terms.
5) Further research should be conducted on the continuous upgrading of early warning systems with new measures and indicators adapted and taking into account the volatility of the macroeconomic environment of the global economy.

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