EXPANSIONARY MONETARY POLICY VS. BANK CONCENTRATION: THE EUROZONE & OTHER EUROPEAN COUNTRIES

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Summary: Expansionary monetary policy, combined with unconventional measures, led to a decline in the profitability of U.S. and European banks. In this paper, we study whether such measures also affected the asset concentration in the European banking sector. The findings of this research add value to previous research, taking a step deeper into examining the consequences of expansionary monetary policy. We find that reductions in the ECB's key policy rate can predominantly explain the concentration growth in the Eurozone countries. The ECB's monetary policy had a more substantial influence on the growth of the concentration of banks outside the Eurozone than the own monetary policies of those countries. In this way, expansionary monetary policy poses specific challenges to financial stability in Europe.

Keywords: Monetary policy regimes, bank profitability, bank concentration, Eurozone, VAR model

JEL: E44, E52, E58, G21

Research in the last more than a decade shows that low interest rates and unconventional monetary policy have several effects on the banking sector: increased risk-taking, declining profitability, rising lending, shifting operations to fee-generating activities, declining provisions for credit losses, etc. This paper goes a step further in considering the effects of expansionary monetary policy on the banking sector in European countries. The initial thesis of the study is that the previously confirmed reduced profitability has certain consequences for the banking sector – an increase in concentration in the banking sector. In this study, we want to further examine whether banks were inclined to increase their concentration of assets in order to maintain profitability in the conditions of its decline caused by low interest rates. In particular, it will be examined whether a stronger effect comes from the spillover effects of monetary policies from developed countries or from own monetary policy measures.

The rest of the paper is organized as follows. Section 1 gives a brief overview of economic theory and a review of the empirical literature. The methodological

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framework is presented in Section 2. An analysis of expansionary monetary policy and the data to be used in the survey are presented in Section 3. Empirical results and discussion of findings will be given in Section 4, and concluding remarks are summarized in Section 5.

1. Literature Overview

Theories of money and monetary theory have a long history, its traces can be found in the works of David Hume, Adam Smith, Karl Marx, etc. However, the real theoretical possibilities for a comprehensive consideration of the impact of monetary policy on other areas of the economy were created in the XX century. In the 1940s, a connection between monetary theory and business cycle theory was made (Olivier Blanchard 2000). The main contribution to this integration was given by Keynes' theoretical result and its later quantitative elaboration through the IS-LM model. After that, there was a period of intensive development of monetary theory as one of the areas of macroeconomics. The development of monetary theory went through "the battles between Monetarists and Keynesians of the 1950s and 1960s, to the Rational Expectations revolution of the 1970s, and the battles between New Keynesians and New Classicals of the 1980s" (Blanchard 2000). In parallel, in practice, the importance of central banks in controlling the money supply and its impact on the real economy is growing. Monetary policy is recognized as a macroeconomic policy, but also as a topic of importance for science, through research into the mechanism of its transmission (for a detailed overview of monetary policy transmission channels see Ben S. Bernanke 1983; Bernanke and Alan S. Blinder 1988; Jean Boivin, Michael T. Kley and Frederic S. Mishkin 2010). Certain papers recognize that the risk-taking channel can be developed through the transmission mechanism of monetary policy, which is defined as the credit channel theory (Bernanke and Mark Gertler 1995). See also Anil K. Kashyap & Jeremy C. Stein (2000), Xavier Freixas and Jose Jorge (2008) and Joe Peek and Eric Rosengren (2010). This was the theoretical confirmation that monetary policy has its effects on topics in the field of financial stability (see also Douglas W. Diamond and Raghuram G. Rajan 2006; Nobuhiro Kiyotaki and John Moore 2012; Joseph E. Stiglitz 2016).

In his work, Mishkin (2017), as one of several topics for reconsideration of monetary policy after the Great Recession, introduces the "dichotomy between monetary policy and financial stability policy". Overall developments after the global financial crisis have increased the relevance of prudential policy as a topic but have not fully answered a number of theoretical and empirical questions that accompany its use and relationship with other policies (Blanchard, Giovanni Dell'Ariccia and Paolo Mauro 2013). Since then, monetary policy and prudential policy have been seen mainly as two separate macroeconomic policies whose coordination is necessary (Xavier Freixas,

José-Luis Peydró and Luc Laeven 2015). These findings open space for additional empirical consideration of the impact of monetary policy on prudential policy, within which the banking sector has a key and unavoidable role.

From the Great Recession until today, a number of papers have appeared that analyze the impact of low interest rates and unconventional monetary policy measures on the banking sector. These are studies that deal with the impact on risk-taking (risk-taking channel) on the one side and the impact on banking profitability and other changes in banks (credit growth, increase in non-interest income, etc.) on the other side.

First of all, these are studies that have empirically examined the existence of risk-taking channels. On data from the U.S. and the European Union, Altunbas, Gambacorta and Marques-Ibanez (2014) get results that confirm that low interest rates over time affect the risk in banks. There are two ways in which low interest rates can increase the risk in banks: 1) banks have a more positive perception of income and cash flows of customers, resulting in the underestimation of risk and 2) banks' search for yield (reduced risk aversion). The authors suggest that monetary policy has an impact on banks' risk and that monetary and prudential policy coordination is needed to achieve both policy objectives: price and financial stability. In his research, Silvo Dajcman (2017), using the bank lending survey (BLS) response to identify the risk-taking channel of monetary policy, shows that the environment of low interest rates affects the increase in risk-taking in banks. The author states that "the results suggest that the risk taking channel in the euro area is operational".

Some research shows that in conditions of low interest rates, banks with lower capital levels are more prone to take risks. By analyzing banks in the U.S. in the 1997–2011 period, Dell'Ariccia, Luc Laeven and Gustavo Suarez (2013) provide evidence that monetary policy creates a channel for risk-taking. According to the results of this paper, the environment of negative interest rates increases the risk-taking by banks. This effect is more pronounced in banks with lower capital levels. Also, Gabriel Jiménez, Steven Ongena, José-Luis Peydró and Jesús Saurina (2014) confirm the impact of monetary policy on credit risk taking in banks. Their findings show that low interest rates on overnight loans by banks affect low-capital banks granting higher amounts of collateral-free loans to riskier clients, increasing lending to clients who are riskier – later they will be more likely to default.

The nonlinearity of the relationship between monetary policy and risk-taking in banks has been examined by certain authors. On the data on European banks in the 2000–2015 period, Sophie Brana, Alexandra Campmas and Ion Lapteacru (2019) confirm that low interest rate policies and injecting large amounts of liquidity encourage risk-taking. They point out that the relationship between monetary policy and risk-taking is non-linear and that below a certain threshold this effect intensifies.

In addition to research examining the existence of risk-taking channels, there are papers dealing with the direct consequences of expansionary monetary policy, such as the impact on net interest margins and bank profitability. Concentration is typically considered as a determinant of banking sector profitability (see, Philip Bourke 1989). Certain empirical research deals with the impact of expansionary monetary policy on net interest margins and bank profitability. On data for 47 countries, in the 2005–2013 period, Stijn Claessens, Nicholas Coleman and Michael Donnelly (2018), using regression models, get results that the current decline in interest rates leads to a decline in net interest margins. The paper shows that a longer period of time in an environment of low interest rates increases the negative impact on the net interest margin. In their work, Borio, Gambacorta and Hofmann (2017), on data for over one hundred international banks from fourteen developed economies in the 1995–2012 period, examine the relationship between monetary policy and bank profitability. The results of this research show a positive relationship between changes in interest rates and bank profitability, with the extremely important observation that "unusually low interest rates and an unusually flat term structure erode bank profitability". The results show that in the 2011–2014 period, which coincides with the period of expansionary monetary policy, there was a negative impact of low interest rates on bank profitability, measured by the rate of return on assets (ROA). The authors conclude that the long duration of low interest rates can be extremely negative for banks' profitability.

The question was whether the reduction in interest rates affected the approval of a larger number of loans, which would compensate for the banks' income through the economies of scale. Franziska Bremus and Marcel Fratzscher (2015) show in their work that expansionary monetary policy affects the increase in cross-border lending both in euro area and non-euro area countries. In the context of the volume of bank lending (bank lending channel), conventional monetary policy measures are more strongly transferred to banks with lower capital, while unconventional measures are more strongly transferred to banks with higher capital levels (Ugo Albertazzi, Andrea Nobili, Federico M. Signoretti 2021). On the data for the eurozone covering the 1999–2009 period, Gert Peersman (2011) finds that the reduction in interest rates has a stronger impact on the growth of lending than the growth of the monetary base of the central bank. The author explains that this is a consequence of a stronger manifestation of risk-taking channels in the case of falling interest rates than in the case of a growing monetary base. Borio and Gambacorta (2017), in another paper, develop a model that analyzes the impact of interest rate changes on lending growth, on data for international banks in the 1995–2014 period. The obtained results confirm that in the zone of low interest rates, additional lowering of interest rates contributes less to the growth of lending. This further explains the decline in bank profitability in an environment of low interest rates.

There are studies that show some changes in banks due to falling interest income. Jacob A. Bikker and Tobias M. Vervliet (2017), on U.S. banks in the period 2001–2015, examine how the long-term environment of low interest rates affects the profitability of banks. The authors confirm that low interest rates have led to a decline in traditional banking income, such as net interest income. Due to such effects, banks reduced provisions for credit risk losses, thus compensating for the decline in profitability. Carlo Altavilla, Miguel Boucinha and José-Luis Peydró (2018) show that low interest rates are not associated with lower bank profitability. They explain this by the fact that the impact of negative interest rates on the reduction of interest income is compensated by the growth of non-interest income and the decline in loan-loss provisions. Michael Brei, Borio and Gambacorta (2019), analyzing data on operations of international banks from fourteen developed economies in the 1994–2015 period, found that banks in conditions of low interest rates redirect their activities from those that generate interest rates to activities that generate commissions and trading activities. The paper notes that due to these circumstances, risk-weighted assets and loan-loss provisions are reduced, which may be related to evergreening. The reduction of loan-loss provisions may be related to the tendency of banks to underestimate certain risks, to have a more positive perception of income and cash flow in an environment of low interest rates (Altunbas, Gambacorta and Marques-Ibanez 2014).

Also, the environment of low interest rates affects the market value of banks' capital. Miguel Ampudia and Skander Van den Heuvel (2018), in their work, showed that the reduction of one-month and three-month EONIA rates affects the increase in stock prices of banks in Europe. Altavilla, Boucinha and Peydró (2018) also confirm that "monetary policy easing surprises during the low interest rate period improve bank stock prices".

Certain studies have linked bank profitability to risk taking. Research by Yen-Ling Chang and Daniel A. Talley (2017) suggests that banks (especially large ones) tend to take on riskier projects to protect their profitability. Natalya Martynova, Lev Ratnovski and Razvan Vlahu (2020) come to the conclusion that "a more profitable core business allows a bank to borrow more and take side risks on a larger scale".

The impact of expansionary monetary policy on banks has been the subject of analysis of several central banks. In its Financial Stability Review (November 2015), the Bundesbank states that low interest rates pose a risk to financial stability because they reduce the earnings of banks and insurance in Germany. It is, however, pointed out that these adverse effects are limited and that the banking sector as a whole is resistant to these negative effects. The report emphasizes that they must respond to these challenges in order to avoid a trade-off in the medium term between monetary policy and financial stability. It is recommended that in the conditions of longer duration of

low interest rates, banks be additionally protected by reducing costs and interest rate risk, increasing capital and reducing leverage.

In the review of previous works about the impact of expansionary monetary policy on banks, we could see a confirmed impact on the increase in risk-taking and confirmation of the presence of risk-taking channels. Also, the impact of expansionary monetary policy on the decline in bank profitability was recognized, as well as changes in bank operations due to falling profitability (increase in lending and non-interest income, decrease in loan-loss provisions, etc.). The link between declining profitability and increasing banks' propensity to take risks has also been confirmed. These findings clearly identify the need for coordination of monetary policy and prudential policy measures. In all these researches, in the context of realizing the consequences of falling profitability in an environment of low interest rates, there is a lack of papers that examine the impact on banking concentration. There are papers investigating whether the concentration of banks affects the efficiency of the transmission of monetary policy measures (Barbara Baarsma and Melvin Vooren 2017; Sean Severe 2016), but not whether monetary policy affects banking concentration. In the conditions of low interest rates, there is an increase in the volume of lending, but it has not been confirmed whether this growth is uniform across banks. If there is an increase in banking concentration, then the growth of larger banks was higher (or the only one present). Asymmetric credit growth in favor of large banks can have its prudential implications. Examining whether there is an increase in the concentration of banks in Europe and whether this opens some topics in the field of prudential policy is the basic research question of this paper.

The central banks of developing countries have largely followed the path of monetary policy expansion. Also, some papers show that the quantitative easing of central banks of developed countries is transferred to other countries through global banks and the international credit channel (Carmela D'Avino 2018; Judit Temesvary, Steven Ongena and Ann L Owen 2018; Peter Tillmann 2016). Along with the effects of their own monetary policies, the effects of the monetary policies of developed countries are spilling over to developing countries (Pablo Anaya, Michael Hachula and Christian J. Offermanns 2017). Marcel Fratzscher, Marco Lo Duca and Roland Straub (2016) show that there is an effect of the ECB's unconventional monetary policy spilling over to other developed and developing countries on the stock market and confidence, while the impact on the bond market has been negligible. In the circumstances of the presence of the global financial cycle, the question of the independence of monetary policies of smaller countries arises, especially if those countries are largely dependent on external capital inflows (Hélène Rey 2015). On the example of the analysis of Denmark, Sweden and Norway, Saskia ter Ellen, Edvard Jansen and Nina Larsson Midthjell (2018) come to the conclusion that "although spillovers impose challenges on domestic monetary policy effectiveness, small open economies still have some control over their yield

curve". Numerous recent papers have shown the spillover effect of the ECB's monetary policy on European countries (see also, Georgios Georgiadis and Johannes Gräb 2016; Oxana Babecká Kucharčuková, Peter Claeys and Bořek Vašíček 2016; Roman Horvath and Klara Voslarova 2016; Galina Potjagailo 2017; Łukasz Goczek and Karol J. Partyka 2019). Małgorzata Walerych and Grzegorz Wesołowski (2021) confirm that the ECB is the main foreign central bank influencing the markets of Central and Eastern European countries, while the Fed is "playing a very moderate role". Having in mind the findings of these researches, a special research question of this paper is whether there is an effect of the spillover of the ECB policy on countries outside the eurozone (especially to emerging countries), in the context of banking concentration.

This paper contributes to the empirical literature in four ways. First, it expands the scope of the analysis of the impact of expansionary monetary policy by considering the second wave of effects. Numerous empirical papers have confirmed that expansionary monetary policy affects the growth of risk-taking and the decline in bank profitability (the first wave of effects). This research examines whether reduced profitability and increased risk-taking have consequences in the form of increased banking concentration (the second wave of effects). Second, unlike other studies that mainly use money market interest rates (rates on interbank loans) as an indicator of the low interest rate environment, in this paper we use only the key interest rate of the central bank as a variable. Money market interest rates contain mixed effects of the central bank's key interest rate and the volume of money on the market, while the use of only the central bank's key interest rate contains a pure effect of expansionary monetary policy (excluding effects of unconventional measures). Third, as far as we know, this is the first empirical study to assess whether bank concentration in emerging countries in Europe is more affected by the spillover effects of the ECB's monetary policy (and its consequences) than their own monetary policies. Fourth, there are implications and challenges to monetary and prudential policy.

2. Methodological Framework

"In standard monetary theory, banks play no role—this is true even for the models used by central banks" (Stiglitz 2016). However, over time, economic theory has recognized the many imperfections of the market and the theoretical models based on them, so that theories have begun to emerge that include the behavior of banks in the models (Bruce Greenwald and Stiglitz 1991; Greenwald and Stiglitz 1993a; Blanchard 2000). This opened the space to consider the behavior of banks in the framework of monetary policy (Greenwald and Stiglitz 1993b; Greenwald and Stiglitz 2003). This study deals with the topic of monetary policy, investigating how expansionary monetary policy affects the behavior of banks. Confirmation of the presence of this influence is tried to be found in

the increase in concentration on the banking market. Numerous previous studies, presented in the literature review, have shown the impact of expansionary monetary policy on the decline in bank profitability and on the risk-taking channel. The aim of this study is to check whether all these changes had an effect in the direction of increasing bank concentration. In certain studies, it has been confirmed that the concentration of banks affects the effectiveness of the transmission mechanism of monetary policy (Baarsma and Vooren 2017; Severe 2016). In contrast to the already confirmed influence of bank concentration on the effectiveness of monetary policy, this research attempts to confirm the influence of a certain type of monetary policy on bank concentration. The confirmation of the hypotheses in this research would increase the importance of observing the concentration of banks in the context of analyzing the effectiveness of the transmission mechanism of monetary policy. In further research, the inclusion of bank concentration as a transmission factor in models for analyzing the effectiveness of the transmission mechanism of monetary policy could be considered.

The methodological framework in this paper includes defining an adequate measure of banking concentration and selecting an adequate procedure for the econometric analysis. For the purposes of measuring concentration in the banking market, we will use the HHI (Herfindahl-Hirschman Index), an indicator created by the above-mentioned authors for measuring market concentration in general (see Albert O. Hirschman 1945; Hirschman 1964). Although there are criticisms in the literature of this indicator and numerous alternative ways of measuring banking concentration (Gini coefficient, Concentration Ratio, etc), the HHI is one of the most frequently used indicators in the literature. Based on the Hannah Kay axioms, which state that other measures of concentration have greater disadvantages compared to the HHI (Leslie Hannah and John Anderson Kay 1977), we decided to use the HHI as a measure of concentration. In practice, central bank reports contain this indicator as a measure of banking sector concentration (ECB 2021; Bank of England 2021; etc), as well as the procedures of anti-monopoly authorities in the U.S. and the European Union.

Based on the data for each observed year, we created a time series *COUNTRY_HHI*, where *COUNTRY* is the general designation for the name of the country. For each country, we obtained a time series with HHI values. We also calculated the average HHI values for certain groups of countries, such as the eurozone.

The econometric analysis is performed by using VAR. The use of VAR to analyze the effects of monetary policy began with Christopher A. Sims (1980). A general guide to applying the VAR model will be used from Hiro Y. Toda and Taku Yamamoto (1995), Helmut Lütkepohl (2005), William H. Greene (2017) and Lutz Kilian and Lütkepohl (2017). Since then, numerous papers have been written on the empirical analysis of monetary policy transmission using VAR. In the context of the topic of this paper, emphasis is placed only on certain papers that analyze the effect of

monetary policy in the U.S. (Bernanke and Blinder 1992; Bernanke and Ilian Mihov 1998) and the eurozone (Peersman and Frank Smets 2001). Bearing in mind that unconventional monetary policy has significantly influenced the change in the economy, the question arises as to what is an adequate model for assessing economic relations in such circumstances. "Assume the true model of the economy is unknown, it is based on an unrestricted vector autoregression (VAR)" (Vito Polito and Mike Wickens 2012). The recent papers on the impact of expansionary and unconventional monetary policy in the EU have largely been written on the basis of the use of VAR (we only mention a few, Peersman 2011; Gambacorta, Hofmann and Peersman 2012; Dajcman 2017; etc). Also, the papers of Pavle Petrović and Zorica Mladenović (2015) were used as a methodological guide in the application of the VAR model.

Furthermore, in methodological terms, the procedures defined by Robert F. Engle and Clive Granger (1987) will be used in cointegration testing.

This methodological framework will be applied to test the following hypotheses:

- first: examination of whether the ECB policy rate (*ECB_PR*) affects the movement of the average HHI of the banking sector in the group of eurozone countries (*EZ_HHI*) where this indicator grew,
- second: examining whether the policy rate of the central bank of a specific country outside the eurozone *(COUNTRY_PR*[2]*)* affects the HHI of a specific country *(COUNTRY_HHI*[3]*)*, respectively, and
- third: examining whether the average HHI for selected eurozone countries (*EZ_HHI*) causes the movement of the average HHI for selected countries outside the eurozone *(COUNTRY_HHI)*.

The stated hypotheses will be examined through the following methodological framework: 1) development of bivariate models and 2) development of tri-variate models.

The procedure for developing bivariate models includes the following steps: a) if the time series are integrated of order I(1), testing of cointegration (Engle and Granger 1987) and b) application of Granger non-causality test according to the Toda and Yamamoto (1995) procedure and estimate a VAR with (k+d_max) lags. This methodological procedure implies that special bivariate models are developed for testing each individual hypothesis.

We will use following bivariate VAR model to test the three hypotheses:

$$\boldsymbol{Y}_t = \Phi_1 \boldsymbol{Y}_{t-1} + \Phi_2 \boldsymbol{Y}_{t-2} + \cdots + \Phi_p \boldsymbol{Y}_{t-p} + \Omega \boldsymbol{Z} + \varepsilon_t \qquad (1)$$

[2] *POLAND_PR, HUNGARY_PR, BULGARIA_PR, etc.*

[3] *POLAND_HHI, HUNGARY_HHI, BULGARIA_HHI, etc.*

where $\mathbf{Y_n}$ is the vector time series of variable with order $\boldsymbol{p}$[4] and dimensions 2x1 *((Y_t=[ECB_PR EZ_HHI] or Y_t=[COUNTRY_PR COUNTRY_HHI] or Y_t=[OEC_HHI EZ_HHI])*), $\boldsymbol{Z}$ vector of deterministic components, Φ matrix of parameters along the vector of variables and Ω matrix of parameters along the vector of deterministic components.

The procedure for developing tri-variate models includes the following steps: a) application of Johansen cointegration test (Soren Johansen 1996.), b) if there is cointegration, the development VEC (Vector Error Correction) model and testing constraints on model parameters (Lütkepohl 2005 and Kilian and Lütkepohl 2017).

An additional VAR model for testing the previous three hypotheses will include three variables and will have the following specification:

$$\boldsymbol{Y}_t = \theta_1 \boldsymbol{Y}_{t-1} + \theta_2 \boldsymbol{Y}_{t-2} + \cdots + \theta_p \boldsymbol{Y}_{t-p} + \Psi \boldsymbol{Z}^* + \varepsilon_t \qquad (2)$$

where $\mathbf{Y_n}$ is the vector time series of variable with order $\boldsymbol{p}$ and dimensions 3x1 (Y_t=[*ECB_ PR OEC_HHI EZ_HHI]*), $\boldsymbol{Z^*}$ vector of deterministic components, θ_n matrix of parameters along the vector of variables and Ψ matrix of parameters along the vector of deterministic components.

VEC model would have the following specification:

$$\triangle Y_t = \alpha\beta' \boldsymbol{Y}_{t-1} + \Gamma_1 \triangle \boldsymbol{Y}_{t-1} + \cdots + \Gamma_{t-p+1} \triangle \boldsymbol{Y}_{t-p+1} + \varepsilon_t \qquad (2a)$$

where β is the vector of cointegration parameters and α is the vector of adjustment parameters ($\Pi = \alpha\beta'$).

3. Expansionary monetary policy and data overview

After the methodological aspects, we will consider the data that will be used in the empirical analysis. First of all, we will present the monetary policy of the ECB, the central bank responsible for the eurozone, in the period from 2002 to 2020, through the movement of the reference interest rate and its impact on key money market interest rates – three- and six-month EURIBOR (see Figure 1).

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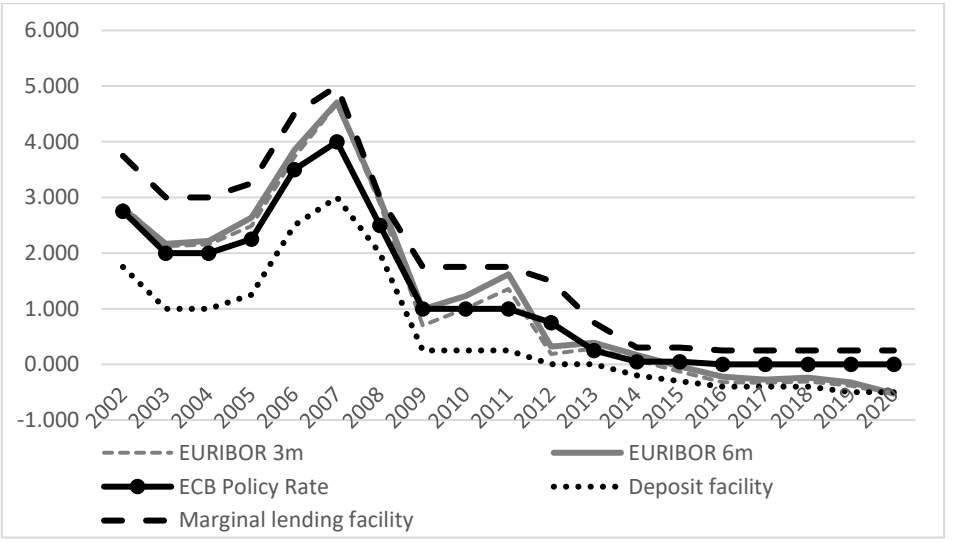
[4] The order of the model and the deterministic components will be specified in the empirical part of the paper. The value of p will be obtained as the sum of the lags (k) and the maximum order of integration of the time series (d-max).



Source: ECB 2021, Eurostat 2021 and Reuters 2021

Figure 1 ECB policy rate and EURIBOR

As we can see (Figure 1), the decline in the reference interest rate was started by the ECB in 2007 with a sharp drop in the rate, and in the following years the reference rate was lowered to 0%. During the observed period, interest rates on the money market (three- and six-month EURIBOR) follow the movement of the ECB's policy rate. EURIBOR rates move within the monetary policy corridor, between the deposit facility rate and the marginal lending rate. The fall in interest rates was accompanied by the application of unconventional monetary policy measures – injecting large amounts of money into the system through a program of quantitative easing. The aim of this research is to examine the pure effect of key interest rates of the central bank on changes in the structure of the banking sector, without the impact of unconventional monetary policy. Therefore, only the ECB's key interest rate will be used in this study. Also, the visual analysis of Figure 1 shows that money market interest rates are predominantly driven by ECB's policy rate movements.

Below is an overview of the key central bank interest rates used in the survey (see Table 1).

Table 1 Data overview

Country/Group of countries	Name of the observed policy rate	Data source	Period*
The eurozone	ECB Policy rate (The interest rate on the main refinancing operations)	ECB	2002-2020
Slovenia	Reprezentativna obrestna mera	The Bank of Slovenia	2002-2006
Cyprus	Rate on the main refinancing operations	Central Bank of Cyprus	2002-2007
Malta	Central intervention rate	Central Bank of Malta	2002-2007
Slovakia	Two week REPO tender limit rate	Narodna banka Slovenska	2002-2008
Latvia	Latvijas Banka refinancing rate	Latvijas Banka	2002-2013
Czech Republic	Two-week repo rate	Czech National Bank	2002-2020
Denmark	The Nationalbank's lending rate	Danmarks Nationalbank	2002-2020
Great Britain	Bank Rate	Bank of England	2002-2020
Poland	Reference rate	Narodowy Bank Polski	2002-2020
Sweden	Repo rate	Sveriges Riksbank	2002-2020
Bulgaria	Base interest rate	Bulgarian Central Bank	2002-2020
Romania	Monetary policy rate	National Bank of Romania	2002-2020
Hungary	Central Bank Base rate	Magyar Nemzeti Bank	2002-2020
Croatia	Discount rate	Croatian National Bank	2002-2020

North Macedonia	The interest rate achieved at the CB bills auctions	National Bank of the Republic of North Macedonia	2002-2020
Albania	Base Interest rate	Bank of Albania	2002-2020
Serbia	NBS interest rate (key policy rate)	National bank of Serbia	2002-2020
Montenegro	ECB Policy rate (The interest rate on the main refinancing operations)	ECB	2002-2020

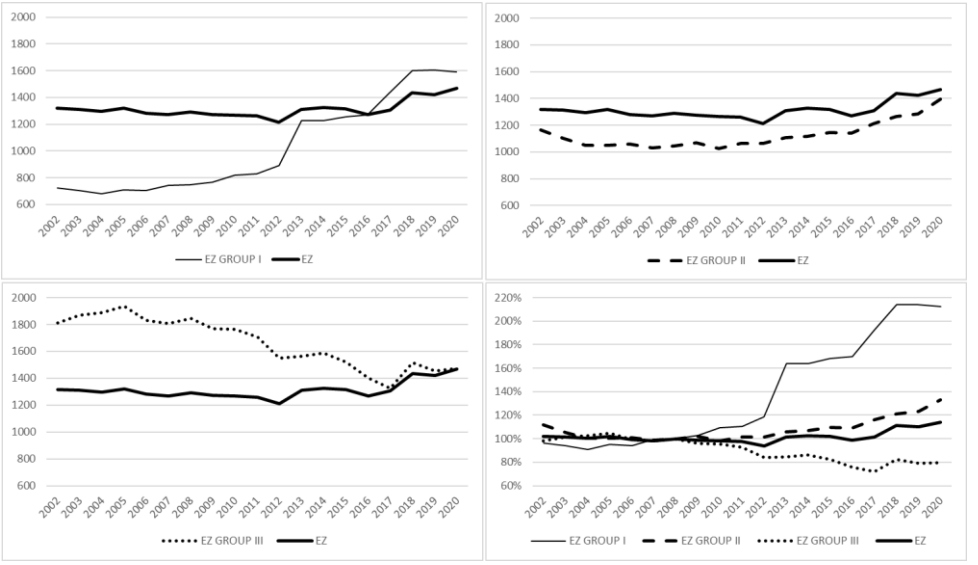
Source: ECB 2021, BOS 2021, CBC 2021, CBM 2021, NBSL 20221, LB 2021, CZNB 2021, DN 2021, Bank of England 2021, NBP 2021, SR 2021, BCB 2021, NBR 2021, MNB 2021, CNB 2021, NBS 2021, CBBH 2021, NBRM 2021, CBCG 2021 and Bank of Albania 2021

Note: *The selected period includes the phase of expansionary monetary policy of the observed central banks from 2007 to 2020, as well as the phase before that, when there was an increase in key interest rates of central banks, which can be related to the restrictiveness of monetary policy. The linking of the beginning of the observation period for 2002 is mainly due to technical reasons related to the availability of publicly available data on key interest rates of central banks.

The data that will be used for the purposes of bank concentration analysis cover the 2002–2020 period, with a special focus on 2008–2020, when the expansionary monetary policy was intensively pursued for a longer period. The subject of the observation will be monetary policies and data on the banking sector for 33 European countries, which includes the eurozone countries, EU countries and European countries outside the EU. The data source is publicly available statistics on the website of the European Central Bank (ECB 2021), Eurostat (Eurostat 2021) and Thomson Reuters (Reuters 2021), as well as publicly available statistics on the websites of central banks of non-EU countries (Bank of England 2021, NBS 2021, CBBH 2021, NBRM 2021, CBM 2021, Bank of Albania 2021, etc). According to the relevant monetary policy, the countries are divided into eurozone countries, where the monetary policy of the ECB is applied, and other European countries, where each country has its own central bank responsible for conducting monetary policy.

The group of eurozone countries includes all countries (19 countries): Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain. European countries outside the eurozone (other European countries) includes: the Czech Republic, Denmark, Poland, Sweden, Bulgaria, Hungary, Romania, Croatia, Great

Britain and Balkan countries – North Macedonia, Albania, Montenegro, Bosnia and Herzegovina and Serbia.



Source: ECB 2021

Figure 2 HHI in eurozone (EZ) countries

In the previous part, we have shown on the example of numerous papers that this direction of monetary policy has affected the decline in profitability and change in the structure of financial performance of banks in Europe. We will now analyze the extent to which all this has had further consequences for the banking sector, visible through changes in the structure of the sector, which have implications for the conduct of prudential policy. In this sense, we present the HHI as an indicator of concentration in the eurozone banking sector (Figure 2). The overview is given through the average HHI for all eurozone countries, but also as an average indicator by groups of countries. The first group of countries (EZ GROUP I) includes countries that had an increase in the HHI between 2008 and 2020 of about two times (Greece, Cyprus, Spain and Italy). The second group of countries (EZ GROUP II) includes countries that in the 2008–2020 period had an increase in the HHI between 10 and 50% (Germany, Lithuania, Latvia, Portugal, Slovakia, Malta and Ireland). The third group of countries (EZ GROUP III) includes countries that in 2008–2020 maintained the same level or decreased the HHI value (France, Belgium, the Netherlands, Austria, Slovenia, Luxembourg, Finland and Estonia).

The average HHI for all eurozone countries (EZ) displayed mostly stable movement in 2008–2020, with occasional breaks at the end of the observed period, which caused a slight increase of about 14%. Visual comparisons did not identify the links between the movement of this indicator and the movement of the ECB reference interest rate, so there was no basis for a further analysis and modeling of these relations. Also, the HHI movement in the eurozone countries is so diverse that it would not be adequate to observe it through the average indicator for the eurozone. Hence the need to single out certain homogeneous groups of countries according to the HHI movement after the Great Recession.

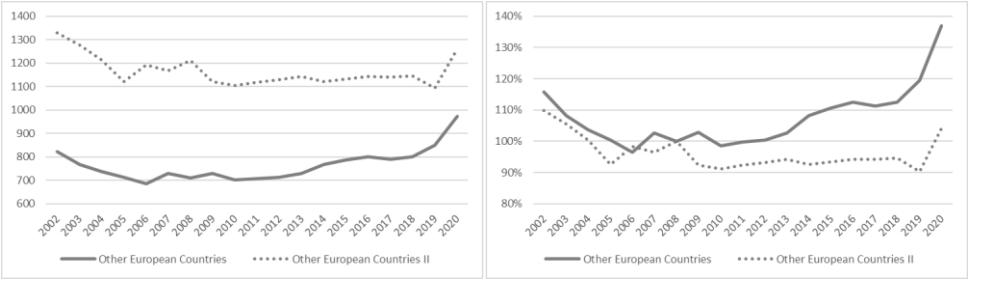
The explosive growth of the HHI in the first group of eurozone countries (EZ GROUP I) is not driven by the gradual action of factors coming from monetary policy but by measures to stabilize the banking sector after the Great Recession produced strong effects on the banking systems of this group (Greece, Cyprus, Spain and Italy). Therefore, the movement of the time series describing the HHI value in EZ GROUP I is not suitable for a further analysis and econometric modeling. In the context of this research, countries in this group can be treated as outliers.

The third group of eurozone countries (EZ GROUP III) is characterized by a stable movement or decline of the HHI (a decline on average). Countries with low HHI values had a stable movement of this indicator during 2008–2020 (France, the Netherlands, Luxembourg, Austria and Slovenia). Countries with high HHI values recorded a decline in this indicator during the same period (Belgium, Finland and Estonia). The decline in the HHI in these countries occurred in the first two to three years after the Great Recession, while in the rest of the period the HHI displayed a stable trend. The HHI movement in these countries is neutral, which suggests that this cannot be related to the ECB's expansionary monetary policy.

The second group of eurozone countries (EZ GROUP II) showed the HHI movement during the 2008–2020 period, which can be related to expansionary monetary policy measures and provides a basis for a further analysis and modeling. Later in the analysis, we will use the value of this series, which we denote by *EZ_HHI*.

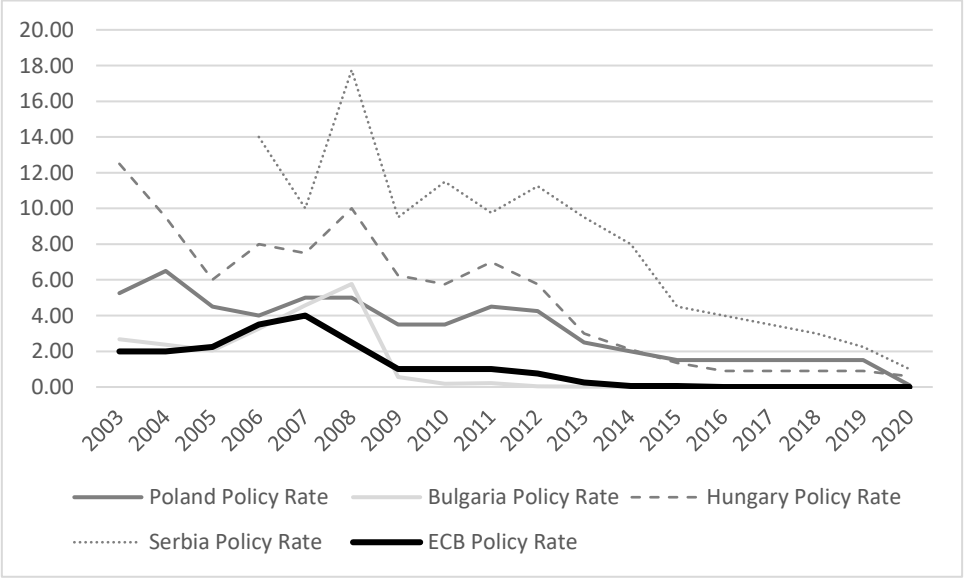
In countries outside the eurozone that have their own monetary policy, including EU countries and other selected European countries, the existence of the banking market that recorded an increase in the HHI in 2008–2020 was identified. We also identified countries that had almost unchanged HHI during most of the period (except for the jump in the year before the end of the period). The first group of countries (Other European Countries – OEC) includes: Poland, Hungary, Bulgaria and Serbia. The second group of countries (OEC II) includes: the United Kingdom, Sweden, Denmark, the Czech Republic, Romania, Croatia, Albania, Bosnia and Herzegovina, North Macedonia and Montenegro (see Figure 3). We can see that in the second group there are countries with a moderate level of banking concentration, above 1,000,

measured by the HHI. The first group includes countries that have a low level of concentration (HHI below 1,000), so there was more space for market growth on account of increasing concentration. For the purposes of further analysis, we can use only the time series that describes the average movement of countries in the first group (OEC), where there was an increase in the HHI during the 2008–2020 period. In what follows, we will denote the value of the OEC series by *OEC_HHI*.



Source: ECB 2021, Bank of England 2021, NBS 2021, CBBH 2021, NBRM 2021, CBCG 2021 and Bank of Albania 2021

Figure 3 HHI in European countries outside the eurozone



Source: ECB 2021 and NBS 2021

Figure 4 ECB and other central banks' policy rates

In what follows, we will only analyze the reference interest rates of the central banks of the countries belonging to the first group – the countries in the OEC group (see Figure 4). We will first compare them with the movement of the ECB policy rate. As we can see, in 2008 the reference interest rates of the countries in this group were found at different levels, but during 2008–2020 they all tended to fall. The Central Bank of Bulgaria had the closest movement to the ECB reference rate. The central banks of the other observed countries (Poland, Hungary and Serbia) had a similar tendency as the ECB, but the reference interest rates of these three countries remained above the ECB policy rate during the observed period. Certainly, these trends provide a basis for examining whether the expansionary policy of the central banks of these countries and the ECB has affected the increase in concentration in the banking sector. Further in their work, their logarithmic values will be marked: ECB policy rate – *ECB_PR*, policy rate of the Central Bank of Poland – *POL_PR*, policy rate of the Central Bank of Hungary – *HUN_PR*, policy rate of the Central Bank of Bulgaria – *BUL_PR* and policy rate of the Central Bank of Serbia – *SER_PR*.

4. Results and Discussion

4.1. Empirical Result

The results of the Augmented Dickey Fuller (ADF) non-stationarity test for the time series that we will use in the research are given in the following table:

Table 2 ADF test statistics

Null Hypothesis:		I(1)	I(2)
ECB_PR	*without a constant*	-0.86	-3.53***
	with a constant	-0.91	-3.57***
	with constant and trend	-3.21*	-3.41**
EZ_HHI	*without a constant*	1.31	-4.21***
	with a constant	1.73	-4.14***
	with constant and trend	0,89	-5,76***
OEC_HHI	*without a constant*	0.20	-3.81***
	with a constant	-1.19	-3.63**
	with constant and trend	-0,27	-5,98***

Source: Author's calculations.
Notes: The asterisks ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. In first difference terms in the ADF-tests we use same lag length in all tests (1 lag).

As we can see in the previous table, for the considered time series, the null hypothesis of the existence of one unit root was accepted, while the hypothesis of the existence of two unit roots was rejected for the defined significance levels.

In order to test the cointegration between the *ECB_PR* and *EZ_HHI* series, using the Engle and Granger (1987) procedure, we set up a regression model at the time series levels, in which the linear trend is included as a deterministic component. The considered variable is statistically significant at the 1% significance level. We created series of residuals (RH) that contains a constant as a deterministic component.

In table 3, we provide the results of the cointegration tests.

Table 3 Cointegration test statistics

	DF (Dicky Fuller) residual test	Lags
RH	-4,79***	1

Source: Author's calculations.
Notes: The asterisks ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively.

Bearing in mind that the value of the DF residual test statistics is lower than the critical value, at the 1% significance level, we reject the null hypothesis of the existence of a unit root in the series of residuals. The series of residuals is stationary so there is cointegration in the movement between *ECB_PR* and *EZ_HHI*.

We continue the analysis of the relationship between the ECB policy rate and the HHI for a selected group of eurozone countries (*EZ_HHI*) by defining specification of the VAR model at the time series level using Toda and Yamamoto (1995) procedure. In the VAR model specification, only the constant is included as a deterministic component (consistent with previous results in which the linear trend did not show statistical significance). Based on information criteria tests (general to specific), lag 2, lag 4 and lag 5 appear as significant at a defined confidence level of 5%. However, only lag 2 passes the normality, autocorrelation and stability tests (see Table 4).

Table 4 Lag length in the VAR model specification I

k	Wald test	p-value (Wald test)	Doornik-Hansen normality test	Portmanteau autocorrelation test – Q(12)/adjusted Q(12)	Stability condition (No AR roots)
1	146.80	0.000			
2	9.01	0.060	0.08	0.97/0.31	Satisfy
3	12.74	0.012			
4	9.41	0.051	0.46	0.77/0.07	Not satisfy
5	6.77	0.148	0.78	0.31/0.00	Satisfy
6	15.09	0.004			

Source: Author's calculations.

In Table 1, we saw that I(1) is the maximum order of integration in the *ECB_PR* and *EZ_HHI* series. Based on the lag that stood out as significant (k=2) and of the maximum order of integration (d_max=1), we estimate the VAR (2+1) model.

Now, we test the non-causality using the Granger test. The model has stability, AR roots have values below one.

Table 5 Analysis of causality (*EZ_HHI* and *ECB_PR*) in model specification I

Granger non-causality test (H_0: Non-causality)	**VAR (2+1) p-value**
H_1: The impact of the ECB policy rate on the average HHI for a selected group of eurozone countries (*EZ_HHI*)	0.06
H_1: Influence of the average HHI for the selected group of eurozone countries (*EZ_HHI*) on the movement of the ECB policy rate	0.09
Normality, autocorrelation and stability tests	**p-value**
Doornik-Hansen normality test	0.29
Portmanteau autocorrelation test – Q(12)/adjusted Q(12)	0.93/0.19
Stability condition (No AR roots)	Satisfy

Source: Author's calculations.

Although the value of the Granger non-causality test is above 5%, we cannot rule out the presence of causality, i.e. the impact of the ECB policy rate on the movement of the average HHI for a selected group of eurozone countries. At the significance level of 10%, we see that there is two-sided causality.

When analyzing selected countries outside the eurozone (OEC), looking at the relationship between *pol_pr* and *pol_hhi* for Poland, *hun_pr* and *hun_hhi* for Hungary,

bug_pr and *bug_hhi* for Bulgaria and *ser_pr* and *ser_hhi* for Serbia, no cointegration was found. Also, the application of the Granger test did not reject hypothesis of non-causality between the movements of these time series.

It remains to be checked whether the indicators of bank concentration in the eurozone have an impact on the concentration of banks in these four countries outside the eurozone. Therefore, we continue our analysis by looking at whether there is a change for countries outside the eurozone (*OEC_HHI*). As we could see, the *OEC_HHI* time series has one unit root, as does *ECB_PR*.

In order to test the cointegration between the *ECB_PR* and *OEC_HHI* series, using the Engle and Granger (1987) procedure, we set up a regression model at the time series levels. We create a series of residuals, denoted by R.

In table 6, we provide the results of the cointegration tests.

Table 6 Cointegration test statistics

	DF residual test
R	-5,32

Source: Author's calculations.

Bearing in mind that the value of the DF residual test statistics is lower than the critical value, at the 1% significance level, we reject the null hypothesis of the existence of a unit root in the series of residuals *R*. There is cointegration between the eurozone HHI and the HHI for the non-eurozone countries.

In the following, we develop a bivariate VAR model that includes *EZ_HHI* and *OEC_HHI*. As a deterministic component, we include only a constant, which is consistent with previously obtained statistics. Based on information criteria tests (general to specific), lag 2, lag 3, lag 4 and lag 6 appear as significant at a defined confidence level of 5%. However, only lag 2 and 3 passes the normality, autocorrelation and stability tests (see Table 7).

Table 7 Lag length in the VAR model specification III

k	Wald test	p-value (Wald test)	Doornik-Hansen normality test	Portmanteau autocorrelation test – Q(12)/adjusted Q(12)	Stability condition (No AR roots)
1	111.87	0.000			
2	6.17	0.186	0.77	0.98/0.81	Satisfy
3	5.64	0.228	0.19	0.98/0.73	Satisfy

4	5.73	0.221	0.29	0.84/0.002	Not satisfy
5	16.94	0.002			
6	3.98	0.408	0.69	0.08/0.00	Not satisfy

Source: Author's calculations.

Based on the statistics from the previous table, we can see that a stable model can only be set for lag 2. According to the Toda and Yamamoto (1995) procedure, it is VAR (2+1).

Below we present the results of the Granger non-causality test.

Table 8 Analysis of causality (*OEC_HHI* and *EZ_HHI*)

Granger non-causality test (H_0: Non-causality)	**VAR (2+1) p-value**
H_1: Influence of the average HHI for the selected group of eurozone countries (*EZ_HHI*) on the average HHI for the group of non-eurozone (*OEC_HHI*)	0.00
H_1: Influence of the average HHI for the group of non-eurozone countries (*OEC_HHI*) on the average HHI for the group of eurozone countries (*EZ_HHI*)	0.01
Normality, autocorrelation and stability tests	**p-value**
Doornik-Hansen normality test	0.49
Portmanteau autocorrelation test – Q(12)/adjusted Q(12)	0.97/0.69
Stability condition (No AR roots)	Satisfy

Source: Author's calculations.

At the significance level of 1%, we can reject the null hypothesis of non-causality and accept the alternative hypothesis of an effect of EZ_HHI on OEC_HHI. Also, at the 5% significance level, there is a two-way causality.

After the previously obtained results, we developed a special model that includes three variables: ECB policy rate (*ECB_PR*), eurozone bank concentration (*EZ_HHI*) and non-eurozone country bank concentration (*OEC_HHI*). As a deterministic component, we include only a constant, which is consistent with previously obtained results. Based on information criteria tests (general to specific), lag 2 and lag 3 appear as significant at a defined confidence level of 1%. However, only lag 2 passes the normality, autocorrelation and stability tests (see Table 9).

Table 9 Lag length in the tri-variate VAR model

k	Wald test	p-value (Wald test)	Doornik-Hansen normality test	Portmanteau autocorrelation test – Q(12)/adjusted Q(12)	Stability condition (No AR roots)
1	166.53	0.000			
2	8.86	0.449	0.11	0.94/0.07	Satisfy
3	19.75	0.019	0.12	0.82/0.00	Not satisfy
4	61.50	0.000			

Source: Author's calculations.

After that, we will test for the presence of cointegration using the Johansen test.

Table 10 Johansen cointegration test (*ECB_PR*, *EZ_HHI* and *OEC_HHI*)

	Trace test		**Eigenvalue test**	
	Statistics	**p-value**	**Statistics**	**p-value**
First step H_0: No cointegration H_1: There is at least one cointegration equation	49.14	0.00	28.24	0.00
Second step H_0: There is one cointegration equation H_1: There are at least two cointegration equations	20.89	0.01	19.33	0.01
Third step H_0: There is two cointegration equation H_1: There are at least three cointegration equations	1.56	0.21	1.56	0.21

Source: Author's calculations.
Note: A constant term enters the VAR model unrestrictedly. There are two lags in the VAR model.

Based on the previous results of the Johansen test, we see that the null hypothesis of no cointegration can be rejected in the first step. In the second step, the null hypothesis of the existence of one cointegration equation was rejected. In the third step of testing, we accept the null hypothesis of the existence of two cointegration equation.

Estimated cointegration vectors and vectors of adjustment coefficients (Table 11) show that in the first vector there is a positive relationship between the concentration

of banks in the eurozone (*EZ_HHI*) and the concentration of banks outside the eurozone (*OEC_HHI)*. Also, in the first vector we see that there is a positive relationship between the ECB policy rate (*ECB_PR*) and the concentration of banks in countries outside the eurozone (*OEC_HHI*). In the second vector, we see a positive relationship between the ECB policy rate (*ECB_PR*) and the concentration of banks in the eurozone (*EZ_HHI*). The positive relationship between the concentration of banks outside the eurozone (OEC_HHI) and the concentration of banks in the eurozone (*EZ_HHI*) has appropriate economic interpretation.

Table 11 Estimated cointegration vectors and vectors of adjustment coefficients

Variable	β_1	β_2
OEC_HHI	1	-0.669
EZ_HHI	-0.610	1
ECB_PR	-0.441	-0.521
Variable	α_1	α_2
OEC_HHI	-0.374 (-2.66)	0.777 (2.92)
EZ_HHI	-0.135 (-0.98)	0.318 (1.22)
ECB_PR	-0.051 (-1.95)	0.087 (1.76)

Source: Author's calculations.
Note: t-ratios are in parentheses.

As the next step, we impose the corresponding restrictions on cointegration vectors and vectors of adjustment coefficients. Due to the relationship that does not have a suitable economic interpretation, in the second vector we define that banking concentration outside the eurozone has a value of zero. In the first vector we define that ECB policy rate has a value of zero. Also, we introduce restrictions in the vector of adjustment coefficients by defining the value zero for *ECB_PR* in both equations. The model is estimated under these restrictions and the results are reported in Table 12.

Table 12 Model estimated under imposed restrictions

Variable	β_1	β_2
OEC_HHI	1	0.000
EZ_HHI	-0.943	1
ECB_PR	0.000	-1.489
Variable	α_1	α_2
OEC_HHI	-1.162 (-3.82)	0.192 (3.28)
EZ_HHI	-0.381 (-1,16)	0.112 (1.76)
ECB_PR	0.000	0.000
$\chi^2(2)$ statistics	**value: 4.98**	**p-value: 0.08**

Source: Author's calculations.
Note: t-ratios are in parentheses.

Imposed restrictions are tested and not rejected. The development of a separate model that includes three variables led to additional findings about the dynamics of the relationship between the variables. It has been shown that the ECB policy rate affects the increase in banking concentration in the eurozone countries. However, the added value of this model is that it shows the separate effects of ECB Policy Rates and HHI in eurozone countries on the banking concentration of non-eurozone countries. Bearing in mind that the use of the ECB policy rate and HHI for eurozone countries can explain most of the change in the HHI of countries outside the eurozone, this largely justifies the absence of reference interest rates of individual countries outside the eurozone in the model.

4.2. Discussion

During the observed period of 2008–2020, which is characterized by the expansionary monetary policy of the ECB, eleven of the nineteen countries of the current members of the eurozone saw an increase in concentration in the banking sector, measured by the HHI value. Also, four of the fourteen countries outside the eurozone recorded an increase in concentration in the banking market in the observed period. Low interest rates have already been confirmed in the literature as a determinant of declining bank profitability in Europe. We define this as the first wave of the effects of expansionary monetary policy. The impact of falling profitability on the growth of concentration in the banking market is a secondary wave of the effects of expansionary monetary policy. This is indirect (additional) proof of the existence of that. Direct evidence of the existence of the impact of expansionary monetary policy on the increase in banking concentration was obtained through the previously presented results of the VAR and VEC models. We will present these findings as follows.

Based on the results of econometric models (VAR and VEC), we came to the conclusion that seven of eleven eurozone countries (Germany, Lithuania, Latvia, Portugal, Slovakia, Malta and Ireland) can explain the increase in concentration in the banking sector by the ECB's low interest rate policy. In the remaining four eurozone countries (Greece, Cyprus, Italy and Spain) we could not model this relationship due to the strong impact of the Great Recession on the banking sector, where the impact of monetary policy was lost in many government activities to restructure the banking sector. The findings of this research show that with a certain time lag, which can be attributed to the cumulative long-term manifestation of the present circumstances, the HHI increase in the observed eurozone countries (Germany, Lithuania, Latvia, Portugal, Slovakia, Malta and Ireland) can be explained by the ECB's expansionary monetary

policy. Over time, the effect intensifies, which confirms that the long-term environment of the expansionary monetary policy has a cumulative effect on the increase in the concentration of banks in the eurozone.

This finding is consistent with some previous research, cited in the literature review, which confirmed that low interest rates in Europe and the eurozone have had the effect of reducing bank profitability and increasing risk-taking. The result of this research gives a certain added value in relation to those researches, showing the possible consequences of the thus caused drop in profitability. This research shows that one of the consequences of the decline in profitability caused by low interest rates is actually an increase in concentration in the banking sector. The increase in concentration represents a rational reaction of banks to such circumstances, an attempt to neutralize the negative effects through the economies of scale.

This is a pure effect of the ECB's expansionary monetary policy, as only the impact of the ECB's key interest rate on banking concentration has been analyzed. This research did not examine the impact of unconventional monetary policy measures, but the obtained results indicate that in the case of bank concentration, the effects of expansionary monetary policy dominate over the effects of unconventional measures.

This research also shows that the increase in concentration in the banking sector of eurozone countries affects the increase in concentration in the banking sector of certain countries outside the eurozone (Poland, Hungary, Bulgaria and Serbia). It has been shown that the expansionary monetary policy of these countries outside the eurozone has no significant impact on encouraging concentration in the banking sector and that the most significant impact on concentration in the banking sector of these countries comes from increasing concentration in the eurozone. This confirms that the indirect effect of the ECB's expansionary policy on these countries is dominant to such an extent that it excludes the importance of the operation of its own monetary policies. This finding about the spillover of the effects of concentration from the eurozone to countries outside the eurozone and about the predominance of the effects of the ECB's monetary policy over the monetary policies of specific countries represents an additional contribution to the field of research into the effects of expansionary monetary policy on the banking sector.

However, the decline in profitability and the resulting increase in concentration in the banking sector brings with it a number of accompanying challenges for prudential policy makers. The increase in the volume of lending opens a risk-taking channel, so that this requires additional consideration by regulatory bodies. This is especially important when it comes to the growth of larger banks that are systemically important, which is exactly the case when market concentration is increasing. The prudential authority will have to pay special attention to whether the growth of a bank is accompanied by the growth of the concentration of loans in its portfolio. The question

is to what extent the process of expanding the banking sector will improve the impaired performance of banks that will remain in the market. Also, will this ultimately improve the overall performance of the banking sector or will it remain part of the weakened banks that this market mechanism will not absorb. If the consolidation process does not provide satisfactory results, a special issue for the prudential policy maker is the assessment of the potential for future recapitalization of banks and investments in the banking sector at such weakened rates of return on capital. The issue of fit and proper conditions for investors who want to participate in further consolidation in such circumstances also stands out. All these implications indicate that expansionary monetary policy can generate a number of challenges for prudential policy and that coordination of these policies is necessary. This topic is especially important when the expansionary policy of developed countries (in our case the ECB) spills over to emerging countries, creating tasks for prudential policy makers in those countries. In such circumstances, there is no formal basis for the coordination of monetary and prudential policies, and there is probably a lack of motivation in the central banks of developed countries.

5. Conclusion

The growth of concentration in the banking market in the observed 33 European countries in the 2008–2020 period was driven by the extent to which expansionary monetary policy reduced the profitability of banks (see Borio, Gambacorta and Hofmann 2017). This driver was supported by the greater capacity of larger banks to respond to such circumstances by growing their business volume, as well as the low level of market concentration in a particular country at the beginning of this period.

In the seven countries of the eurozone where banking concentration increased during the 2008–2020 period (Germany, Lithuania, Latvia, Portugal, Slovakia, Malta and Ireland), the increase in banking market concentration can be explained by the ECB's expansionary monetary policy. The long duration of the expansionary monetary policy intensifies its effect on the growth of banking concentration. As the literature confirms the impact of expansionary monetary policy on the decline in bank profitability in Europe (the first wave of effects), the findings of this study contribute to the literature in this area, expanding the scope of consideration of the effects of expansionary monetary policy on the growth of banking concentration (the second wave of its effects). An additional contribution of this research lies in the fact that by examining the impact of the ECB's key policy rate on banking concentration, we analyzed the pure effect of expansionary monetary policy. The use of other rates, such as money market interest rates (interest rates on interbank loans), would include, in addition to expansionary monetary policy, the effects of unconventional monetary policy.

Although the central banks of countries outside the eurozone pursue an expansionary monetary policy, its impact on the movement of banking concentration was not recognized. In four countries outside the eurozone (Poland, Hungary, Bulgaria and Serbia), where there was an increase in banking concentration in 2008–2020, the increase in banking concentration can be explained by the increase in banking concentration in the eurozone countries. This is evidence of the spillover effect from the eurozone and implicit confirmation that the ECB's expansionary monetary policy has a stronger effect on these emerging countries outside the eurozone than their own monetary policies.

These findings open numerous challenges for conducting prudential policy and reiterate the need to coordinate monetary and prudential policies. The growth of concentration as an example of asymmetric growth of business volume in favor of larger banks, opens for prudential regulation numerous issues, such as risk-taking channels, growth of systemic importance of the bank, fulfillment of prudential requirements by smaller banks and new investors, etc. In the event of spillover effects of the ECB's expansionary monetary policy on underdeveloped countries, a particularly important issue is how to ensure coordination of local prudential policy and the ECB's monetary policy.

The results showed that there is no single way of reacting to a change in the ECB policy rate at the level of the eurozone, but the reaction of eurozone countries depends on the characteristics of their national financial systems. All this indicates that the implications for conducting monetary policy and prudential policy are not unique at the level of the eurozone. This situation further complicates the coordination of monetary policy, which is conducted centrally, and prudential challenges that arise at the level of national financial systems.

The findings of this research open space for some further research. First of all, it is necessary to undertake further research into the factors that determine whether a country in the conditions of low interest rates will start to increase banking concentration or not. Further research in this area could focus on whether increasing concentration in the banking sector affects the performance of the sector, but also whether there are banks / groups of banks that remain out of consolidation, facing numerous uncertainties in the environment of long-term expansionary monetary policy. The advantages and disadvantages of using concentration measures in assessing the efficiency of the transmission mechanism is a topic that could be opened in some further research. In particular, whether the models for evaluating the effectiveness of the transmission mechanism of monetary policy with included measures of concentration would have a greater explanatory power compared to models without included indicators of concentration. Also, room is opened for additional research into the relationship between prudential policy in small countries and monetary policy of large central banks.

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