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Bank's Profitability in Period of Low and Negative Interest Rates

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Abstract

In the financial landscape of the Euro Area, the role and profitability of banks are influenced by unconventional monetary policies and market changes. This study analyzes the impact of low and negative interest rates on banks' profitability indicators, specifically net interest margin (NIM), return on assets (ROA) and return on equity (ROE). Utilizing data from 2690 banks from 2004 to 2024, a linear regression is used to draw the conclusion that low or negative interest rates do not mean lower bank profitability. Moreover, the analysis of market concentration shows that in countries with significant market concentration there is a positive correlation between profitability and market concentration. The results provide important information for stakeholders, emphasizing how difficult it is for banks to be profitable in the context of continuous changing monetary policies and market conditions.

Key words

Bank Profitability, Banks, Interest Rates, Low or Negative Interest Rate Environment, Market Concentration, Net Interest Margin, Return on Assets, Return on Equity

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Introduction

Nowadays, banks play a very important part in the economic system. They are vital to our modern economy, as they move the capital of individuals who need it for spending or investment to those who have excess.

In response to economic challenges, central banks around the world have implemented unconventional monetary policies, which have resulted in notable changes, over the last few days, to the economic panorama around the world. Low and negative interest rates have been one of the instruments used in these attempts to promote financial stability and economic growth.

In countries where there is a significant portion of transactions taking place through financial institutions, banks have a more significant role. They facilitate the easier transfer of funds between savers and borrowers by acting as intermediators. In addition, banks offer a variety of financial services, such as loans, investments and deposits, that are fundamental to the economical activity.

Compared to bank-based financing systems, market-based financing systems rely more on the capital markets. By issuing debt and equity instruments, companies can raise more capital without the need for intermediation (Hanzlík, P. (2022)).

Low and negative interest rates can have a big effect on asset prices, investor behavior and risk-taking in the capital markets. The search for higher returns in a low rate environment can lead to prolonged low interest rates. This situation can lead to excessive risk-taking and an increase in the economy's vulnerability to external ruptures.

Banks have an even more significant role in financial systems that rely on them, processing the majority of financial transactions and giving people and companies with the support they need. Their ability to effectively manage risks and allocate resources is essential to maintaining financial stability and ensuring the efficient functioning of the economy. Low and negative interest rates have a major effect on their profitability. Traditionally, banks generate revenue by borrowing money at lower short-term rates and lending it at higher long-term rates. Banks' profit margins are then calculated by this difference. This can affect net interest income, a significant source of funding for

banks (Bossone, B. (2001)). It is difficult for banks to charge negative interest rates to their depositors, as investors are less predisposed to put aside money to pay for negative interest rates on their saving accounts, which eventually will affect the bank's earnings. But, even today, the European Central Bank (ECB) and some other European central banks keep their interest rates negative.

Extended periods of negative or low interest rates may have an effect on the economy as they help banks perform better and improve their financial performance, which leads to capital gains and a reduction in loan loss provisions. They can also promote excessive borrowing and consequently lead to asset price bubbles. For banks, these interest rates present a challenge, as while they can increase profitability, they can also have the opposite effect to that expected.

After the global financial crisis of 2007 to 2009 and the significant national debt crisis of 2010 to 2012, banks were faced with an unusually low interest rate environment. This situation is generally referred to as the zero lower bound (ZLB) of interest rates and was historically known as the "liquidity trap" (Eggertsson, G. B., & Woodford, M. (2004)). The ZLB refers to a situation in which nominal interest rates are close to zero. Central bank's monetary policy is a useful instrument to control the economy, changing interest rates when needed. The negative side is that this situation does not happen when the ZLB occurs (Hanzlík, P. (2022)).

The constraints imposed by the ZLB have led central banks around the world to implement unconventional monetary strategies, such as quantitative easing (QE) and negative interest rates (Hannoun, H. (2015)). These approaches seek to maintain economic growth and the stability of the financial system, even when traditional monetary policy instruments lose some of their effectiveness in the ZLB. It has been demonstrated by Havreánek & Kolcunová (2018) and other empirical investigations that the effective lower bound for the value of monetary policy interest rates is slightly less than zero, not precisely zero.

Setting low interest rates can also lead to speculative bubbles and an incorrect evaluation of risk, as investors seek for higher earnings in an attempt to increase their returns. This presents challenges for banks, as it can increase the possibility of a severe financial crisis or recession. On the other hand, the usefulness of unorthodox monetary

policy is still up for dispute. Although these measures have helped stabilize financial markets and contributed to the economic recovery, they also carry dangers and unintended consequences, as stated by Hannoun, H. (2015). Negative interest rates, for instance, have the ability to reduce banks' profit margins and encourage excessive risk-taking, that in the long-term can jeopardize the stability of the financial system.

This poses many challenges, such as ineffectiveness of unconventional monetary policy, where the ZLB limits the ability of central banks to support the economy, as it prevents them from lowering rates, limiting the possibility of encouraging investment and lending. It poses many consequences such as the possibility of market stagnation and instability, as well as asset bubbles, for extended periods of low interest. This makes it difficult for banks to maintain or increase their profit margins and may lead them to riskier methods, that translates into a more vulnerable financial situation.

This theme has attracted a lot of attention from academics, such as Borio et al. (2017) and Claessens et al. (2017), who have looked at the effect of the ZLB of interest rates on bank profitability and the effectiveness of monetary policy.

The relationship between banks' NIM and the structure of interest rates, reflected in the short-term market interest rate, is the subject of previous research, as noted by Borio et al. (2017). Since previous investigations have not taken into account the impact of market concentration from the influence of a ZLB environment, market concentration is examined in this study as another country-specific factor affecting NIM.

The empirical research is conducted using a panel data sample of 2690 banks based in the Euro Area, using annual data from 2004 to 2024. Because of the sample's structure, some unique characteristics to banks are considered, such as the type of bank based on specialization, that distinguishes four types of banks (commercial banks, cooperative banks, saving banks, real estate & mortgage financial institution) and the size of the bank (measured by its overall assets).

The findings demonstrate that the three profitability indicators used by banks, that are net interest margin (NIM), return on assets (ROA), and return on equity (ROE) do not suffer during times of low or negative interest rates. An additional noteworthy

discovery is that interest rate variations have a favorable impact on bank profitability in nations with strong market concentration, implying that interest rate fluctuations have a beneficial effect on a bank's profitability, showing that a fall in NIM is less pronounced in the case of greater market concentration.

The remaining work is organized as follows. In Section 2, the effects of net interest margin, monetary policy and interest rates on bank profitability are reviewed and two hypotheses are presented. Section 3 discusses what determinants influence the commercial bank's performance. Section 4 presents the hypotheses that are going to be tested. In Section 5 is propose a descriptive analysis of the data, introducing variables and discussing about the selected dataset as well as explaining the technique. The results and conclusions based on the proposed hypothesis are shown in Section 6. The paper's conclusion, located in Section 7, summarizes the key findings.

1 Literature Review

This study's aim is to examine how different factors affect the NIM, a crucial indicator of bank profitability. Prior studies on bank profitability in the wake of the Global Financial Crisis (GFC) have mostly concentrated on the consequences of very low interest rates and, in many cases, even negative interest rates, that is caused by the unorthodox monetary policies put in place by major central banks.

In an attempt to boost the economy following the GFC, central banks established extremely low and sometimes negative interest rates. Due to a slowing growth in the economy and low inflation, the emergency procedures that were intended to be temporary have lasted longer than expected. Because of this, banks are now having more difficulty in making a profit from the interest rates charged on loans than from the interest rates received from deposits.

Many studies have been conducted to determine what influenced NIM in an environment where interest rates remain so low. In order to understand how banks are handling the situation and what strategies are being used, this review will synthesize and analyze the available research.

1.1 Trends in Bank Profitability

In the banking sector, profitability is the key to success. The literature identifies the most relevant aspects for bank profitability, that include modifications to the economy and regulatory landscapes. It is very difficult for banks with the rise and fall of interest rates to be able to make money on loans due to these fluctuations.

Borio et. Al (2017) examined how monetary policy affects bank profitability. The study examined many variables and uses data from 109 international banks headquartered in 14 major economies between 1995 and 2012. According to the results, bank's ROA is positively correlated with yield curve direction and interest rate levels due to their favorable effects on NIMs. It was found that the positive impacts of the interest rate structure on NIM outweighs its negative effects on loan loss provisions and non-interest income. Furthermore, it was determined that odd interest rates

combined with unusual term structures decrease bank profitability and that interest rates have a greater impact on bank profitability when they are low.

However, this is a very debatable topic because there is no consensus on the effect of interest rates on bank's profitability, some authors found that low or negative interest rates do not always negatively affect bank's profits. Scheiber et. Al (2016) conducted an investigation focusing in three European countries (Denmark, Sweden and Switzerland) during the period of 2010-2015 and concluded that negative interest rates didn't lead to a significant drop in banks profitability or interest income. Another study made by Madaschi and Pablos Nuevo (2017) proves similar results. Altavilla et. Al (2017) analyzed the impact of unconventional monetary policy on EU banks from 2000-2016 and concluded that lowering short-term interest rates doesn't mean lower profits for banks.

As opposed, the studies conducted by Shahin, R et. al (2022) comes to a different conclusion regarding the interest rates on banks profitability, that low lending rates are associated with decreasing banks' profits and a decline in NIM overtime. This has a negative impact in attracting capital and maintaining their lending growth. Avdjev and Serena (2020) found that low lending rates deteriorate borrower quality and Rubio and Yao (2020) state that low lending rates increase borrowers' indebtedness, making borrowers more exposed to credit risks every time there is a rise in the interest rates. On the other hand, evidence by Almaqtari et. Al (2018) suggests that in periods of low lending rates, banks can generate significant profits.

The majority of the studies focus on a low-rate environment and not on a negative rate environment. On one hand, a few studies conducted by Kerbl and Sigmund (2017) and Molyneux et al. (2018), demonstrate that negative rates have a detrimental impact on profitability. Also, Heider et al. (2018) states that banks take higher risks and provide less credit to the economy in the presence of negative interest rates. However, some studies made by Scheiber et al. (2016), Madaschid and Nuevo (2017), Jobst and Lin (2017), Basten and Mariathsan (2018) state the opposite.

1.2 Research on Net Interest Margin

This section will look specifically to the low interest rates environment, in concrete, the relationship between the NIM of EU banks and market interest rates. In order to determine how ZLB interest rates impact bank profitability and the efficacy of monetary policy, Borio et al. (2017) and Claessens et al. (2017) conducted a study.

Using a regression model, Claessens et al. (2017) investigate how interest rates affect net NIM in bank profitability. Between 2005 and 2013, information on 3385 banks from 47 countries was gathered. Regressing NIM across several independent variables: *“on the three-month government bond yield, the spread between 10-year and 3-month government bond yield, dummy variable detecting whether the country was in a “low-rate environment” and a set of country specific and bank specific variable”*. It was found that the impact of interest rates on NIM is bigger during low interest rate periods than during high interest rate periods. Although, it was demonstrated that this study might not have been sufficient in light of the various financial systems and their variances (Hanzlík, P. (2022)).

There were more researches conducted, Bikker & Vervliet (2017) was one whose results are similar to the ones that were described by Claessens et.al (2017). Their results shown that larger banks typically have smaller earnings margins and that it can be explained by the assumption that larger banks obtain their biggest percentage of income from sources rather than from loans. Bernanke & Reinhart (2004) and many other authors, discuss the issue of ZLB related to interest rates and unconventional monetary policy instruments. In light of earlier studies, two hypotheses are formulated in order to continue this research.

Hypothesis 1 (Erosion of NIM, ROA and ROE): Despite the kind of bank (commercial, cooperative, savings, and real estate & mortgage financial institutions), the NIM, ROA, and ROE of Euro Area banks are expected to decline in a low or even negative interest rate environments. The variables of all four bank types are expected to suffer during a low interest rate period (since 2004), which includes even negative short-term rates in the Euro Area.

Hypothesis 2 (Influence of market concentration): According to this hypothesis, a higher concentration is associated with a lower cointegration between IR

and NIM. It also suggests that the specific market characteristics, such as market concentration and bank ownership structure. This situation varies from country to country. Thus, greater market concentration can result in a slower decline in banks' NIM.

1.3 Comparative Analysis in Low and Negative Interest Rate Periods

According to Borio and Zhu (2012), the employment of unconventional monetary policies for an extended length of time may alter the bank's view of risk. It has become widely accepted in recent years that monetary policy encourages banks to take on greater risk and there is a claim that monetary policy encourages banks to take on excessive risk (Taylor, 2009). Additionally, Borio et. Al (2017) also concludes that an environment of low interest rates erodes banks profitability.

Many authors support the idea that when interest rates are near to zero it slows down the economy. Based on Meltzer (1963), and in agreement with Fan, Y. (2021), it states that people would rather hold on onto their cash than give up other assets, as these present more liquidity. Cash is expensive to hold on to and once it reaches the ZLB the investment in cash provides worse returns than investing in other assets. In the short run, lowering interest rates can be helpful since it boosts cash reserves without encouraging investment or consumption by banks. According to Neri & Notar Pietro (2014), banks lose money when a debt deflation mechanism occurs under ZLB interest rates, which can lead to massive economic problems. For Craig & Fisher (2016), the ZLB will increase financial instability, which will have an impact on the economy. On the other hand, Buiter (2010) argues that both zero and negative interest rates can promote economic growth, presenting a contrary opinion to those mentioned.

If lending standards remain the same and bank's total risk assets increase substantially, it can cause a drop in the bank's value and increase a possibility of a crisis. Rajan (2006) states that this behavior is typical of a low interest rate environment. A prolonged period of low interest rates leads to a change in bank's behavior. It is associated with the decrease in the volatility of the rates and provides

flexibility in managing their risk budgets. In addition, by not allocating a large part of their resources as they would in periods of higher interest rates, banks feel more confident and take more risks in the search for greater returns.

According to Fan, Y. (2021) and some studies on negative interest rates, the cost of holding cash is linked to the effective lower bound of negative interest rate policies (Brunnermeier & Koby, 2016). Central banks implemented those rates and have been using a system of reserves to reduce this risk. These negative interest rates when applied can reduce the costs for the banks, particularly for those who depend on deposits to fund their operations. In addition, when applied, banks encourage credit operations.

2 Determinants of Commercial Bank's Performance

Following the 2007–2008 period, which marked the beginning of the global financial crisis, numerous nations made the decision to modify their financial institutions in order to give banks a more competitive environment. Numerous investigations have been conducted to look at the variables that influence the stability and profitability of the banks.

Although corporate governance has already been thoroughly examined as a factor in determining a company's success, financial institutions have become more aware of it in the wake of the US housing bubble crash. Numerous investigators have assessed the events leading to failures and weaknesses in corporate governance arrangements (Kirkpatrick 2009) as a potential reason for the start of the global crisis and the bad performance of banks.

Furthermore, national governance and regulation appeared to have a significant impact at the time and large banks operating in nations with stronger regulations performed better than others in terms of non-performing loans. (Beltratti and Stulz 2012). Although corporate governance helps explain the weaknesses of the bank system at the time, the inflated risk that financial institutions exposed themselves to and the absence of control and supervision over the bank's operations serves to explain the severe crisis that was experienced during this time and the years that followed.

According to Shleifer and Vishny (1997), corporate governance focuses on the methods used by lenders to firms to guarantee a profit on their investment. According to the writers, ownership concentration is essential to the success of corporate governance, which gives management additional oversight and control. According to Dey (2008), corporate governance practices are better in organizations with higher levels of agency conflicts. Additionally, governance mechanisms are likely to positively affect overall firm performance only under certain circumstances.

The impact of size on performance has been the subject of conflicting research on bank-specific literature. Wang, Lu, et al. (2012) and Pathan and Faff (2013) confirmed a negative relationship using samples from banks. Aebi et. Al (2012) state

that there is a positive correlation between larger boards and better performance. This is likely because larger boards have more control over management and a greater number of directors, that bring more experience and knowledge. There are also some scholars that do not find any connection between bank performance prior to and during the crisis and the size of the board (Minton et al. 2014).

As a tool for assessing bank safety, the CAMEL rating system has become more significant in the aftermath of the most recent financial crises in the banking sector. Based on many sources of information, this system is a powerful internal tool that regulators and examiners need to ensure the integrity of the bank. Hirtle and Lopez (1999) state that this rating is extremely private and only shared with authorized people, so that a new plan can be developed. The acronym CAMEL is: Capital Adequacy, Asset Quality, Management Efficiency, Earnings and Liquidity.

Capital adequacy describes the minimum amount of capital required by a financial institution in relation to the risks it faces. By doing this, the organization may protect its debt holders and cover any damages. Essentially, it assesses whether a financial institution follows the rules with minimal capital reserves. Research indicates that by reducing the expected expenses of financial distress, capital increases can increase expected revenues (Mathuva 2009). Because they are less likely to fail, banks with a large amount of capitalization also have lower funding costs.

Asset quality has the most significant asset category, the loan portfolio, that presents a higher risk that banks can face, due to their risk of losses from defaulted loans. The credit analyst needs to assess the quality of the loans that a bank has granted. They do this by analyzing the degree of risk of these loans and comparing them with loans provided by similar banks. Although it is difficult because it depends on the analyst's opinion, that can differ from one person to another. Daly and Zhang (2014) found a favorable correlation between asset quality and profitability and this implies that banks with effective leadership have lower levels of non-performing loans and loan loss provisions, which increases their profitability.

Management quality refers to the way in which a company's leadership, including the board of directors and the management team, is capable of identifying, evaluating and managing the risks associated with the company's operations. It also

refers to their capacity to run a company in a safe, effective and compliant manner, following all relevant laws and regulations. Essentially, it's about how effectively the leadership ensures the maximization between profit and risk, and that the company operates in a stable manner, minimizing risks and complying with legal requirements. An inefficient management could result, in the long run, in lower profit margins for the bank because of higher costs and other problems resultant from bad investment decisions.

Earnings, if managed poorly, can cause loan losses, which raises the need for loan provisions and increase the risk of the market, resulting in requirement for larger loan provisions. This assesses factors such as NIM, income from fees and operating expenses in relation to revenues.

Liquidity evaluates the capacity to meet short-term financial needs. This considers the availability of net assets and the bank's access to funding sources in periods of high demand or unexpected ones. A strong liquidity inspires confidence for people wanting to invest. Generally, maintaining a wealthy position is crucial for the stability of the bank and, because of the financial crisis, several banks had difficulties in reaching their liquidity. Liquidity risk can have a negative impact on a bank's performance since it raises funding costs, that also increases NIM (Chen et al., 2018).

Determinants of Bank's Financial Performance

When referring to performance determinants in the banking business, Short (1979) is among the founders (Căpraru, B., & Ihnatov, I. (2014)). By using data from twelve different countries between 1972 and 1974, the researcher investigated the connection between banking concentration and profitability and the results show that higher concentration levels are linked to higher rates of profitability.

The financial performance of a bank is determined by three categories of factors: macroeconomic, industry-specific and bank-specific variables (Menicucci, E., & Paolucci, G. (2016)). The empirical results show that variables related to shifts in the macroeconomic landscape can affect profitability. It is also expected that the level of development of the banking sector will affect the profitability of banks. The

ownership and market concentration of banks are industry-specific factors that affect the earnings of the banks. Higher profit margins and less competition are usually linked to high market concentrations, while the inverse is happens in a with low market concentrations.

In this research it is looked into the size of a bank, that according to Antoun et. Al (2018) is considered as a specific variable in the industry. It was studied by many authors that the size of a bank is likely to have a positive impact on bank performance, meaning that larger banks will perform better (Klomp & Haan, 2012; Menicucci & Paolucci, 2016). However, other studies show an opposite conclusion, saying that bank size have a negative impact Antoun et. Al (2018). Additionally, increasing a bank's size doesn't necessarily mean that it will reduce the costs of the bank (Berger et al., 1987).

3 Theoretical Framework

3.1 Models of Banking Profitability

In several Central and Eastern European countries, there has been a continuous discussion over the years about the profitability of the banks. Regarding the function of banks and their ability to stimulate the economy, there have been multiple opinions, particularly in nations with low levels of banking activity.

A number of significant indicators are used to assess the bank's profitability, that are going to be mentioned further. An essential factor in determining a bank's profitability is the net interest margin. It computes the interest income received from interest-earning assets held by banks including investments, loans and interest paid on borrowings and deposits (Cœuré, B. (2016)). Despite being a widely used ratio, it ignores the bank's other revenues and expenses. A higher NIM results in less efficiency, which raises costs and limits bank's growth. All of this has an impact on the rise of the economic activity caused by lower investments, and markets only benefit from a lower NIM because it encourages greater investment and boosts economic growth.

A typical financial indicator named ROA indicates a company's wealth in relation to its total assets. This metric is determined by dividing net income by total asset, it is given as a percentage and compares bank's performance with their rivals. A bank with a higher ROA is producing more money for every dollar invested in assets; on the other hand, a lower ROA indicates less efficient asset usage. This illustrates how the organization uses its resources to generate profit.

ROE is a financial ratio that assesses a bank's profitability regarding shareholders' equity. It is computed as the ratio of net income to shareholders' equity and displays the amount of profit that shareholders have invested and represents the bank's profitability in relation to the shareholder's investment. A lower ROE denotes a less effective use of shareholder's capital, whereas a higher ROE shows that the bank is making more money with each dollar of equity held by shareholders.

Equity/total assets is a metric that analyzes the financial health and the level of leverage of banks. It indicates the proportion of a bank's total assets that are financed

by equity as opposed to debt. Lower leverage and a solid equity position of a bank are indicated by a higher ratio, which can provide protection against losses and other events.

The cost/income ratio is a financial indicator that measures a bank's operational efficiency. It determines how much of the bank's operating income or net profit goes toward operating expenses. A higher suggests that operating expenses make up a bigger portion of the bank's income, while a lower cost-to-income ratio indicates better cost control and operational efficiency.

In these following sections, the metrics that are going to be studied are NIM, ROA and ROE, due to its main importance in a bank's profitability.

3.2 Hypothesis Development

Threw the analysis of the data it will be tested this hypothesis. We used a regression analysis as a method to confirm these theories over the period of 2004-2024.

Hypothesis 1 (Erosion of NIM): In this hypothesis it is going to be tested if the NIM of Euro Area banks erodes in the low or even negative interest rate environment. Such erosions carried on by an extended period of low or even negative interest rates can have a big influence on the activities of the banks and consequently their profitability.

Through a 20-year analysis in which the interest rate functions as an independent variable, the link between the interest rate and each of the dependent variables, NIM, ROA, and ROE, is examined. Finding out if the interest rate environment negatively affects NIM, ROA, and ROE separately in a statistically meaningful way is the aim of the study.

Hypothesis 2 (Influence of market concentration): According to this hypothesis, particular characteristics of the market have an impact on the profitability of banks. It specifically says that a smaller decline in NIM is typically the outcome of a larger market concentration, which is defined as fewer competitors controlling the market.

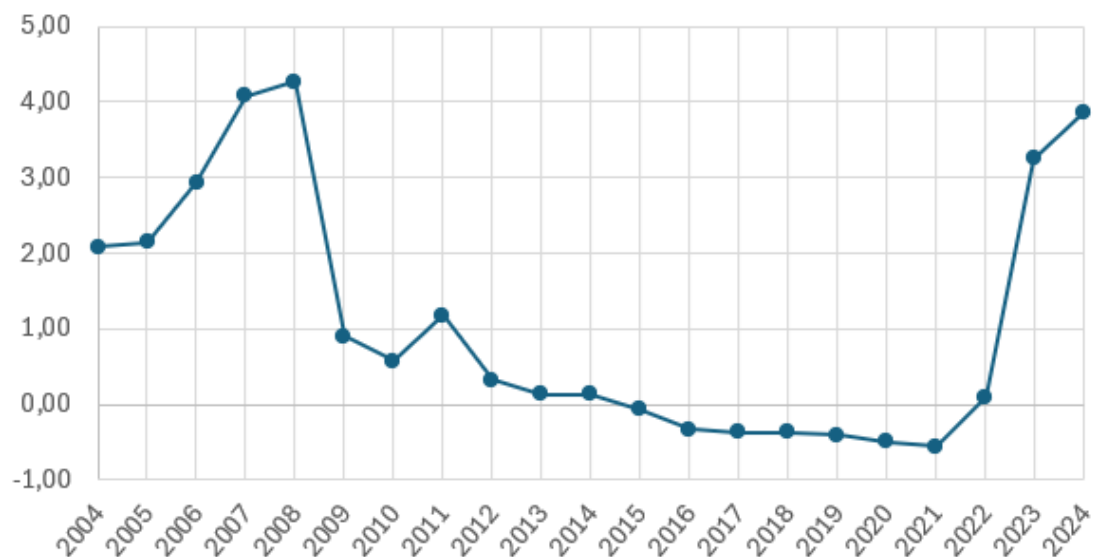
The ECB provided the Herfindahl-Hirschman Index (HHI), a measure of market concentration. To assess the connection between market concentration and profitability, data on NIM for banks was gathered from all of the Euro Area's member states. This analysis will assess the effect of IR on NIM in the nations with high and low concentrations based on the HHI index values obtained from each country.

4 Data and Methodology

4.1 Data

The dataset, extracted by Orbis Bank Focus, includes 2690 banks from Euro Area countries during the 20-year period from 2004 to 2024. The sample institutions are all listed for active banks whose specialization was categorized as commercial banks, saving banks, cooperative banks, real estate & mortgage banks. Because Orbis Bank Focus did not offer short-term rates, the interest rate values were obtained by Eurostat, that provided the country-specific variables.

Figure 1 - Interest Rates (%) in Euro Area in 2004-2024



Source: Author based on Eurostat

Figure 1 shows the change in interest rates every year. Several variations can be seen over time, primarily between 2006 and 2009. These differences may have a direct correlation to the global financial crisis and its aftermath.

After that, it continued to be stable between 2012 and 2021 but gradually decreasing, reaching negative values from 2016 to 2021.

Since interest rates began to rise sharply in 2022 and have not lowered since, 2024 will likely see high interest rates.

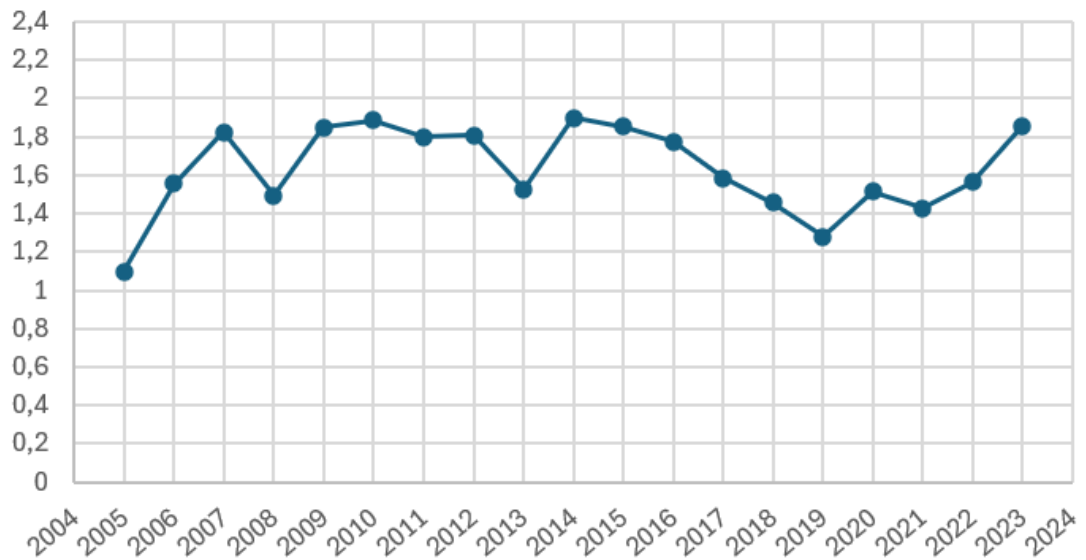
Table 1 - Bank Specific Variables

Name	Description
Loan Loss Reserves	This measure evaluates a bank's asset quality by setting aside a percentage of loans for possible losses. It serves as a safeguard against potential loan losses and is an indication of the bank's solid financial health and risk management procedures.
Equity	A metric that represents the bank's financial stability and net value that shows the shareholders' rights to the bank's assets. Because it offers protection against losses and promotes the expansion and operations of the bank, a strong capital position is essential to maintaining liquidity and attracting more investment.
Total Assets	An essential indicator of a bank's size and stability that impacts its market share and risk profile and encompasses all of its owned or managed assets.
Equity/ Total Assets	An indicator of the bank's debt level and ability to absorb losses. The coefficient's intended sign is unclear because a large ratio can indicate that investment opportunities were squandered, while a low ratio might point to a capital shortage.

Total Earning Assets	Metric that reflects the total of all assets, including loans, investments, and paying interest deposits, that bring in money for the bank. It is an important indicator of the bank's profitability and stability since it shows that it can generate revenue from its assets.
Cost-to-Income Ratio (efficiency)	An indicator of the bank's operational effectiveness. Profitability tends to be negatively impacted generally. This should especially apply to NIM because of the close relationship between NIM and the denominator of the cost to income ratio.
Liquid Assets / Deposits & Short-term Funding	A liquidity metric that represents the liquid amount on the asset side of the bank's balance sheet.

Source: own presentation

Figure 2 - Net Interest Margin (annual average) (%) in Euro Area in 2004-2024



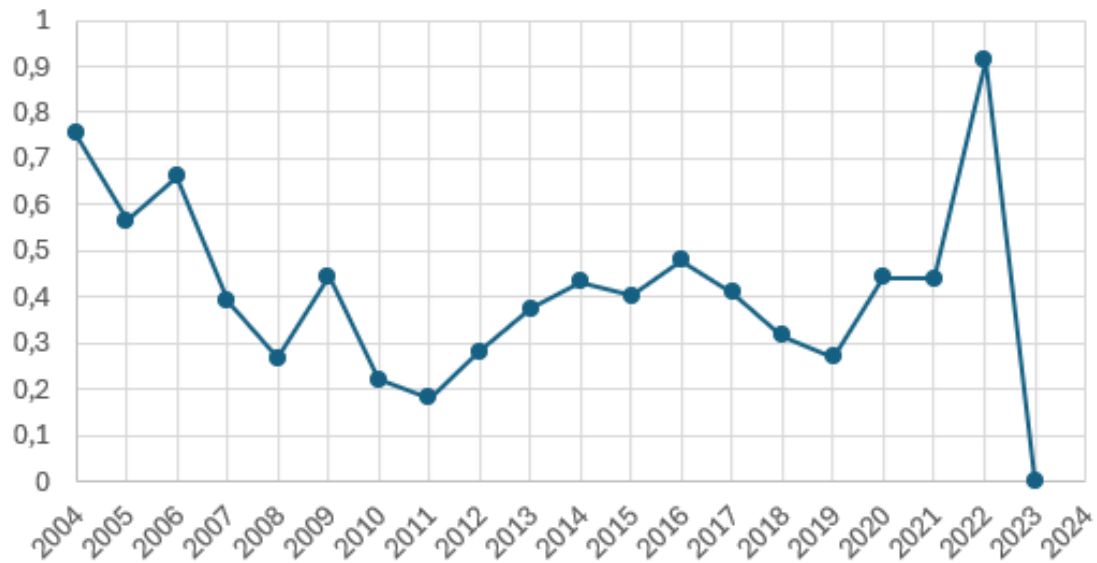
Source: Author based on Orbis Bank Focus

Figure 2 shows the trend of NIM during the 20-year period from 2004 to 2024 of the 2690 banks from Euro Area countries.

As can be seen the NIM varied over the years but kept a certain constancy after each variation, although in 2008, 2013 and especially in 2019, had decreases, that could be due to several economic factors. However, after 2019 it started to increase constantly.

According to Figure 1, it can be concluded in first sight that variations in the IR do not affect at all the behavior of NIM, since it remains constant over the years, with small oscillations when compared to the ones from IR over the years.

Figure 3 - ROA (annual average) (%) in Euro Area in 2004-2024



Source: Author based on Orbis Bank Focus

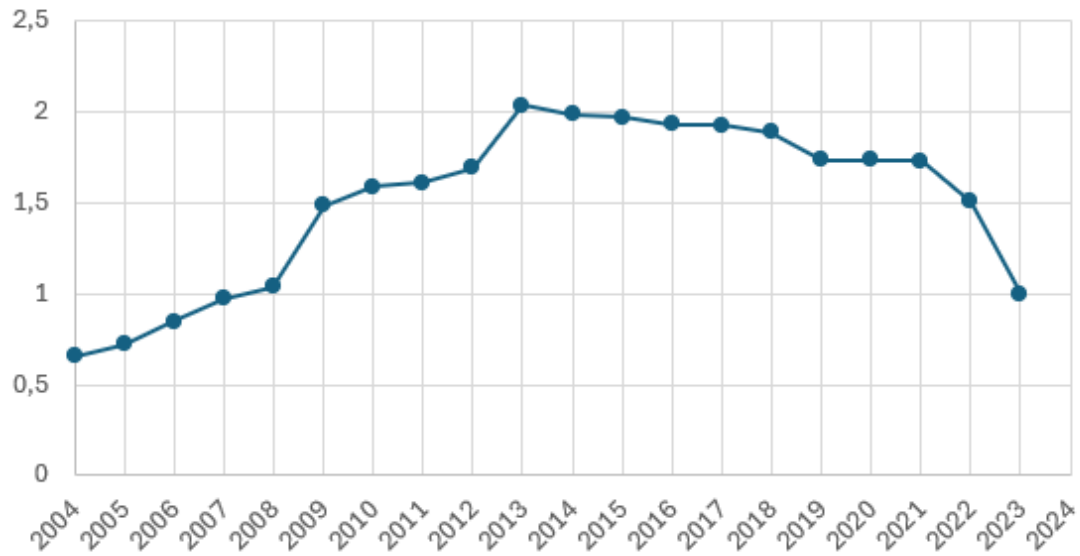
Figure 3 shows the movement of ROA according to the years. Some years such as 2004, 2006, 2009, 2016 and 2022 presented high values, suggesting a good use of assets from the banks and so, more profitability.

The years of 2008, 2011, 2018, 2019 and 2023 display low values, especially in 2023, implying that in these years banks faced challenges and possibly losses in their profitability.

Additionally, it is possible to see that after each year of challenges, banks were able to recover in the following years. These recoveries can be due to the implementation of new strategies to mitigate possible risks and adjust them to the market. However, it is important to have an analysis of ROA combined with other metrics.

Further in this research it is going to be studied the relationship between IR and ROA.

Figure 4 - ROE (annual average) (%) in Euro Area in 2004-2024



Source: Author based on Eurostat

Figure 4 illustrates the trend of ROE over the years. Particularly, ROE increased significantly in 2009 and peaked in 2013. These year's most likely reflect bank's strong profitability and effective use of equity.

However, the levels of ROE were also relatively high in the period of 2013 to 2018, showing a great performance and profitability during those years.

On the other hand, it decreased a little in 2019 and then had a big fall from 2021 to 2023, with 2023 having the lowest number. These years could point to challenges or a decrease in credit institution's profitability.

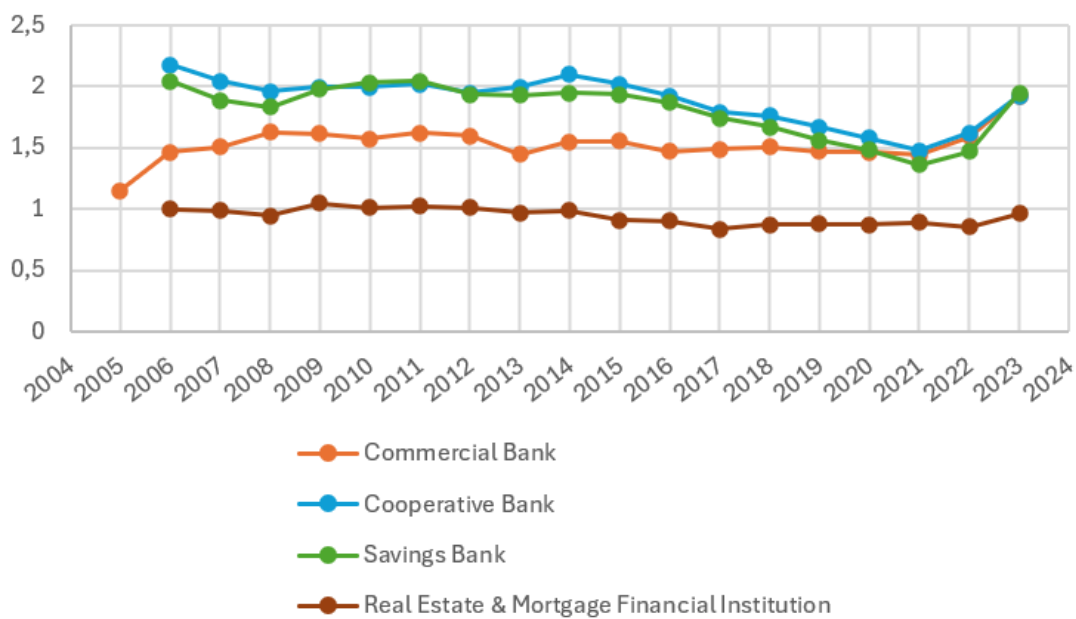
Variable Selection

A selection of variables to investigate was established based on research on bank profitability and the effect of low interest rates on profitability by Borio et al. (2017) and Claessens et al. (2017). Table 1 gives an explanation of the factors unique to each bank.

Descriptive Analysis

There are 1174 small banks, 935 medium-sized banks, and 580 larger banks in the dataset. It has 91 real estate and mortgage financial institutions, 1330 cooperative banks, 516 savings banks, and 752 commercial banks, depending on their area of specialization.

Figure 5 - Average NIM by bank specialization (%) in Euro Area in 2004-2024



Source: Author based on Orbis Bank Focus

Figure 5 shows the behavior of the average NIM for each bank specialization.

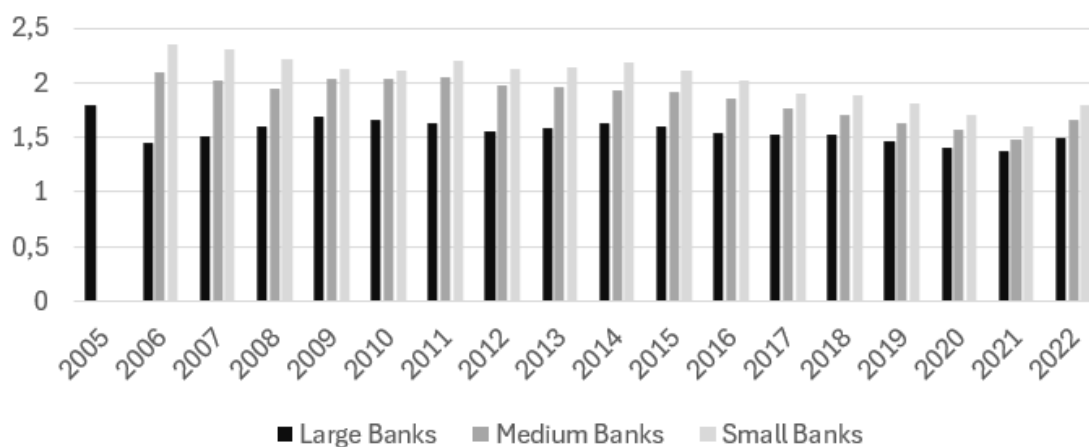
Commercial banks show an increase in 2005, maintaining a moderate NIM over the years. In 2013 had a slight decrease and then continued stable all long, until 2021 where it started to rise continuously. This value can result from a more diversified loan portfolio. Due to bigger deposit amounts and shorter deposit terms, commercial banks usually benefit from lower funding costs, which enables them to fund their business activities more effectively. They have managed to maintain a high NIM, which is reflected in good operations management.

Cooperative banks have shown a high NIM with periods of oscillations over time. Since 2015 it has been decreasing, rising in 2021 until 2023. These figures can be the reflection of their variety of income sources.

Savings banks have a high NIM when comparing to other types of banks, excluding cooperative banks, and the NIM has moved similar to cooperative banks. Starting from 2006, has varied and decreased in 2011 ever since. In 2021 rise and remained the increase until 2023. This higher NIM can be related to their lower cost of funds and their economic efficiency.

Real estate and mortgage financial institutions have the lowest NIM, that remains practically the same in all periods. This can be explained by their dependence on the source of their income, which comes from long-term loans with fixed or adjustable rates that do not respond quickly to changes in the market. In addition, these institutions incur higher costs due to their long-term borrowing. These two factors contribute to a lower NIM.

Figure 6 - Average NIM by bank size (%) in Euro Area in 2005-2022



Source: Author based on Orbis Bank Focus

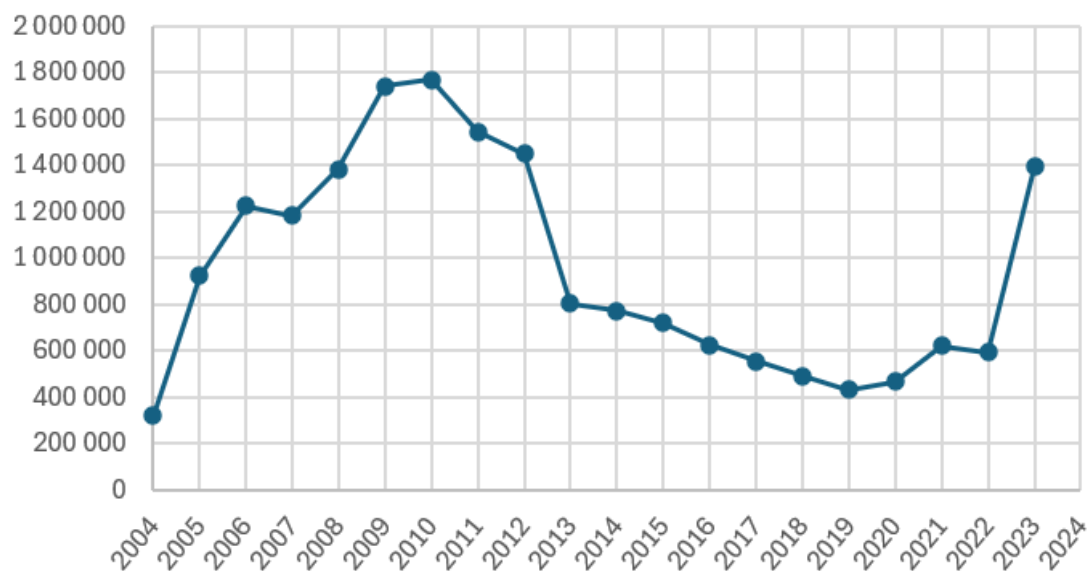
According to Figure 6, medium-sized banks fall between large and small banks in terms of average NIM in the Euro Area. Smaller banks have the highest average NIM and larger banks have the lowest. Additional finding is that large bank's average NIM doesn't change over the course of the periods.

On the other hand, small banks show a progressive decrease from 2006 to 2021, increasing slightly in 2022, which is further evidence that the heterogeneity of banks is likely to cause variations in the way they respond to variable rate environments. Also, medium-sized banks show the same type of behavior as small banks.

Larger banks are believed to serve all or most of private investors, SMEs, among others (Hanzlík, P. & P. Teplý (2019)). Since small and medium-sized banks possess less diversified portfolios and are thus more susceptible to risk as a result of unfavorable economic conditions, their loan and deposit portfolios often have a greater risk profile than the portfolios of larger banks.

Various opinions presented in the literature are supported by these results. Some researchers indicate a negative or insignificant relationship between bank size and performance, while other studies support the theory that bank size positively enhances performance through economies of scale. Antoun et al. (2018)'s research clearly shows that bank size has a negative impact on performance, meaning that larger banks would have more difficulty obtaining cost savings and efficiency gains.

Figure 7 - Loan Loss Reserves (annual average) in Euro Area in 2004-2024



Source: Author based on Orbis Bank Focus

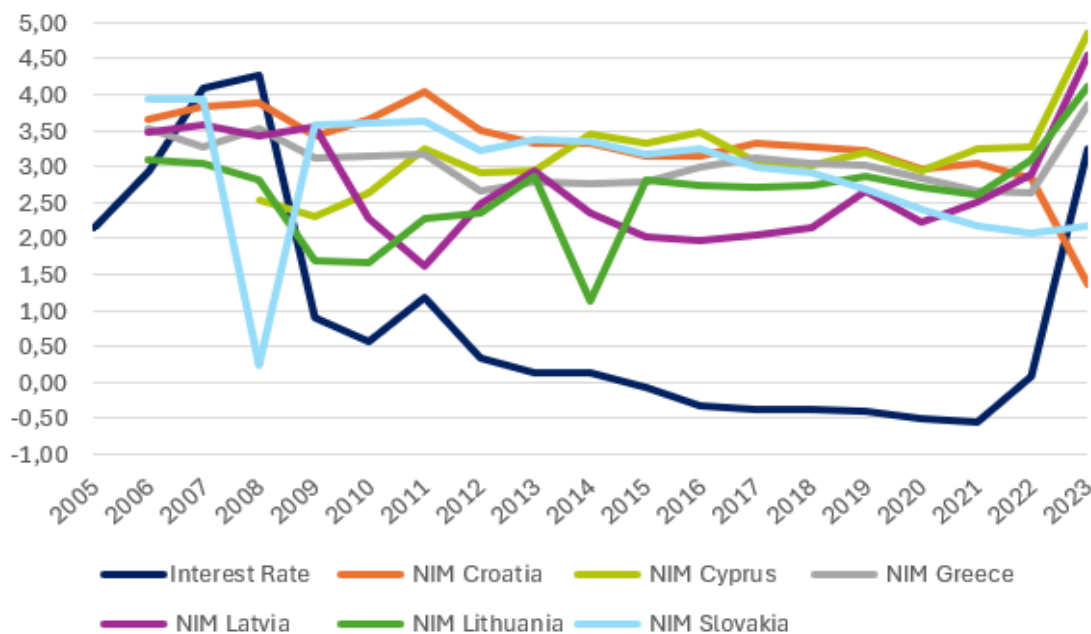
Figure 7 shows the variations among the years of the loan loss reserves. Since 2004 that the loan loss reserves increased enormously. The rise between 2007 and 2009 may have been caused by the GFC.

The high values in the years that followed 2010-2013 could have been due to the economy's post-crisis recovery. From 2017 to 2021, there were minor changes, until 2023 where there was an increase.

To have an overall view of NIM's behavior in relation to changes in interest rates, three graphics were drawn up, distinguished by groups of NIM values, in order to have a clear picture.

The distinguish was made based on the average of the value of the NIMs, meaning that the ones with higher NIM are shown in the first table, the ones with lower NIM are in the third table and the ones between these two average values are in the second table. This was done because of the number of NIM countries, twenty countries, and to make it easier to see them and draw a conclusion.

Figure 8 - Annual Interest Rates vs. Annual NIM in a group of countries (%) in Euro Area in 2005-2023



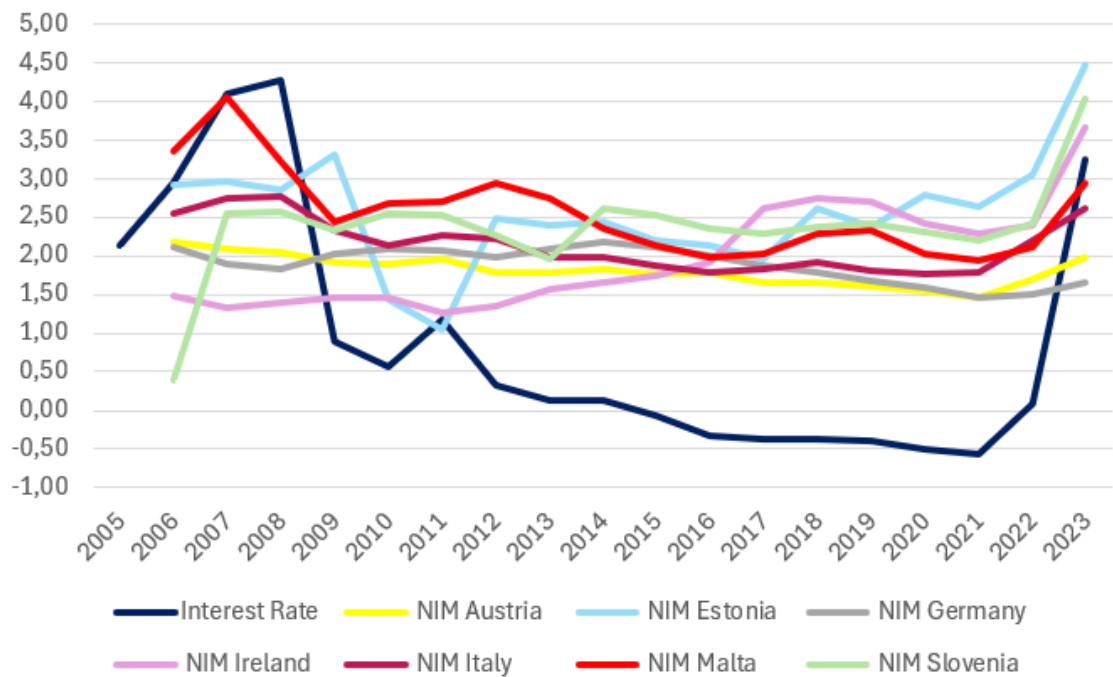
Source: Author based on Orbis Bank Focus

Figure 8 shows the variations of the countries with the highest NIM when compared to all the countries with the movement of the interest rate.

It is evident that Lithuania has the most variety, followed in decreasing order by Latvia, Croatia, Cyprus, Greece, and Slovakia.

Furthermore, there was a trend in the 2009 interest rate decline, which did not lead to a decrease in NIM in those nations.

Figure 9 - Annual Interest Rates vs. Annual NIM in a group of countries (%) in Euro Area in 2005-2023



Source: Author based on Orbis Bank Focus

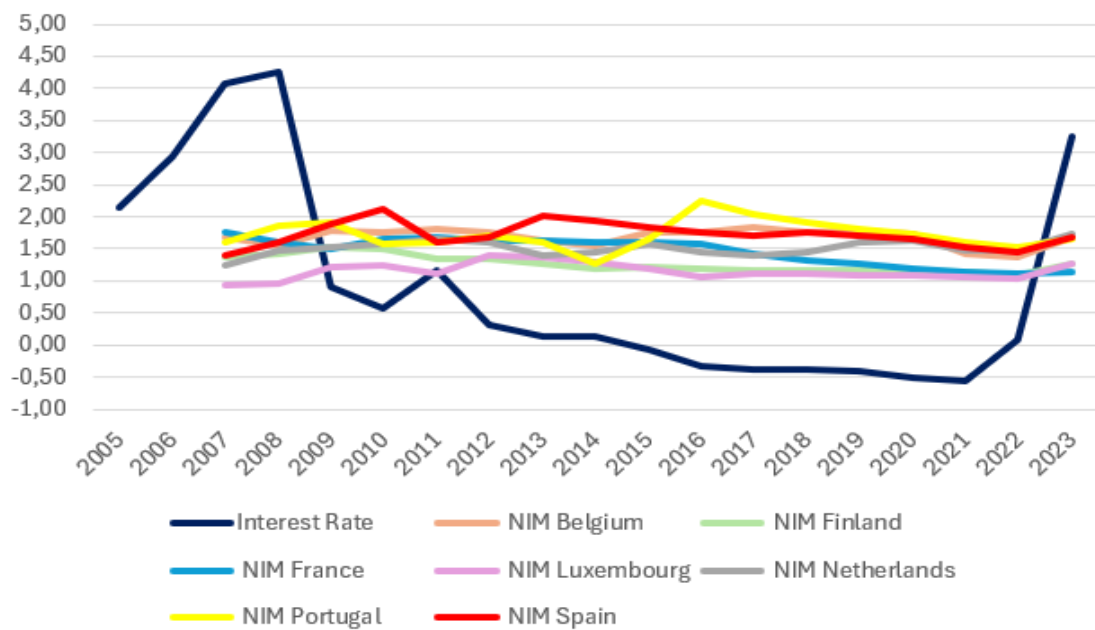
Figure 9 shows the variations of the countries with the medium NIM when compared to all the countries. It is possible to see that the country with the highest variation is Estonia, followed by descending order Slovenia, Ireland, Austria, Germany, Italy and Malta.

Since funding costs often decline more slowly than interest income from assets such as loans and investments in fixed-income securities, banks normally expect their interest margins to narrow in a context of low or negative interest rates. Even in the

presence of low or negative interest rates, analysis of the data indicates notable differences in NIMs between countries.

For example, countries such as Estonia and Slovenia have higher NIMs, contrary to the expectations of decline in interest rates as shown in the graphic, a fall in interest rates didn't influence the behavior of NIM.

Figure 10 - Annual Interest Rates vs. Annual NIM in a group of countries (%) in Euro Area in 2005-2023



Source: Author based on Orbis Bank Focus

Figure 10 shows the variations of the countries with the lowest NIM when compared to all the countries. Is possible to see that the countries differ very little, even so, the highest variation is in Luxembourg, following by descending order Finland, Belgium, Netherlands, Spain, France and Portugal. In this graphic is clearer that the variation in the interest rates has no impact at all on the net interest margins.

To conclude, with these graphics, it is possible to have an overall idea of the average NIM of each country and their descending order.

4.2 Methodology

The study's goals were achieved by a multi-step procedure that integrated statistical regression analysis with the Augmented Dickey-Fuller (ADF) test, which looks for cointegration and unit roots. The Johansen cointegration test is an additional option for assessing cointegration that is used to ascertain whether or not the time series are moving together. The Excel command was utilized for this investigation.

To examine the link between the independent and dependent variables, a linear regression was used. The following is the formula for this:

$$y_{it} = \alpha + \beta_{it}x + \epsilon_{it}$$

where $i = 1, \dots, N$ (units of cross-section) and $t = 1, \dots, T$ (time periods) and $\epsilon_{it} \sim i.i.d. N(0, \sigma^2_{\epsilon})$.

In this study, the independent variable is the interest rate and the dependent variable is net interest income, return on assets and return on equity. In the case of net interest income, return on assets and return on equity, all these variables are studied separately from each other with the interest rates.

The ADF assesses the stationarity of the time series data, with the value of the residuals from the linear regression and is represented by the following equation:

$$\Delta y_{i,t} = \alpha + \beta y_{i,t-1} + \gamma_1 \Delta y_{i,t-1} + \gamma_2 \Delta y_{i,t-2} + \dots + \gamma_p \Delta y_{i,t-p} + \epsilon_{i,t}$$

Where $\Delta y_{i,t}$ is the differenced series, $y_{i,t-1}$ is the lagged level of the series, $\gamma_1, \gamma_2, \dots, \gamma_p$ are the coefficients for the lagged differences and $\epsilon_{i,t}$ is the error term, which is assumed to be independently and dispersed equally distributed (i.i.d.) with a normal distribution $N(0, \sigma^2_{\epsilon})$.

The alternative hypothesis for the ADF test states that the time series is stationary, while the null hypothesis claims that there is a unit root in the series, suggesting non-stationarity.

To find out if there was a long-term link between interest rates and net interest margin, the Johansen cointegration test was used for the cointegration analysis. The following equation represents the test:

$$\Delta y_{i,t} = \Pi y_{i,t-1} + \Gamma_1 \Delta y_{i,t-1} + \Gamma_2 \Delta y_{i,t-2} + \dots + \Gamma_p \Delta y_{i,t-p} + \epsilon_{i,t}$$

Π represents the cointegration vector, $\Gamma_1, \Gamma_2, \dots, \Gamma_p$ are the coefficients for the lagged differences and $\epsilon_{i,t}$ is the error term, which is assumed to be i.i.d. with a normal distribution $N(0, \sigma^2_\epsilon)$.

5 Results and Discussion

As presented in the previous chapters, the estimates were conducted based on linear regression tests and ADF tests. Although it is a useful way to test for cointegration, the Johansen cointegration test was not performed because the findings were achieved with the other two tests described.

The impact of the independent variable, in this case, interest rates, on the dependent variable, the net interest margin, was studied using linear regression. The Augmented Dickey-Fuller (ADF) test was used to identify whether a time series was stationary or non-stationary. This makes it possible to recognize patterns or seasonality throughout time. They show that there is a long-term equilibrium relationship between the variables even when neither variable is stationary on its own. It is also possible to determine whether cointegration exists between the time series using this technique.

To verify the hypothesis, these tests were repeated two more times to examine the effect of IR on ROA and ROE, to fulfilling the hypothesis.

The estimations were performed based on two hypotheses formulated: Hypothesis 1 (erosion of NIM, ROA and ROE) and Hypothesis 2 (influence on market concentration). For the estimations, it was used the Excel command.

Hypothesis 1

The analysis revealed that periods of low or negative interest rates do not affect negatively the NIM, ROA and ROE of Euro Area countries.

NIM

The results show that in periods of low or negative IR, the NIM is not affected negatively. Instead, they indicate a long-term relationship between the two, this means that even in a context of high variable IR, a bank's NIM is sustained over time by several factors that act together to balance the effects of IR fluctuations.

In the regression model, the negative coefficient suggests that when IR increases, the NIM decreases and vice versa. As the p-value is greater than 0.05 it indicates that there is not enough statistical evidence to predict the NIM nor between the relationship with IR.

Table 2 - Regression Analysis Results: Relationship Between NIM and IR

<i>Regression Statistics</i>					
Multiple R	0,1084763				
R Square	0,0117671				
Adjusted R	-0,0463642				
Standard E	0,2952986				
Observatio	19				

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regressior	1	0,01765	0,01765	0,202422755	0,6584565
Residual	17	1,48242	0,0872		
Total	18	1,50007			

	<i>Standard</i>							
	<i>Coefficients</i>	<i>Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	1,4566918	0,07848	18,5616	1,00975E-12	1,2911164	1,622267	1,2911164	1,62226728
IR	-0,019481	0,0433	-0,44991	0,658456493	-0,1108345	0,071873	-0,110835	0,07187259

Source: own presentation

The residuals were then tested, using ADF test to check whether or not the time series is stationary and to look for seasonality or trends that could have an impact on their statistical properties. This helped to validate the robustness of the regression model. Given that the p-value is greater than 0.05, the ADF test results indicate that the residuals are non-stationary, so there is no cointegration between the IR and the NIM, meaning there isn't a long-term equilibrium link between the IR and the NIM.

Table 3 - ADF Results: Relationship Between NIM and IR

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Residuals	19	0	19	-1,010	0,240	0,000	0,287

Dickey-Fuller test (ADF (stationary) / k = 2) / Residuals:

Tau (Observed value)	-2,778
Tau (Critical value)	-3,635
p-value (one-tailed)	0,193
alpha	0,05

Test interpretation:

H0: There is a unit root for the series.

Ha: There is no unit root for the series. The series is stationary.

As the computed p-value is greater than the significance level $\alpha=0,05$, one cannot reject the null hypothesis H0.

Source: own presentation

By analyzing the ADF test, when looking at the coefficient values, that are negative, it can be proven that there is negative impact between IR and NIM. Nonetheless, based on the p-value, that is higher than 0.05, the relationship between the IR and NIM is not statistically significant.

The consequences of these findings for financial analysts and policymakers are significant. It can be difficult to forecast the long-term behavior of interest rates and NIMs due to their non-stationary character, which implies that their connection may be impacted by a variety of short-term events or shocks.

Given these findings, the results indicate that changes in interest rates are linked to a persistent and significant impact on the NIM rather than eroding it. This could imply that banks maintain a constant net interest margin by adjusting lending and deposit rates in response to changes in interest rates. Also, the absence of cointegration suggests that this negative relationship may not erode NIMs in the long term. Therefore, the hypothesis is rejected.

ROA

The findings imply that, in the long run, IR fluctuations have little or no impact. The regression model's negative coefficient indicates that when IR drop, ROA increases and the other way around. Given that the p-value is greater than 0.05, the regression model is not statistically significant in predicting ROA, nor is there a significant relationship between IR and ROA at the 5% significance level.

The regression analysis results show that a small part of the variability (R-Squared 30%) is explained by the IR. Based on the data, changes in IR do not appear to have a significant effect on ROA.

Table 4 - Regression Analysis Results: Relationship Between ROA and IR

<i>Regression Statistics</i>	
Multiple R	0,17545589
R Square	0,03078477
Adjusted R Square	-0,0262279
Standard Error	0,19528417
Observations	19

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0,020592	0,02059201	0,539963749	0,472463493
Residual	17	0,64831	0,03813591		
Total	18	0,668902			

<i>Standard</i>								
	<i>Coefficients</i>	<i>Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	0,41319103	0,051899	7,96147759	3,89763E-07	0,30369416	0,5226879	0,30369416	0,5226879
IR	-0,0210411	0,028634	-0,73482226	0,472463493	-0,081454245	0,039372	-0,0814542	0,03937199

Source: own presentation

Additionally, when looking at the residuals, some of them are larger, which could be an indicator of potential outliers, so the ADF test will be used to verify this.

Based on the results of the ADF test conducted on residuals, the residuals are non-stationary, since the p-value is higher than 0.05. There are no cointegration associations at the 5% significance level.

Table 5 - ADF Results: Relationship Between ROA and IR

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Residuals	19	0	19	-0,345	0,501	0,000	0,190

Dickey-Fuller test (ADF (stationary) / k = 2) / Residuals:

Tau (Observed value)	-2,918
Tau (Critical value)	-3,635
p-value (one-tailed)	0,157
alpha	0,05

Test interpretation:

H0: There is a unit root for the series.

Ha: There is no unit root for the series. The series is stationary.

As the computed p-value is greater than the significance level $\alpha=0,05$, one cannot reject the null hypothesis H0.

Source: own presentation

By analyzing the ADF test, it can indeed be concluded that these coefficient values, which are negative, prove a negative impact between IR and ROA. However, based on the p-value, that is greater than 0.05, the relationship between the IR and ROA is not statistically significant. Therefore, it cannot be considered when explaining the model.

This suggests that the two variables don't have a long-term relationship. In simpler terms, IR and ROA series do not move together in the time in the long run and this does not necessarily imply that in the short run they will have the opposite effects, so there is no evidence of a short-term relationship between the series.

ROE

Based on the regression analysis, is possible to conclude the coefficient has a negative value, suggesting that when IR increases, ROE tends to decrease, indicating a negative relationship between them.

Approximately 71% of the changes in ROE can be explained by the interest rates (R-squared value = 0.7099).

Table 6 - Regression Analysis Results: Relationship Between ROE and IR

Regression Statistics	
Multiple R	0,8684893
R Square	0,75427366
Adjusted R Square	0,73981917
Standard Error	0,21579506
Observations	19

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	2,430016	2,43001618	52,18265335	1,42307E-06
Residual	17	0,791648	0,04656751		
Total	18	3,221664			

	Standard							
	Coefficients	Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	1,75704364	0,05735	30,6373277	2,57104E-16	1,636046205	1,878041	1,6360462	1,87804107
IR	-0,2285727	0,031642	-7,2237562	1,42307E-06	-0,29533102	-0,161814	-0,29533102	-0,1618143

Source: own presentation

The residuals were then tested for stationarity, using ADF test. This helped to validate the robustness of the regression model. Given that the p-value is greater than 0.05, the ADF test results indicate that the series likely has a unit root and is non-stationary and so, there is no cointegration between the time series.

Also, analyzing the coefficient values, as it can be seen in the table below, these are negatives and so, they conclude a negative impact between IR and ROE. Due to the p-value being higher than 0.05, it is stated that the relationship between the IR and ROE is not statistically significant to predict the behavior of the ROE.

Table 7 - ADF Results: Relationship Between ROE and IR

Variable	Observations	Obs. with missing	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Residuals	19	0	19	-0,547	0,311	0,000	0,210

Dickey-Fuller test (ADF (stationary) / $k = 2$) / Residuals:

Tau (Observed value)	-2,031
Tau (Critical value)	-3,635
p-value (one-tailed)	0,496
alpha	0,05

Test interpretation:

H0: There is a unit root for the series.

Ha: There is no unit root for the series. The series is stationary.

As the computed p-value is greater than the significance level $\alpha=0,05$, one cannot reject the null hypothesis H0.

Source: own presentation

It was concluded that there is no cointegration, which means that they in the time series they do not move together in the long run, while with possible opposite effects in the short term.

It's difficult to predict long-term IR and NIM because they are always changing. Some implications for stakeholders that should be taken into account are the need to consider the context of interest rates when assessing or even predicting ROE.

Hypothesis 2

The analysis was based on the Herfindahl-Hirschman Index (HHI) as a measure of market concentration. The HHI is an optimal country-specific variable in the model besides interest rate structure.

Countries with high and low market concentration were divided and studied separately. For these two types of market concentration, it was conducted a regression analysis, followed by an ADF test on the residuals for individual countries. This ADF test was conducted to see whether there was cointegration between the NIM and IR or not and in which types of countries, high and low concentration, this occurred.

Based on the values obtained, as shown in the table below, it can be seen the p-values of the ADF test of each country.

Table 8 – Cointegration Analysis Results: Countries with High and Low Market Concentration

High Concentration		Low Concentration	
Cyprus	p-value = 0.495	Austria	p-value = 0.035
Estonia	p-value = 0.488	Belgium	p-value = 0.045
Finland	p-value = 0.999	Croatia	p-value = 0.049
Greece	p-value = 0.660	France	p-value = 0.945
Lithuania	p-value = 0.435	Germany	p-value = 0.015
Netherlands	p-value = 0.195	Ireland	p-value = 0.035
		Italy	p-value = 0.488
		Latvia	p-value = 0.285
		Luxembourg	p-value = 0.181
		Malta	p-value = 0.435
		Portugal	p-value = 0.262
		Slovakia	p-value = 0.370
		Slovenia	p-value = 0.216

Source: own presentation

For countries with high market concentration, it can be seen that all of them exhibit p-values higher than 0.05. The ADF test results indicate that the residuals are non-stationary, so there is no cointegration between the IR and the NIM, meaning there isn't a long-term equilibrium link between the IR and the NIM, observing a short-term opposite relationship. This would mean that when the expected NIM increases, the IR decreases, but it is not certain that IR has a negative impact on NIM in highly concentrated markets.

Regarding the countries with low concentration, some countries present a p-value lower than 0.05 and others with a p-value higher than 0.05. This means that in countries where the market concentration is low, there is a higher probability of observing a long-term relationship between IR and NIM. This implies that in countries with a low market concentration, changes in NIM are more likely to be followed over time by equivalent changes in IR.

In markets where there is low concentration, there is higher competition and the relationship between IR and NIM tends to be more consistent and predictable over time. Also, the presence of cointegration indicates a long-term relationship. It is visible that cointegration occurs more often for countries with low concentration, meaning that when market concentration increases, the NIM also increases.

Based on the results obtained, the hypothesis would not be rejected due to the p-values of the countries with market concentration, which reflect a difference from country to country in the values based on specific market characteristics (high and low concentration in the countries) between the IR and the NIM.

To conclude, based on the testing on the two types of countries (high and low market concentration), the hypothesis is not rejected as the empirical results rather support the hypothesis.

5.1 Summary of Results

This section compares the estimated results of the two proposed hypotheses and, based on the results, confirms whether the hypotheses are rejected or not, in accordance with previous studies.

Hypothesis 1 (Erosion of NIM, ROA and ROE) – reject: The analysis leads to the conclusion that the NIM, ROA, and ROE of Euro Area banks are not affected by low or negative interest rate periods.

The estimate's findings refute the theory that, in the case of low and possible negative short-term rates, the average NIM for each type of bank would respond in a manner consistent with this (see also Figure 5, which shows variations in the average NIM's pace and direction for each type of bank). Even though there is a negative relationship between IR and NIMs, the tests that were made suggest that IR may not necessarily erode NIMs in the long term. Conclusions for ROA and ROE were practically the same. Therefore, the hypothesis is rejected.

Hypothesis 2 (influence of market concentration) – not rejected: The idea is supported by the findings of the study of Euro Area nations with high and low market concentration. There was no cointegration between IR and NIM for highly concentrated countries, indicating that there was no link between them. In reality, this study does not prove beyond a reasonable doubt that the behavior of the IR will have a negative impact on the NIM in highly concentrated markets. Countries with minimal market concentration showed a strong positive connection, indicating a long-term association, implying that NIM typically rises in line with IR. Therefore, it can be concluded that higher market concentration is associated with lower cointegration between IR and NIM.

Based on the hypothesis where it says, “the profitability depends on specific market concentrations”, and by the division of the countries that was made, is possible to conclude that in fact the characteristics of the market will influence the NIM. However, it can also be proven that it also differs from country to country based on the market concentration.

While market concentration plays a role in this, it is clear that specific dynamics of the market also influence the relationship between IR and NIM. To sum, the study concludes that Hypothesis 2 is not rejected, indicating that market concentration influences the relationship between IR and NIM.

5.2 Further Research Opportunities

In this section, several opportunities for future research are identified. The evaluation of factors other than market concentration that affect the market and the possibility of collecting more data. The Herfindahl-Hirschman index was used in this study to assess market concentration but it was not considered ownership structure in the database, so in future researches it could be taken into account. Increasing the data sample by collecting more data from more countries would strengthen the consistency of the conclusions. To obtain more reliable results, it would be ideal to have more data from a greater number of countries.

It would also be interesting to see how a larger sample of banks managed the end of the era of negative interest rates, because interest rates are currently showing very positive figures.

There are limitations in the model in handling complex statistical analysis due to the fact that the program in which the tests were carried out was Excel. Furthermore, some variables were not found to be statistically significant. The interdependence of results from one year to the next can create biases in the model that cannot be fully captured by the tests.

Lastly, external shocks to the economy, such as environmental, health or economic ones, could significantly impact bank data. Exploring these effects on the banks could be very helpful in understanding the data better.

Conclusions

The factors influencing bank's NIM, ROA, and ROE under low or negative interest rate situations were the main emphasis of this study. An annual dataset covering 2690 banks from Euro Area nations between 2004 and 2024 was used for this purpose.

This study contributes significantly to the existing information by offering detailed insights into how these important financial metrics behave in different scenarios, including interest rates and market concentration. The findings demonstrate that low and negative interest rates do not always have a detrimental effect on the profitability metrics (NIM, ROA, and ROE) of banks in the Euro Area. Conversely, it was discovered that there was a negative association between these factors and interest rates, demonstrating the bank's resistance to interest rate fluctuations.

Regarding the analysis of how market concentration affects bank profitability, it is shown that in nations with low market concentration, profitability and market concentration are positively correlated. On the other hand, there could not be a positive correlation between profitability and market concentration in nations with high levels of concentration. The lack of a sustained correlation between market concentration and net interest margin implies that banks could make more money in less competitive markets. However, in nations with low market concentration, where cointegration between net interest margin and interest rates occurs more frequently, a more stable relationship between market concentration and profitability is demonstrated.

Furthermore, it was possible to differentiate between several bank types, including savings banks, commercial banks, cooperative banks, and real estate and mortgage financial institutions, for which significant differences in their net interest margin were found. In addition, there were noted some changes in the size of the banks. These variations demonstrate the variety of approaches and market niches that banks in the Euro Area provide.

To conclude, the findings of this study offer valuable insights for stakeholders and professionals interested in the banking sector. The results suggest that the relationship between low or negative interest rates and bank profitability is more

complex than previously believed, with important roles also played by market concentration and bank specialization.

Understanding these complex relationships will be essential for banks to adapt and thrive in an increasingly competitive landscape as interest rate environments continue to change. In order to give a more comprehensive understanding of the dynamics of bank profitability, future research could examine these links in various regulatory and economic circumstances.

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List of Abbreviations

ADF Augmented Dickey-Fuller

CAMEL Capital Adequacy, Asset Quality, Management Efficiency, Earnings, Liquidity

ECB European Central Bank

EU European Union

GDP Gross Domestic Product

GFC Global Financial Crisis

HHI Herfindahl-Hirschman Index

NIM Net Interest Margin

NIRP Negative Interest Rate Policies

QE Quantitative Easing

ROA Return on Assets

ROE Return on Equity

SME Small and Medium Enterprises

US United States

ZLB Zero Lower Bound