Monetary Policy and European banks: a study of the role of of interest rates on profitability

Daniela Couto Oliveira

Dissertation submitted for partial fulfilment of the requirements for the degree of "Master in Finance" (Mestrado em Finanças) at Universidade Católica Portuguesa.

September of 2024

Dissertation written under supervision of Professor Diana Bonfim

(This paper contains 9603 words)

Abstract

Interest rates are one of the most accompanied themes nowadays. This study is about how monetary policy interest rates impact profitability of European banks. Using a panel of 20 European countries and 359 banks between 2013 and 2022 – a period of low interest rates - and econometric models, I found that interest rates do impact profitability components of European banks, but are not the main component that explains profitability, as the models tested suggest that interest rates only explain a small part of it.

The conclusions obtained from this paper contribute to the literature related with monetary policy and profitability and leave an open door to analyze the effects when there is available data for the moment we are in now, of rising interest rates.

Keywords: interest rates, monetary policy, profitability, European banks.

Sumário

As taxas de juro são um dos temas mais acompanhados nos dias de hoje. Este estudo é sobre como a política monetária impacta a rendibilidade dos bancos Europeus. Recorrendo a um painel de 20 países Europeus e 259 bancos entre 2013 e 2022 – um período de taxas de juro baixas – e modelos econométricos, verifiquei que as taxas de juro impactam, de facto, as componentes de rendibilidade dos bancos Europeus, mas não são a principal componente que explica a mesma, uma vez que os modelos testados sugerem que as taxas de juro explicam apenas uma parte reduzida da rendibilidade.

As conclusões obtidas neste trabalho contribuem para a literatura relacionada com política monetária e rendibilidade e deixam uma porta aberta para uma eventual análise sobre os efeitos, quando existir informação disponível, sobre o momento atual, com taxas de juro mais elevadas.

Palavras-chave: taxa de juro, política monetária, rendibilidade, bancos Europeus.

Table of contents

List of images

List of tables

Acknowledgements

The journey to this thesis began with an interest in understanding how European banks' profitability was impacted by interest rates and how that impact would react when variables such as total assets, non-performing loan ratio and fair value changes in hedging to interest rate risk were added to the models. Does profitability necessarily increase with increases in interest rates? Do other variables play an important role in this effect?

These past years of post-graduate studies and thesis process would not be possible without a great support team. Family comes first and I thank my family for the deep care and patience. My friends and colleagues were examples of kindness and fellowship when I needed to brainstorm about specific topics approached here. Finally, my supervisor, an example of professionalism, and whose recommendations contributed to improve the quality of this work.

1. Introduction

In a post sub-prime crisis scenario, stability is a main concern at the center of debates regarding the banking sector. Facing a financial sector in struggle, Central Banks around Europe adopted a conservative position, implementing several monetary policy measures in order to recover a balanced sector. Minimum capital requirements, as well as liquidity requirements and controlled liability structures were some of the impositions verified after this crisis.

Of course, after that profitability was an issue, as it was more controlled and subject to the fulfillment of the above mentioned conditions. These conditions led to a financial sector in which we were able to see balanced and competitive banks, operating in a more efficient way and following metrics more aligned with the highly regulated environment.

The above mentioned has an impact on how banks nowadays operate. It is also of general knowledge that interest rates have an important influence on banks' profitability. But how does that relationship impacted when in contact with other variables such as bank specific and macroeconomic variables? Macroeconomic variables play by themselves an important role on the profitability of banks, because if there is a contraction in the economy, the demand for loans and other banking sector products will decrease, credit quality will deteriorate, and, even with favorable interest rates, profitability will suffer at some point.

This paper aims to understand the interest rates role on profitability of European Banks. Using a panel of data that includes observations from European banks, we estimate a regression model to determine the influence of monetary policy on profitability, both using interest rates from the current period, as well as lagging periods to understand how profitability in the current year reacts to previous years interest rates. In one of the models, we test how profitability reacts by introducing the effect of fair value changes in hedging against interest rate risk. Since nowadays practice is to use hedging strategies to manage risk, including this variable in the study allows to have a clearer idea of how the hedging is mitigating the impact of interest rate changes on banks' profitability.

The paper obeys to the following structure: section 2 presents a literature review regarding the purpose of the paper, namely monetary policy, banks profitability and regulation. Section 3 presents a theoretical perspective so that the reader can better understand how some concepts relate. In section 4 we detail the methodology and data used, while section 5 presents the

empirical analysis and results obtained from the econometric model. Lastly, section 6 presents the conclusions of the work.

2. Literature Review

Following the 2007 U.S. subprime crisis, financial markets were shaken due to the lack of confidence. Banks were lending less, leading to continued market failure. This crisis led to the end of the era of investment banks in the United States. The two remaining investment banks, Goldman Sachs and Morgan Stanley, were rescued subsequently to the crisis, being elected to continue operations in the quality of commercial banks. This seems to suggest that "commercial banks business model is more resistant to the crisis effect than that of investment banks" (Hao, F, Lu, Y and Su, C (2012)).

It is worldwide known that this financial crisis was caused by excessive risk taking in a moment in which financial institutions had very thin capital cushions to cover for higher or unexpected financial losses.

In 1605, Miguel de Cervantes wrote his famous play Don Quixote. In this play, a specific statement has become famous:

"*It is part of a wise man to keep himself today for tomorrow and not venture all his eggs in one basket.*"

In the aftermath of the subprime crisis, this statement was widely remembered, as the sense of risk and return had been temporarily put aside, which gave rise to an increase in higher risk-taking activities. Worse: it happened while everyone was trusting that financial institutions where managing, specially, interest rate risk.

Anginer,D, Can Bertay, A, Cull,R, Demirguç-Kunt, A and S. Mare, D (2019) show that the level of regulatory capital held by banks was higher around 2016 than in 2010 (post crisis period). This reflects the awareness that banks and regulators had on the topic, also due to regulatory requirements that became mandatory in the aftermath of this financial crisis. Besides the higher level of capital requirements, banks also had liquidity requirements and more controlled liability structures and financial leverage. All this is partly due to the increase in regulation in a post crisis scenario. However, with an increase in requirements, profitability is being challenged, as less risk means necessarily lower returns.

If we want to evaluate the behavior of profitability of banks considering the fluctuations of interest rates, we should first take a look at banking system efficiency. Nowadays, due to very

strict laws and regulations, European banks operate close to the "best practice" of the efficient production function (Fiordelisi, F, Marqués-Ibañez, D and Molyneux, P (2010)).

Banks have strategies to hedge against risks, namely interest rate risk. However, in situations in which banks present themselves with lower efficiency levels comparing to similar banks in the market may force them to try and boost their performance via less intensive monitoring of credit (Fiordelisi, F, Marqués-Ibañez, D and Molyneux, P (2010)). When the strategy goes through lower credit screening, banks may face a higher risk, as their hedging strategies are temporarily overlaid and banks are temporarily unprotected through them. This seems to mean that banks with higher impacts on their profits in a scenario of interest rates fluctuations are the ones with lower levels of efficiency.

Even though we intend to evaluate the role of interest rate fluctuations on profitability, we cannot ignore the fact that profitability by itself is insufficient and does not allow us to assess on the bank's efficiency.

Chortareas, et al (2011) states that financial frictions such as informational and market imperfections are negative contributors to banks' operational efficiency. The authors also defend that higher capital ratios ease on such financial frictions allowing an increase in efficiency.

In the current days, the banking sector, whether it is European or somewhere else, is highly competitive and regulated. This allows for an increase in trust due to several factors: (i) as it is highly regulated, and even though regulation does not allow for 100% prevention, it allows for higher control over the operations in the sector, whether it is under capital and liquidity requirements, governance or under risk management; (ii) as the competition among the sector is so high, there is a lot of pressure for a flawless management. Competition, however, has a not so clear effect. The effect already presented of stability, but also on fragility, as more competition may lead banks to the temptation of becoming less solid on the risk conservative approach and thus, taking higher risks, either on lending or borrowing. Beck, T (2008) found it hard to measure competition, which would be a key in this dilemma, yet defending that stakeholders should align incentives to reduce the risk of bank fragility.

Among many others, the above mentioned factors have been leading to a generalized increase in efficiency amongst the banks, mainly due to the pressure that each bank individually feels to be side by side to its peers. Chortareas, et al (2011) reached the conclusion that "financial

institutions operating in a competitive environment are less vulnerable to the 'quiet life' effect of slack management and display higher efficiency levels".

Therefore, the increase in competition combined with the tight regulation in the post subprime crisis allowed for increases in efficiency. However, at what price? How has profitability been affected by this?

According to Teixeira et al (2019), tighter regulation restricts banks' activities and, consequently, reduces their profitability. Beltratti and Stulz (2012) reached to the same conclusion, yet showed that in financial crisis situations, the impact of regulation on banks' profitability is of less severity.

After the subprime crisis, monetary policy became less effective, according to Filardo and Nakajima (2018), but its intervention during the crisis revealed itself as beneficial according to Dahlhaus (2016). But what effects does it have on banks' profitability?

Borio et al (2017) show that higher interest rates and a steeper yield curve boost profitability. In a post subprime crisis scenario, they verified that monetary policy was effective in the first two years, as interest rates decreased and the yield curve slope increased, which led to a boost in Return on Assets (ROA). However, as the yield curve slope got flattened in the following years, and interest rates were still decreasing, ROA also decreased. More recently, with the increase that has been verified in interest rates, profits experienced a boost.

Until now, we were able to perceive that banks' profitability is affected by many different factors, namely by financial and operational indicators, monetary policy, risk factors such as interest rate risk and credit risk, ownership and management structure and also macroeconomic factors, such as inflation. Considering this, how do interest rates impact on banks' profitability after all?

Chaudron (2018) studied the impact of a prolonged environment of low interest rates on banks' interest rate risk and profitability for Dutch banks. The author concluded that interest rate positions are small because these banks hedge most of the risk. Also, Chaudron noted that "interest rate risk positions are negatively related to on-balance sheet leverage and exhibit a U-shaped relation with solvability".

López-Penabad et al (2021) studied the effect of negative interest rates on European banks' profitability and concluded that, except for investment banks, the greater the weight of customer deposits, the larger negative impact of negative interest rates in net interest margin. In this

study, it was observed the behavior of profitability by each type of bank and there is a change in that behavior according to that nature, mainly due to the composition of each type of main balance sheet positions.

In order to provide funding to the economy, whether it is to companies or individuals, banks need to generate capital. To ensure they have the ability to generate capital, banks need to have profits. After the sub-prime crisis, banks have found it difficult to return to profitable levels. Altavilla et al (2019) shows that "euro area banks' profitability has been gradually recovering from the significant decline that followed the crisis". Now that banks' profitability is recovering its levels, it is expected that banks recover the ability to provide funding with no need of special programs of unconventional monetary policy. Altavilla et al (2019) also mentions that "robust bank profitability (…) contributes towards adequate transmission of monetary policy".

Hancock, D (1985) mentioned that "banks appear to have profits that increase with interest rates" in a paper where she aimed to study the effect of changes in interest rates and other components of monetary and regulatory policy on bank profitability and rate of return on capital. We know that, back then, regulation and monetary policy were not so tight as they are nowadays.

Zimmermann, K (2019), on the other side, aiming to study the effect of monetary policy on bank profitability, with a dataset of 17 American countries and 145 years, advised: "many bankers worry about low interest rate environment and its detrimental effects on bank spreads. However, higher interest rates and wider spreads do not automatically result in larger bank profits". This is interesting, as it may be a clue on what will happen to banks, now that we are going from low interest rates to higher.

This paper will focus on a shorter time span with European banks and, as mentioned, understand the role of interest rates on European banks' profitability.

3. A Theoretical Perspective

As most of us have been following up, the European banking sector has already suffered some challenges that, without the intervention of central banks, would lead to very extensive impacts in the economy. Events such as the subprime crisis, sovereign crisis, COVID-19 pandemic and other country-specific events have been a proof that monetary policy intervention is extremely important and necessary.

Monetary policy refers to a process by which central banks control money supply. Central banks do this often by targeting an interest rate in order to promote economic stability and growth. It is always adjusting to the needs of the economy and its measures vary from less to more aggressive as the economic conditions evolve. The main goals of monetary policy are to maintain price stability, economic growth and employment and, of course, financial stability. These goals stand for Europe, but Asia, Africa and America have very similar ones.

To achieve these goals, central banks have many tools, which, as explained, vary according to the needs of each country in a given period. The most common one is the interest rates, which are adjusted as necessary, influencing borrowing and financing costs and consequently, affecting consumer and business loans. The whole market will then respond accordingly, and economy will tend to move in the direction that is intended. In a scenario of expansionary monetary policy, we will observe central banks lowering interest rates and this will reduce the cost of loans, which consequently leads to an increase in borrowing, which promotes spending and investment. At the same time, banks are also more willing to lend, as this scenario reduces the risk of default. On the contrary, in a scenario of contractionary monetary policy interest rates will rise and, consequently, spending and investment will slow down, allowing to control inflation. In this case, credit risk increases, which makes banks to be more conservative when it comes to lend. There are other instruments, such as open market operations which consist in buying and selling government securities, allowing to control for money supply. For example, if the central bank buys government securities, will be injecting liquidity into the banking system; on the contrary, if it sells, will be absorbing liquidity from the banking system. Another instrument, which has already been mentioned earlier, is the reserve requirements – central banks nowadays require that banks hold a minimum reserve requirement. A change in the reserve requirement may influence the amount that each bank has available to lend and will, consequently, influence money supply.

As mentioned, monetary policy is always adjusting to the needs, and its measures can both be conventional and unconventional, in order to ensure that the economy gets the necessary support in each moment. In situations such as the recent COVID-19 pandemic, we had the opportunity to assist to the implementation of unconventional measures of monetary policy in order to guarantee the necessary money supply in a short time frame, as there were urgent needs of liquidity that banks by themselves were not being able to give response to.

Considering this, we can easily understand how monetary policy is important and how it can impact banks' profitability.

Bank profitability is a critical measure of financial health and operational efficiency of the institution. It is typically measured by Net Interest Margin (NIM), Return on Assets (ROA) and Return on Equity (ROE). In this paper, we will focus on ROA and ROE, from which we can obtain a view both from operational and shareholders' perspective.

As we know, bank profitability can be influenced by several internal and external factors, which can vary in time. Factors such as the cost structure, credit risk, liquidity and funding conditions and technological innovation are factors that are more directly under the control of the bank. However, factors such as macroeconomic environment, market competition and regulation and supervision are factors for which banks do not have direct control and can only manage the best way possible as they observe the impacts. Credit risk is one important factor, since it reflects the economic conditions that are verified. This component reflects the quality of a bank's loan portfolio and may lead to a decrease in profitability if borrowers are defaulting, because this leads to an increase in loan loss provisions, a component of income statement, leading to a decrease in net income. This consequence is one of the reasons why it is so important for banks to have an effective credit risk management in order to maintain profitability, especially when facing economic downturns.

Monetary policy and bank profitability are two concepts that require special care from policymakers, as bank profitability is highly impacted by monetary policy and has a high impact on economic growth and financial stability, which are two main goals of monetary policy. This means that the trade-off between stabilizing the financial system while maintaining high levels of bank profitability to allow for long-term economic growth and financial stability are carefully analyzed and accompanied by central banks.

These trade-offs vary with the priorities in given moments. In periods of economic distress, the priority is financial stability and one of the responses will be to lower interest rates as an attempt

to prevent a collapse of the financial system. This will stabilize the market as a whole and provide access to liquidity, but in the long-term they will have the cost of reduced profitability. Another common reaction from central banks to promote financial stability is to require an increase in capital and liquidity buffers and also a reduction in leverage from banks. Even though these measures may lead to the intended result of achieving financial stability, they will also lead to constrains in profitability, since the there are limits on the amount of risk that banks can take, as well as an increase in costs imposed by regulation.

For nearly 9 years, European economy dealt with very low and even negative interest rates. The goal was to spur lending, but it had a penalizing effect in the banking sector, in which profits have been compromised for this period. We know that low profitability levels for a prolonged time frame will lead to a reduction in banks' capacity to absorb losses, will weaken their ability to support the economy and may even lead to bank failures. While we were on a low interest rate period, we were able to observe that banks in general were not obtaining high profits, and some of them were even in need of intervention from central banks due to the difficulties of low profitability.

When the economy begins to recover, which is something we have been observing since the second semester of 2022, comes the need to adjust monetary policy and normalize it, meaning, to increase the interes rates. This increase, however, needs to be sustained so that it won't cause sharp increases in asset prices and lead to a disruption again. In the banks' perspective, a sharp rise in interest rates may lead to an abrupt increase in the cost of borrowing to consumers and, consequently, to an increase in defaults. The increase in defaults will lead to a decrease in banks' profitability. This reflects the delicate balance between supporting economic recovery while trying to maintain bank profitability.

In the following pages we will analyze how European banks' profitability actually behaves along with monetary policy.

4. Methodology and Data

This paper aims to analyze the effects of interest rates on profitability of the European banking sector. To better understand what we intend, below are the steps we will take to observe the mentioned effects:

1. Obtain data from profitability components by bank;
2. Extract data from fair value changes in hedging against interest rate risk;
3. Retrieve data from interest rates in the Euro zone;
4. Get the yield curve spot rate with spread between 10 years and 3 months maturity for issuers whose rating was triple A.

This analysis is focused on data between 2013 and 2022, collected from Orbis, except when otherwise indicated. All data was retrieved with yearly frequency, except when otherwise indicated.

The set of variables chosen for the purpose of this paper is presented below:

a) Profitability components:

   This set of data was retrieved with yearly frequency.

   - Return on Assets – bank return on assets in percentage;
   - Return on Equity – bank return on equity in percentage;
   - Total Assets – bank total assets in million euros.

b) Interest Rates, from the ECB Database Portal:

   - Euribor 3 months, 6 months and 1 year.

   The following set of data was retrieved with quarterly frequency, as there was no annual information available. Since most of the variables considered in the above sets are balance sheet data, we considered the last day of the year for each variable.

   - Yield curve – Euro Area yield curve spot rate from 10 years to 3 months maturity;
   - 10 year euro area Government bond yield.

c) Hedging, from the ECB Database Portal:

   - Country specific fair value changes in hedge portfolios for hedging against interest rate risk.

d) Other indicators, from the ECB Database Portal:

- Gross Non-Performing Loans as a percentage of total gross loans – country specific data;
- HICP Inflation index;
- GDP growth at current prices – country specific data.

4.1 Data characteristics

As for the data collected from Orbis, I collected specific financial information from banks in Europe, with indication of the country each bank is from.

For each bank, information regarding Total Assets, ROA, ROE, Profit margin and financial profit(loss) was collected.

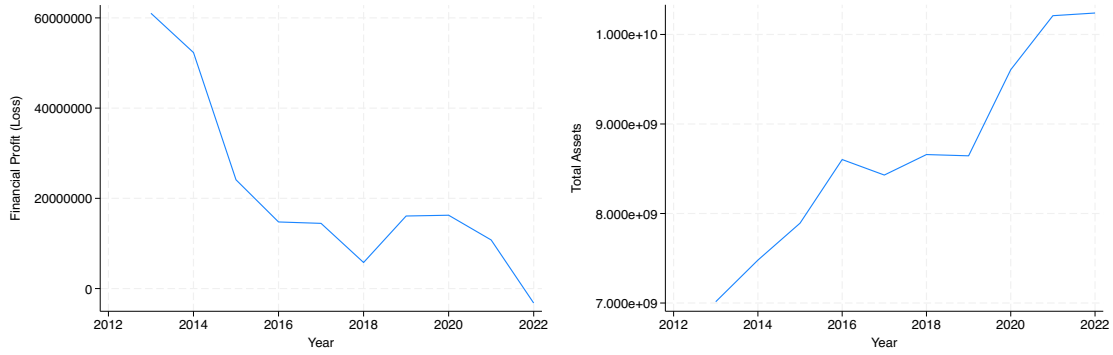

Figure 1: Financial profit (loss) and total assets among European banks

After the sub-prime crisis, financial profit (loss) decreased and total assets increased (Figure 1). Among many other specific reasons, one reason for this is the increase in regulation and the mandatory requirements for higher capital and liquidity reserves. As mentioned earlier, the increase in these requirements should lead to a decrease in profitability. However, even though capital and liquidity requirements did not suffer an ease along the years and since 2018 we can see a slight improvement in financial profit (loss), accompanied by a larger increase in total assets. This would be consistent with initial costs of abiding to stricter regulation, which can be transitory. Moreover, the initial years in the sample are still marked by the recognition of losses from the euro area sovereign debt crisis. As expected, during this period the European Central Bank had to resort to conventional and unconventional monetary policy measures. For the conventional side, we observed measures such as a decrease in the interest rates and a reduction of minimum reserve requirements to be fulfilled by banks. As for the unconventional measures, we observed measures such as longer-term refinancing operations (LTROs), covered bond

purchase programmes and a securities markets programme. The last one had a direct intervention of the Eurosystem on the euro area private and public bond markets, as these markets were vital to ensure the efficiency of the ECB's policy rates transmission. Campmas, A (2018) proved that the overall easing effect of policy interest rates "globally worsens the overall profitability" and when we observe Figure 1, knowing that the low interest rate environment felt until 2022, we can understand this effect.

When we look at the return on equity (Figure 2) we can see that there is a large increase from 2021 on. Among other factors, this is also a reflection of conventional and unconventional monetary policy measures imposed during Covid-19 pandemic.

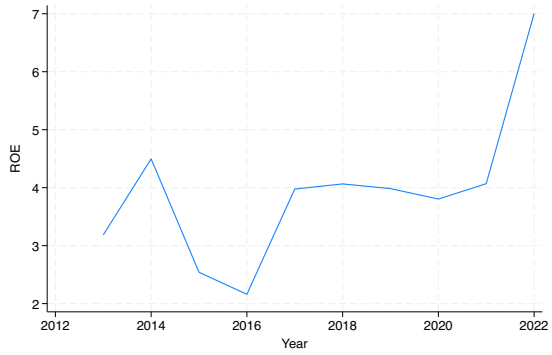

Figure 2: Return on Equity among European banks

After all the attention they had in the aftermath of the sub-prime crisis and the euro area sovereign debt crisis, we could not avoid looking at the gross non-performing loans ratio.

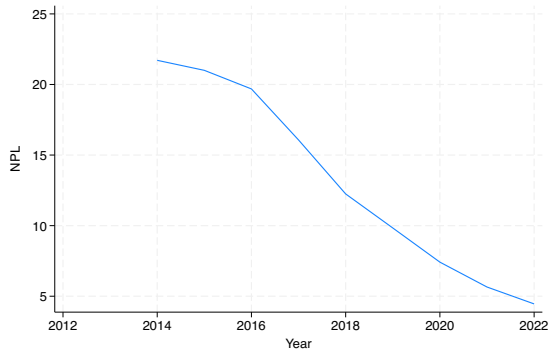

Figure 3: Gross non-performing loans as a % of gross total loans among European banks

It is clear to see that this ratio has been in sharp decline (Figure 3). Kjosevski and Petkovski (2016) found that non-performing loans are affected by GDP, inflation and private credit stock.

Earlier, Messai and Jouini (2013) related it with also GDP growth, unemployment and real interest rates, as it could not be avoided to mention. If we merge the above image with GDP growth and inflation, we will get the below:

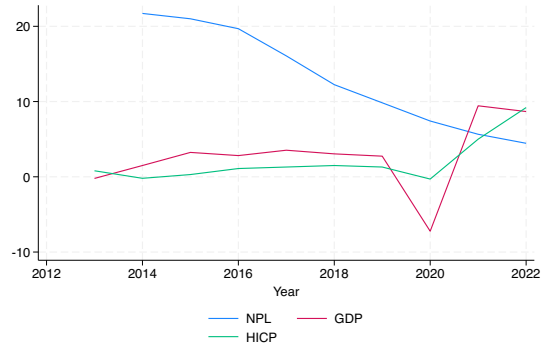

Figure 4: Gross non-performing loans as a % of gross total loans among European banks, GDP growth in current prices and HICP inflation index

All-together (Figure 4), and except for 2020, we can see that GDP in Europe had this slight increase while inflation kept relatively stable, allowing for an increase in the purchase power among the countries, which, consequently, allowed people and companies to keep up with their financial obligations. If we take a magnifying glass on 2019 to 2020, the years that suffered the larger impacts of covid-19 pandemic, we can see that, holding inflation stable as it kept, the sharp decrease in GDP did not lead to a similar behavior for non-performing loans, even though, in this period, non-performing loans did not present a declining behavior, stabilizing instead. This behavior was due to all kind of measures taken during that period, namely fiscal policy, regulatory policy (such as credit moratorium programs) and monetary policy.

As for the interest rates, if we take Euribor 3 months, 6 months and 1 year (Figure 5), we can see that the behavior has been of decline from 2013 until 2021. Between 2015 and the second semester of 2021, these rates even assumed negative values. By the same time, inflation gradually increased until 2019, and had a sharp decline during the pandemic. By 2021, we can observe that both inflation and interest rates started to rise, and we know that since the second semester of 2022 they reached positive levels. From this point until the last trimester of 2023, they kept on rising. Now they are slightly declining again. It matters to say that this effect is not a part of our sample period.

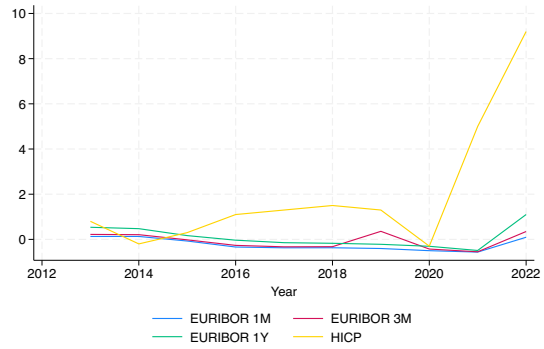

Figure 5: Euribor 3 months, 6 months and 1 year and HICP inflation index

At last, if we take a look at fair value changes of hedged items in portfolios of hedging against interest rate risk (Figure 6), we can see that, since 2020, fair value changes became negative by large amounts, by the same time that interest rates started to rise. There are several ways to hedge against interest rate risk, but most of them have this effect. Taking a step back in order to recall some theory, we know that banks have hedging instruments against interest rate risk, such as swaps, futures or options, that allow them to manage the impact of unfavorable changes in interest rates. The main goal in this practice is to offset potential losses on the underlying assets or liabilities with gains from the hedging instrument. Overall, a rise in interest rates will lead to a decrease in fair value changes of hedged items, which happens because the instrument used for hedging was structured in a way that would lose value if there was such a rise. Take for example futures – if interest rates increase, futures price will fall. This will lead to a fair value decrease in the amount that constitutes the difference between the future's price and the amount of the asset with no future.

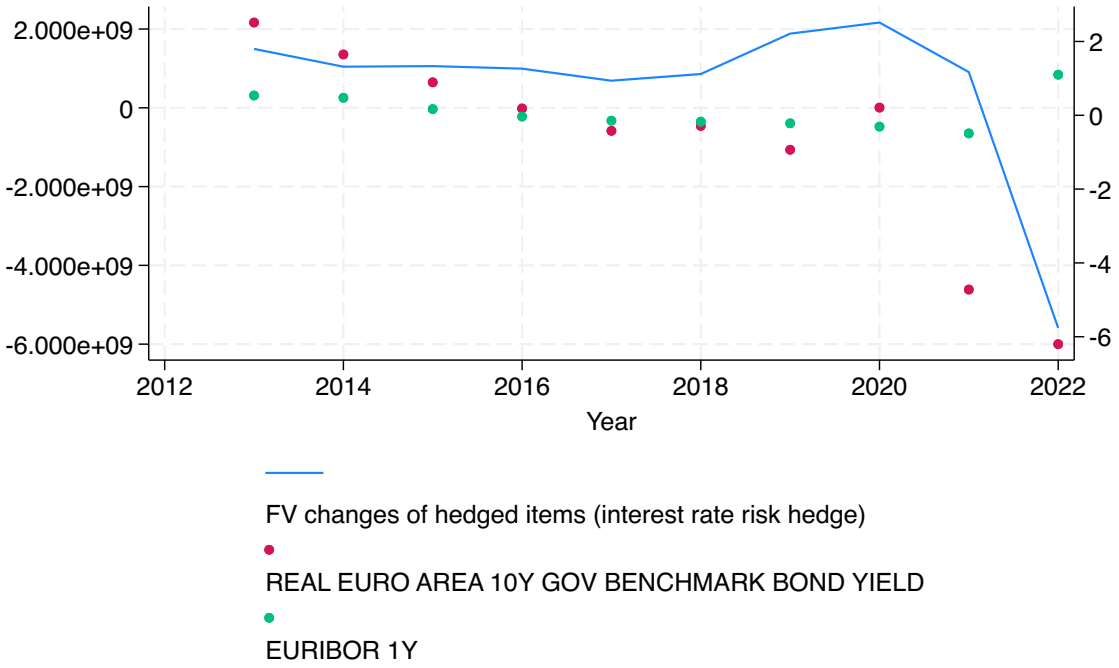

Figure 6: Fair value changes of hedging against interest rate risk, real euro area 10year Government benchmark bond yield and Euribor 1year

Now, we will get to the summary statistics of this data and relate it to the interest rates and yield curve. Specifically, we will find what is the role of changes in interest rates in banks' profitability levels. Are such impacts positive or negative due to interest rate increases and declines? Are the profitability levels higher every time interest rates grow? Can profitability increase with a decrease in interest rates?

4.2 Summary statistics

As for summary statistics, Table 1 displays the data for bank, macroeconomic and financial variables. In the Appendix it is possible to see the below variables clustered by country (Table 9).

	N	Mean	SD	p25	p50	p75	Min	Max
Bank Variables								
TotalAssets	3590	23 300 000	130 000 000	217 116	673 876.5	2 374 296	171.528	1 800 000 000
ROE	3590	4.664	9.838	1.721	3.778	6.46	-78.949	95.839
ROA	3590	0.727	3.439	0.159	0.349	0.612	-36.735	94.319
FinancialProfitLoss	3590	59 398.08	1 050 711	0	0	0	-3 281 193	42 300 000
NPL Ratio	3231	13.354	9.588	5.648	10.906	19.049	0	67.367
FvchangesHedging	3590	1 421 211	7 183 267	0	2 598 997	3 865 614	-45 600 000	45 900 000
Macroeconomic Variables								
GDP	3590	2.663	4.875	1.169	2.406	4.479	-10.157	34.807
HICP	3590	2	2.781	.3	1.2	1.5	-.3	9.2
Financial Variables								
RealEuroArea10YGovBenchmark	3590	-0.712	2.583	-0.934	-0.0514	0.893	-6.199	2.513
Euribor 1M	3590	-0.226	0.255	-0.403	-0.354	0.094	-0.561	0.131
Euribor 3M	3590	-0.078	0.324	-0.329	-0.143	0.221	-0.549	0.357
Euribor 1Y	3590	0.0912	0.458	-0.217	-0.091	0.475	-0.491	1.099

Table 1: Summary Statistics of the variables

Note: Total assets is in million Euros; ROE: Return on Equity (%) is the profitability relative to shareholders' equity; ROA: Return on Assets (%) is the profitability relative to return on assets; Financial Profit Loss: Financial profit or loss (million Euros); the difference between revenue generated from banks' assets and the expenses associated with paying its financing liabilities; NPL Ratio: Gross non performing loans ratio (% of total loans); FvchangesHedging: Fair value changes of hedged items in portfolio hedge of interest rate risk (thousand Euros); GDP: GDP growth rate (%): indicator of economic health of each coutry; represents each country business cycle phase; HICP: Harmonised Index of Consumer Prices (%); measures the change over time in prices of consumer goods and services acquired, used or paid for by euro area households; RealEABenchGovBond: Real Euro area 10 year Government Benchmark bond yield (%); composed of an average of observations through the period; EURIBOR1M: Euribor 1 month (%); composed of an average of observations through the period; EURIBOR3M: Euribor 3 months (%); composed of an average of observations through the period; EURIBOR1Y: Euribor 1 year (%); composed of an average of observations through the period.

The profitability variables all present positive average values. Please recall that return on assets (ROA), return on equity (ROE) and NPL Ratio are ratios. When we look to Table 9, presenting the results by country, we can see that in terms of ROE, Czech Republic and Sweden have the highest average ROE (46.176% and 20.206%, respectively), while Greece and Lithuania have the lower (1.761% and 0.026%, respectively). Nevertheless, when we look to Table 1, we can observe that return on assets and return on equity do not present a high average (0.727% and 4.664% respectively) despite the higher positive and negative values they may assume in terms of minimums and maximums. This low average in these two variables is aligned with the difficulties that most banks assumed in a post sub-prime crisis scenario. As for the NPL Ratio, it presents an average of 13.354% and a maximum of 67.367%. This maximum reflects the fact that our sample is contemplating a post crisis scenario, as in the aftermath of the subprime crisis the non-performing loans were reaching maximum levels. Recall Figure 3, where we can clearly see the descending behavior of this ratio after 2015. As for interest rate metrics and others

related to monetary policy, we can observe a subtle divergence between them. For starters, real Euro area 10-year Government benchmark bond yield assumes a negative average value (-0.712%). The negative average value of the real bond yield may represent the fact that long term interest rates are higher than short term interest rates, leading to a change in investment intentions from short term bonds to long term bonds.

Table 2 exhibits the correlation matrix. The correlation coefficient, as we all know, varies between -1 and 1, being these extreme positions known as perfect negative correlation and perfect positive correlation. Thus, we call upon this coefficient to evaluate the degree of association between two variables. So, even if the coefficient is not -1 or 1, the further away it is from zero and close to -1 or 1, the more correlated the variables are. In this case, and analyzing the results obtained below, we can see an almost perfect negative correlation between real euro area benchmark bond yield and HICP (-0.9261). This is the highest correlation among all the variables and it represents the fact that, as inflation rises, bonds become less attractive to investors, as their return decreases due to the effect of inflation, leading to a decrease in the yield curve.

Another statistically significant correlation was found, yet not as strong, between real euro area benchmark bond yield and NPL ratio (0.5392), which shows that as the yields on government bonds increase, NPL ratio will also increase. This means that higher bond yields, most possibly driven by higher interest rates, are associated to financial distress, which leads to more defaults. Also, fair value changes in hedge portfolios for hedging against interest rate risk and 1-year Euribor are another statistically significant relationship (-0.5653). This shows that, as Euribor increases, lower changes in fair value in hedge portfolios for hedging against interest rate risk will occur. The opposite happens if Euribor decreases. This reflects the fact that hedging against interest rate risk protects banks from suffering severe consequences when interest rates increase. Figure 6 also shows this effect.

Overall, Table 2 presents us a set of economic implications to banks, namely that (1) rising interest rates might lead to increase in financial distress, resulting in more loan defaults, as suggested by the moderate correlation presented above between real euro area benchmark bond yield and NPL ratio; (2) the positive correlation between total assets and financial profit or loss (0.3034) showing the importance of the size on profitability, with larger firms (more assets) experiencing higher financial outcomes; (3) even small, the correlations between fair value changes in hedging and return on assets, return on equity and interest rates indicate that hedging strategies might play an important role in managing profitability and risk.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) TotalAssets	1.0000											
(2) ROE	0.1017*	1.0000										
	0.0000											
(3) ROA	-0.0206	0.6197*	1.0000									
	0.2165	0.0000										
(4) FinancialProfitLoss	0.3034*	0.0107	-0.0061	1.0000								
	0.0000	0.5215	0.7132									
(5) GDP	0.0210	0.0949*	0.0504*	0.0075	1.0000							
	0.2084	0.0000	0.0025	0.6526								
(6) HICP	0.0153	0.0884*	0.0228	-0.0288	0.6749*	1.0000						
	0.3585	0.0000	0.1723	0.0845	0.0000							
(7) NPL	-0.0978*	-0.1606*	-0.0677*	-0.0359*	-0.1794*	-0.4467*	1.0000					
	0.0000	0.0000	0.0001	0.0415	0.0000	0.0000						
(8) RealEABenchGovBond	-0.0195	-0.0821*	-0.0181	0.0384*	-0.6422*	-0.9261*	0.5392*	1.0000				
	0.2423	0.0000	0.2794	0.0213	0.0000	0.0000	0.0000					
(9) EURIBOR1M	-0.0116	0.0328*	0.0231	0.0308	0.0606*	0.1206*	0.2588*	0.2127*	1.0000			
	0.4890	0.0493	0.1660	0.0652	0.0003	0.0000	0.0000	0.0000				
(10) EURIBOR3M	-0.0078	0.0565*	0.0529*	0.0187	0.0832*	0.1705*	0.0595*	0.0620*	0.7534*	1.0000		
	0.6408	0.0007	0.0015	0.2630	0.0000	0.0000	0.0007	0.0002	0.0000			
(11) EURIBOR1Y	-0.0042	0.0609*	0.0312	0.0138	0.1768*	0.4352*	0.0422*	-0.1123*	0.9177*	0.7437*	1.0000	
	0.8004	0.0003	0.0613	0.4094	0.0000	0.0000	0.0165	0.0000	0.0000	0.0000		
(12) FVchangesHedging	0.0436*	-0.0904*	-0.0298	0.0154	-.3925*	-0.6841*	0.2036*	0.5572*	-0.3361*	-0.2915*	-0.5653*	1.0000
	0.0090	0.0000	0.0746	0.3565	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	

*shows significance at the 0.05 level

Table 2: Pairwise correlations

4.3 Econometric model

There are several studies around the impacts of monetary policy on bank's profitability, yet just a few focus on profitability sensitivity to other factors simultaneously with the interest rate effect.

This empirical analysis aims to test the following hypothesis:

- Hypothesis 1: profitability is affected by monetary policy, regardless of other factors such as bank specific factors and macroeconomic factors;
- Hypothesis 2: profitability is impacted by monetary policy along with fair value changes in hedging to interest rate risk.

As we know, panel data is a type of data collected with the aim to observe particular units over a specific period of time. This leads us to understand that we are in the presence of a panel data in this study. This panel data is characterized by a 10-year period, which is considered to be a short T, and a large set of banks by country, which leads us to a large N. It is a balanced panel dataset, since we have the same number of observations (N) for the same number of periods (T). Although it is balanced, there are missing values in some variables, which can lead this to be an unbalanced panel. Since we are in the presence of a panel data with several banks and each of them has its own characteristics, with some being possibly invariant over time, we will focus on a fixed effects model, in order to control for these unobserved invariant factors. Panel data also has the advantage of, by combining the variables we intend to use in our analysis over a period, allowing us to predict how those variables are likely to interact in the future, based on their behavior so far. This means that, by using information from the last 10 years of the variables described earlier, we will try to predict how they will relate between them in the future.

Now, how are we going to obtain these relationships? By performing regression analysis. Regression models allow us to determine the relationship between dependent and independent variables from our panel dataset. The results allow us to understand two effects: (1) the value of our dependent variable when we know the values of the other variables and (2) the effect of the independent variables on our dependent variable.

Considering this, our first hypothesis is presented below:

$$\pi_{bct}=\alpha_{ct}+\beta X_t+\gamma W_{bct}+\varphi Z_{ct}+\theta_b \quad (1)$$

π_{bct}: profitability (return on assets and return on equity) by bank and country at time t;

α_{ct}: y-intercept, the minimum profitability;

βX_t: X stands for the interest rates to consider in our analysis:

- Euribor 1M
- Euribor 3M
- Euribor 1Y

γW_{bct}: W stands for the bank specific control variables, such as:

- Total assets
- NPL ratio

φZ_{ct}: Z is the set of macroeconomic control variables:

- GDP
- HICP.

θ_b: bank fixed effects to capture unobserved factors that vary across banks, but are constant across time.

With this equation, we intend to analyze the effect of interest rate changes in profitability as they occur, controlling for bank specific and macroeconomic conditions.

However, we know that sometimes there is a delay in the effects, so what about the effect of changes occurred in interest rates in previous periods in the current period profitability? To understand this effect, we ran the below equation:

$$\pi_{bct}=\alpha_{ct}+\beta X_{t-n}+\gamma W_{bct}+\varphi Z_{ct}+\theta_b \qquad (2)$$

Holding all other variables explained above, the change in equation (2):

βX_{t-n}: X stands for the interest rates to consider in our analysis in *n* previous periods (*n* stands for number of years back):

- Euribor 1M
- Euribor 3M
- Euribor 1Y

For hypothesis 2, we are estimating the following:

$$\pi_{bct}=\alpha_{ct}+\beta X_t+\theta FVchangesHedging_{ct}+\gamma W_{bct}+\varphi Z_{ct}+\theta_b \quad (3)$$

π_{bct}: profitability (return on assets and return on equity) by bank and country at time t;

α_{ct}: y-intercept, the minimum profitability;

βX_t: X stands for the interest rates to consider in our analysis:

- Euribor 1M
- Euribor 3M
- Euribor 1Y

$\theta FVchangesHedging_{ct}$: country specific fair value changes in hedging against interest rate risk at time t;

γW_{bct}: W stands for the bank specific control variables, such as:

- Total assets
- NPL ratio

φZ_{ct}: Z is the set of macroeconomic control variables:

- GDP
- HICP.

θ_b: bank fixed effects to capture unobserved factors that vary across banks, but are constant across time.

This model allows us to analyze the determinants of banks' profitability across different banks and countries over time, considering the effects of interest rates, fair value changes in hedging against interest rate risk, bank specific factors and country specific macroeconomic conditions.

However, we also intend to analyze how fair value changes in hedging against interest rate risk change when interest rates change, and how that overall effect changes profitability. In other words, is the impact of interest rates on profitability different depending on the effectiveness of the banks' hedging strategy? For that, we will estimate the below equation:

$$\pi_{bct}=\alpha_{ct}+\beta X_t+\theta FVchangesHedging_{ct}+\sigma X_t*FVchangesHedging_{ct}+\gamma W_{bct}+\varphi Z_{ct}+\theta_b \quad (4)$$

Holding the above variables constant, the change here is:

σ X_t*FVchangesHedging$_{ct}$: product between interest rates (Euribor 1M, Euribor 3M and Euribor 1year) and fair value changes in hedging against interest rate risk.

In the next chapter, we will see how these variables interact and what predictions can we obtain from the regressions.

5. Empirical Results

For the purpose of the analysis here on, Total Assets and Fair value changes in hedging for interest rate risk are natural logarithms.

5.1 Role of monetary policy

In Table 3 and Table 4 we present the results for equation 1 and 2.

Table 3 represents the results of equation (1) presented in chapter 4.3. Recall that the goal here is to understand how profitability is affected by monetary policy, controlling for other effects, such as bank specific or macroeconomic effects. By analyzing the results, we can take that 1-month Euribor has a positive, statistically significant effect at the 10% level on return on assets when we look at it isolated but becomes statistically significant at 1% level when combined with bank specific and macroeconomic effects. 3-month and 1-year Euribor also have positive, statistically significant effects on return on assets, individually and combined with the other effects. On the other side, if we analyze the effects on return on equity, we can see that all Euribors have a positive statistically significant effect at 1% level, whether by themselves, whether when combined with bank specific and macroeconomic effects. Higher interest rates are associated with higher bank profitability. In the scenarios with bank specific and macroeconomic effects, we can see that bank specific variables also have statistically significant effects on profitability: positive effect from total assets and negative effect from non-performing loan ratio. This last variable is important to recall that banks with higher non-performing loan ratio tend to have lower profits.

These results imply that, for return on assets, by itself, 1-month Euribor is significant, but becomes more representative when we analyze also the impact of control variables. 3-month Euribor, even though with a similar behavior, presents itself as statistically significant at 1% level even without control variables effect, showing that there is a true relationship between independent and dependent variables regardless of other effects. 1-year Euribor by itself is statistically significant at 5% level and when combined with control variables becomes statistically significant at 1% level. For return on equity, 1-month, 3-month and 1-year Euribor are statistically significant at 1% level by themselves and combined with the control variables, showing a true relationship between interest rates and ROE regardless of other effects.

VARIABLES	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA	(6) ROA	(7) ROE	(8) ROE	(9) ROE	(10) ROE	(11) ROE	(12) ROE
EURIBOR1M	0.311*			1.004***			1.264***			4.292***		
	(0.189)			(0.282)			(0.489)			(0.677)		
EURIBOR3M		0.563***			0.781***			1.717***			2.251***	
		(0.149)			(0.171)			(0.385)			(0.412)	
EURIBOR1Y			0.234**			0.660***			1.308***			2.626***
			(0.105)			(0.171)			(0.272)			(0.411)
log_TotalAssets				0.515***	0.495***	0.531***				1.209***	1.028***	1.247***
				(0.155)	(0.154)	(0.155)				(0.372)	(0.370)	(0.373)
NPL				-0.032***	-0.019*	-0.034***				-0.169***	-0.099***	-0.173***
				(0.012)	(0.010)	(0.012)				(0.028)	(0.024)	(0.028)
GDP				0.025	0.019	0.042**				0.091**	0.053	0.153***
				(0.017)	(0.017)	(0.019)				(0.041)	(0.040)	(0.045)
HICP				-0.085**	-0.062*	-0.145***				-0.170*	0.002	-0.386***
				(0.039)	(0.035)	(0.048)				(0.095)	(0.085)	(0.116)
Constant	0.798***	0.771***	0.706***	-5.513***	-5.618***	-5.915***	4.950***	4.798***	4.545***	-8.298	-7.911	-9.749*
	(0.064)	(0.049)	(0.049)	(2.119)	(2.115)	(2.126)	(0.167)	(0.128)	(0.127)	(5.087)	(5.095)	(5.106)
Observations	3,590	3,590	3,590	3,231	3,231	3,231	3,590	3,590	3,590	3,231	3,231	3,231
R-squared	0.001	0.004	0.002	0.008	0.011	0.009	0.002	0.006	0.007	0.036	0.033	0.037
Number of Banks	359	359	359	359	359	359	359	359	359	359	359	359

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Regression results between the effect of interest rates on profitability

Table 4 and table 5, in turn, show us the results of equation (2) explained in chapter 4.3.

Again, we shall recall that equation (2) aims to analyze the effect of *n* years lagged Euribor in profitability. Table 4 considers one-year lags and Table 5 considers two-year lags. If we focus on Table 4, we can observe that lagging for 1 year, with no other effects, does not bring a statistically significant impact on return on assets. However, when analyzed together with the control variables, 1-year lagged 1-month and 1-year Euribor become positive, statistically significant to the model. When we turn our attention to return on equity, we observe that 1-year lagging of the three maturities is negative, statistically significant without the effect of the control variables and positive with their effect. Specifically for 3-month Euribor, it becomes positive, statistically significant at 1% level when combined with the control variables.

Turning our attention to Table 5, now lagging interest rates for two years, we can see that, individually, they have a negative, statistically significant effect on profitability. However, in this case, when we add the effect of bank specific and macroeconomic variables, only 3-month Euribor remains statistically significant at 1% level, but still negative.

VARIABLES	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA	(6) ROA	(7) ROE	(8) ROE	(9) ROE	(10) ROE	(11) ROE	(12) ROE
L.EURIBOR1M	-0.185			0.798*			-2.418***			3.554***		
	(0.212)			(0.413)			(0.515)			(0.994)		
L.EURIBOR3M		-0.215			0.100			-2.019***			1.371*	
		(0.169)			(0.322)			(0.411)			(0.776)	
L.EURIBOR1Y			-0.175			0.567*			-1.908***			3.163***
			(0.158)			(0.341)			(0.383)			(0.822)
log_TotalAssets				0.470***	0.429***	0.464***				1.025***	0.856**	1.040***
				(0.155)	(0.154)	(0.155)				(0.373)	(0.370)	(0.373)
NPL				-0.024*	-0.008	-0.022*				-0.138***	-0.080***	-0.146***
				(0.013)	(0.010)	(0.013)				(0.031)	(0.024)	(0.031)
GDP				0.005	0.014	0.002				0.003	0.075	-0.019
				(0.017)	(0.020)	(0.017)				(0.041)	(0.049)	(0.042)
HICP				0.012	-0.009	0.019				0.251***	0.181**	0.317***
				(0.035)	(0.034)	(0.038)				(0.085)	(0.083)	(0.092)
Constant	0.684***	0.706***	0.729***	-5.213**	-5.030**	-5.361**	4.110***	4.490***	4.703***	-7.048	-6.342	-8.093
	(0.076)	(0.056)	(0.052)	(2.120)	(2.119)	(2.128)	(0.184)	(0.136)	(0.126)	(5.106)	(5.109)	(5.122)
Observations	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231
R-squared	0.000	0.001	0.000	0.005	0.004	0.005	0.008	0.008	0.009	0.027	0.024	0.028
Number of Banks	359	359	359	359	359	359	359	359	359	359	359	359

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Regression results between the effect of interest rates lagged by one year on profitability

VARIABLES	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA	(6) ROA	(7) ROE	(8) ROE	(9) ROE	(10) ROE	(11) ROE	(12) ROE
L2.EURIBOR1M	-0.476*			0.057			-3.758***			0.831		
	(0.246)			(0.488)			(0.573)			(1.132)		
L2.EURIBOR3M		-0.605***			-0.863***			-2.556***			-2.354***	
		(0.202)			(0.269)			(0.474)			(0.624)	
L2.EURIBOR1Y			-0.331*			0.253			-2.831***			1.250
			(0.191)			(0.397)			(0.446)			(0.922)
log_TotalAssets				0.646***	0.667***	0.664***				1.325***	1.341***	1.382***
				(0.190)	(0.187)	(0.191)				(0.441)	(0.434)	(0.442)
NPL				-0.009	-0.000	-0.016				-0.107***	-0.067***	-0.125***
				(0.015)	(0.011)	(0.016)				(0.036)	(0.025)	(0.037)
GDP				0.011	0.049**	0.009				0.031	0.140***	0.023
				(0.018)	(0.021)	(0.018)				(0.042)	(0.049)	(0.042)
HICP				-0.015	-0.067*	-0.008				0.153*	-0.005	0.172**
				(0.037)	(0.039)	(0.038)				(0.087)	(0.090)	(0.087)
Constant	0.626***	0.689***	0.745***	-7.986***	-8.458***	-8.192***	3.899***	4.558***	4.849***	-12.396**	-13.424**	-13.205**
	(0.080)	(0.059)	(0.058)	(2.596)	(2.588)	(2.613)	(0.186)	(0.139)	(0.135)	(6.024)	(6.002)	(6.064)
Observations	2,872	2,872	2,872	2,872	2,872	2,872	2,872	2,872	2,872	2,872	2,872	2,872
R-squared	0.001	0.004	0.001	0.006	0.010	0.007	0.017	0.011	0.016	0.032	0.037	0.032
Number of Banks	359	359	359	359	359	359	359	359	359	359	359	359

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Regression results between the effect of interest rates lagged by two years on profitability

Overall, if we lag interest rates for one year, we can observe that this has a more significant impact on return on equity (individually and combined with control variables). The change from negative to positive impact when control variables are added to the model may be explained by total assets, as they are indicators of banks' size, showing that larger banks may have the ability to manage or absorb the increase in costs associated with the increase in interest rates. By including the non-performing loan ratio in the model, we are adjusting also to the quality of the

portfolio. We know that, when interest rates rise, the cost of borrowing will also increase and thus, more defaults will occur. This has a negative impact on profitability. However, if banks' remaining portfolio is of high quality, banks might also profit from the increase in interest rates, which explains the shift from negative to positive impact in lagged interest rates after adding the control variables. When lagging for two years, the effect of interest rates on profitability is predominantly negative. The difference in the results between lagging for one year and for two years can be explained by many factors associated with banks' regular activity, but one factor that may impact the main asset of banks is borrowers' behavior. In higher interest rates environment, borrowers may become cautious by delaying investments or reducing borrowing and the full impact of this behavior is not immediately reflected in banks' profitability, but after two years the economy has already adjusted and these effects materialize.

When we observe the R-squared values for both models we see that in both they assume very low values, meaning that this model only explains a small part of the effects that profitability suffers when we lag interest rates for one and two years (Table 4 and Table 5). However, R-squared assumes slightly higher values in Table 5, when we lag interest rates for two years. Even though the difference is small, we can infer that interest rates from two years ago have a somewhat stronger explanatory power on the profitability of the current year than interest rates from the year before.

5.2 Role of monetary policy along with fair value changes in hedging to interest rate risk

We will now analyze the results of equations (3) and (4). Now the goal is to understand how profitability varies with monetary policy along with fair value changes in hedging to interest rate risk.

Table 6 presents the results of equation (3) presented in chapter 4.3. As we can see, all the maturities of interest rates are positive, statistically significant at different levels, with stronger impact on return on equity. When combining other factors, they all become positive, statistically significant at 1% level. However, when we analyze the effect of fair value changes in hedging against interest rate risk, we notice that it is not significant to the model for return on assets. For return on equity, it becomes negative statistically significant at 5% level when analyzed

together with 3-month Euribor. Despite the fact that hedging has the goal of reduzing risk, the negative coefficient that it has may mean that it lowers the potential returns, as effective hedging may reduce the potential for unexpected gains from favorable interest rate movements.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	ROA	ROA	ROA	ROA	ROA	ROA	ROE	ROE	ROE	ROE	ROE	ROE
EURIBOR1M	0.311*			1.072***			1.264***			3.877***		
	(0.189)			(0.326)			(0.489)			(0.782)		
EURIBOR3M		0.563***			0.779***			1.717***			1.913***	
		(0.149)			(0.180)			(0.385)			(0.433)	
EURIBOR1Y			0.234**			0.742***			1.308***			2.418***
			(0.105)			(0.202)			(0.272)			(0.486)
log_FVChangeHedge				0.006	-0.000	0.011				-0.037	-0.080**	-0.029
				(0.015)	(0.013)	(0.015)				(0.035)	(0.032)	(0.036)
log_TotalAssets				0.513***	0.495***	0.530***				1.218***	1.099***	1.250***
				(0.155)	(0.154)	(0.155)				(0.372)	(0.371)	(0.373)
NPL				-0.032***	-0.019*	-0.035***				-0.168***	-0.113***	-0.171***
				(0.012)	(0.010)	(0.012)				(0.028)	(0.024)	(0.028)
GDP				0.024	0.019	0.042**				0.096**	0.073*	0.151***
				(0.017)	(0.017)	(0.019)				(0.042)	(0.041)	(0.045)
HICP				-0.080*	-0.062	-0.142***				-0.205**	-0.119	-0.395***
				(0.042)	(0.040)	(0.048)				(0.100)	(0.097)	(0.116)
Constant	0.798***	0.771***	0.706***	-5.545***	-5.617***	-6.022***	4.950***	4.798***	4.545***	-8.107	-7.681	-9.477*
	(0.064)	(0.049)	(0.049)	(2.120)	(2.116)	(2.131)	(0.167)	(0.128)	(0.127)	(5.090)	(5.091)	(5.117)
Observations	3,59	3,59	3,59	3,231	3,231	3,231	3,59	3,59	3,59	3,231	3,231	3,231
R-squared	0.001	0.004	0.002	0.009	0.011	0.009	0.002	0.006	0.007	0.037	0.035	0.037
Number of Banks	359	359	359	359	359	359	359	359	359	359	359	359

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Regression results between the effect of interest rates and hedging against changes is interest rate risk on profitability

The difference between Tables 6 and 7 is that in Table 7 we compute the product of interest rates and fair value changes in hedging against interest rate risk, aiming to understand how fair value changes in hedging against interest rate risk react to changes in interest rates and how it affects profitability.

From the results below we can understand that the relation between 3-month Euribor and hedging is the only one with a statistically significant effect, which turns out to be negative. This negative impact may be a reflection of what has been explained above, namely the fact that hedging stabilizes earnings. Also, the variable of fair value changes in hedging against interest rate risk presents to be negatively statistically significant in model (11), when related to 3-month Euribor. This negative effect may be a reflection of the costs of hedging outweighting its benefits and consequently, eroding shareholders' gains. Once again, when we analyze the R-squared, we can understand that the model only explains a small part of the profitability.

VARIABLES	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA	(6) ROA	(7) ROE	(8) ROE	(9) ROE	(10) ROE	(11) ROE	(12) ROE
EURIBOR1M	0.311*			1.201**			1.264***			3.452***		
	(0.189)			(0.534)			(0.489)			(1.281)		
EURIBOR3M		0.563***			2.131***			1.717***			3.545***	
		(0.149)			(0.417)			(0.385)			(1.004)	
EURIBOR1Y			0.234**			0.896***			1.308***			2.177***
			(0.105)			(0.322)			(0.272)			(0.774)
EUR1M_FVChangeHedge				-0.014						0.047		
				(0.046)						(0.111)		
EUR3M_FVChangeHedge					-0.119***						-0.144*	
					(0.033)						(0.080)	
EUR1Y_FVChangeHedge						-0.022						0.035
						(0.036)						(0.086)
log_FVChangeHedge				0.003	-0.004	0.012				-0.028	-0.084***	-0.030
				(0.017)	(0.013)	(0.015)				(0.041)	(0.032)	(0.036)
log_TotalAssets				0.516***	0.530***	0.535***				1.209***	1.141***	1.242***
				(0.155)	(0.154)	(0.156)				(0.373)	(0.371)	(0.374)
NPL				-0.031**	-0.022**	-0.033***				-0.171***	-0.117***	-0.175***
				(0.012)	(0.010)	(0.012)				(0.029)	(0.024)	(0.030)
GDP				0.025	0.039**	0.046**				0.093**	0.097**	0.145***
				(0.018)	(0.018)	(0.020)				(0.042)	(0.043)	(0.047)
HICP				-0.083*	-0.137***	-0.159***				-0.194*	-0.209*	-0.368***
				(0.043)	(0.045)	(0.056)				(0.104)	(0.109)	(0.134)
Constant	0.798***	0.771***	0.706***	-5.575***	-5.996***	-6.146***	4.950***	4.798***	4.545***	-8.006	-8.137	-9.283*
	(0.064)	(0.049)	(0.049)	(2.123)	(2.114)	(2.141)	(0.167)	(0.128)	(0.127)	(5.096)	(5.095)	(5.141)
Observations	3,59	3,59	3,59	3,231	3,231	3,231	3,59	3,59	3,59	3,231	3,231	3,231
R-squared	0.001	0.004	0.002	0.009	0.016	0.010	0.002	0.006	0.007	0.037	0.036	0.037
Number of Banks	359	359	359	359	359	359	359	359	359	359	359	359

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Regression results between the effect of interest rates and hedging against changes in interest rate risk (isolated and combined) on profitability

6. Conclusion

The purpose of this paper was to understand the relationship between interest rates and European banks' profitability. According to the main results, we can take that interest rates assume statistically significant positions in the regression models estimated, meaning that there is a strong relationship between interest rates and profitability measures of European banks.

When looking at the impact of monetary policy by itself on profitability, we can take that interest rates do have a positive, strong influence on profitability by themselves. When combined with other variables, such as total assets or non-performing loan ratio and macroeconomic variables this influence becomes stronger. We could also see that interest rates from previous periods still influence profitability, but negatively, in the current period of European banks when lagged for one year. In this situation, the effect is negative with no control variables. When we add the control variables, the effect becomes positive. When lagging for two years, we notice that the effect becomes positive only for 1-month and 1-year Euribor. This probably happens due to the different maturities of assets and liabilities of banks, as previous years' operations may still impact current years' balance sheets. It can also happen due to the hedging strategies that banks adopt to manage interest rate risk and changes in their business models. It was also possible to observe that the impact on return on equity reveals to be higher than on return on assets.

On the other side, when we take a look at the impact of monetary policy along with fair value changes in hedging to interest rate risk, we take that interest rates do have a strong relationship with profitability, but the effect of fair value changes of hedging against interest rate risk does not significantly influence this model, except when we combine the effect of fair value changes in hedging against interest rate risk with 3-month Euribor, where it has a negative statistically significant effect. This was associated to the fact that, at some point, hedging strategies stabilize earnings, not allowing to maximize profits when certain opportunities show.

Overall, from the regression models estimated we can conclude that interest rates are a strong influence in profitability measures, assuming positive and negative influence in different situations. Yet, as in all models, there are limitations in this analysis, being one of them the fact that not all banks have information available for all periods. For future studies, it would be interesting to study this same effects, but already with data representing this current period of positive and higher levels of interest rates, combining with other indicators that would allow to

capture other aspects regarding banks' structure and business plans. It matters to remember that regulatory measures and monetary policies imposed by regulators and central banks can happen at any time and thus, impact profitability regardless of the banks' strategy previously designed without consideration to such changes.

Finally, it is also important to state that the conclusions taken from this analysis are based on the results given by the models estimated and it is important to keep in mind that changes in market and country variables might influence the conclusions observed in these econometric models.

Appendices

	Variable	Definition/measure
Bank Variables	Total Assets	Total assets (million Euros).
	ROE	Return on equity (%); profitability relative to shareholders' equity.
	ROA	Return on assets (%); profitability relative to return on assets.
	Financial Profit Loss	Financial profit or loss (million Euros); the difference between revenue generated from banks' assets and the expenses associated with paying its financing liabilities.
	NPL Ratio	Gross non performing loans ratio (% of total loans).
	FvchangesHedging	Fair value changes of hedged items in portfolio hedge of interest rate risk (thousand Euros).
Macroeconomic Varibles	GDP	GDP growth rate (%): indicator of economic health of each coutry; represents each country business cycle phase.
	HICP	Harmonised Index of Consumer Prices (%); measures the change over time in prices of consumer goods and services acquired, used or paid for by euro area households.
Financial Variables	RealEABenchGovBond	Real Euro area 10 year Government Benchmark bond yield (%); composed of an average of observations through the period.
	EURIBOR1M	Euribor 1 month (%); composed of an average of observations through the period.
	EURIBOR3M	Euribor 3 months (%); composed of an average of observations through the period.
	EURIBOR1Y	Euribor 1 year (%); composed of an average of observations through the period.

Table 8: Variables definition

		TotalAssets	ROE	ROA	FinancialProfitLoss	GDP	HICP	NPL	RealEABenchGovBond	EURIBOR1M	EURIBOR3M	EURIBOR1Y	FVchangesHedging
Belgium	N	40	40	40	40	40	40	36	40	40	40	40	40
	Mean	1 514 202	17.366	3.043	24 377.66	5.297	699.489	3.740	2	0.977	-0.226	-0.078	6 142 194
	SD	2 022 853	16.478	4.349	44 908.98	1.939	2 146.538	3.691	2.816	0.532	0.259	0.328	6 165 401
	p25	2 398.242	7.394	0.082	-71.0395	3.704	2.248	2.577	.3	0.542	-0.403	-0.329	6 050 199
	p50	831 983.9	11.189	0.672	21.416	4.241	8.415	3.385	1.2	0.982	-0.354	-0.143	7 468 739
	p75	2 147 765	26.535	7.223	22 194.5	6.644	814.732	4.049	1.5	1.221	0.094	0.221	8 964 328
	Min	1 701.137	-10.49	-3.7	-305.958	3.208	-5 372.443	-3.745	-.3	0.176	-0.561	-0.549	-11 000 000
	Max	8 289 405	53.771	15.155	197 576.4	8.581	5 421.814	10.24	9.2	2.161	0.130	0.357	12 300 000
Cyprus	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	10 500 000	14.112	0.8702	-17 553.89	34.754	0	3.810	2	0.977	-0.226	-0.078	0
	SD	4 594 395	20.105	1.126	108 429.4	23.949	0	6.836	2.931	0.554	0.269	0.341	0
	p25	7 397 373	1.271	0.11	-100 788	14.330	0	-3.09	0.3	0.542	-0.403	-0.329	0
	p50	8 257 851	13.799	0.885	-37 445.5	32.817	0	6.335	1.2	0.982	-0.354	-0.143	0
	p75	16 100 000	24.756	1.834	21 161	56.923	0	6.933	1.5	1.221	0.094	0.221	0
	Min	6 568 417	-22.926	-1.202	-142 484	5.216	0	-7.464	-0.3	0.176	-0.561	-0.549	0
	Max	18 700 000	46.119	2.591	231 583	67.367	0	12.863	9.2	2.161	0.130	0.357	0
Czech Republic	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	1 429.391	46.176	24.906	-0.468	20.552	-159.994	5.247	2	0.977	-0.226	-0.078	-283 131.2
	SD	251.544	7.875	6.536	1.048	17.808	349.178	3.436	2.931	0.554	0.269	0.341	595 935.5
	p25	1 271.292	44.067	25.271	-1.253	6.147	-203.602	3.708	0.3	0.542	-0.403	-0.329	-241 839
	p50	1 294.796	48.26	25.758	-0.406	21.01	-45.256	6.152	1.2	0.982	-0.354	-0.143	-80 947
	p75	1 748.223	50.75	28.553	-0.290	33.876	37.567	6.999	1.5	1.221	0.094	0.221	48 232
	Min	1 187.805	27.45	8.403	-1.961	0	-933.706	-1.422	-0.3	0.176	-0.561	-0.549	-1 632 325
	Max	1 830.284	55.04	31.502	1.949	47.828	234.348	11.085	9.2	2.161	0.131	0.357	301 918
Germany	N	30	30	30	30	30	30	27	30	30	30	30	30
	Mean	196 000 000	4.203	0.181	1 118 520	4.264	0	3.538	2	0.977	-0.226	-0.078	0
	SD	37 000 000	6.010	0.209	2 207 739	2.407	0	2.367	2.823	0.535	0.259	0.329	0
	p25	165 000 000	3.262	0.159	0	2.361	0	3.008	0.3	0.542	-0.403	-0.329	0
	p50	191 000 000	4.582	0.207	0	2.707	0	3.48	1.2	0.982	-0.354	-0.143	0
	p75	223 000 000	6.259	0.316	1 770 318	6.559	0	4.224	1.5	1.221	0.094	0.221	0
	Min	128 000 000	-16.338	-0.569	-1 071 467	2.181	0	-2.026	-0.3	0.176	-0.561	-0.549	0
	Max	266 000 000	16.4	0.429	6 879 856	8.955	0	7.17	9.2	2.161	0.131	0.357	0
Estonia	N	30	30	30	30	30	30	27	30	30	30	30	30
	Mean	2 571 110	12.733	2.126	-6 160.9	2.690	0	7.337	2	0.977	-0.226	-0.078	0
	SD	4 752 619	11.028	1.817	9 829.504	1.573	0	4.848	2.829	0.535	0.259	0.329	0
	p25	392 219	3.662	0.574	-11 415	1.333	0	5.412	0.3	0.542	-0.403	-0.329	0
	p50	569 310	12.457	1.895	-1 177.5	1.927	0	6.9	1.2	0.982	-0.354	-0.143	0
	p75	1 137 000	16.545	3.258	0	4.089	0	9.59	1.5	1.221	0.094	0.221	0
	Min	9 346.069	-0.007	-0.001	-30 457	1.146	0	-1.864	-0.3	0.176	-0.561	-0.549	0
	Max	15 000 000	55.505	7.414	14 078	5.516	0	15.535	9.2	2.161	0.131	0.357	0

Table 9: Summary Statistics of the variables by country

		TotalAssets	ROE	ROA	FinancialProfitLoss	GDP	HICP	NPL	RealEABenchGovBond	EURIBOR1M	EURIBOR3M	EURIBOR1Y	FVchangesHedging
Spain	N	910	910	910	910	910	910	819	910	910	910	910	910
	Mean	38 900 000	5.154	0.512	1.002	7.977	3.099	2.849	2	0.977	-0.226	-0.078	466 953.1
	SD	182 000 000	8.521	1.106	13.902	4.094	32.993	5.357	2.783	0.526	0.256	0.324	2 772 395
	p25	186 969	1.619	0.156	0	4.706	0	1.169	0.3	0.542	-0.403	-0.329	0
	p50	1 360 608	4.265	0.344	0	5.894	0.118	3.509	1.2	0.982	-0.354	-0.143	1 358 996
	p75	7 093 777	6.464	0.547	0	10.906	2.815	4.405	1.5	1.221	0.094	0.221	2 137 922
	Min	12 986	-76.468	-5.735	0	4.053	-506.169	-10.157	-0.3	0.176	-0.561	-0.549	-7 255 940
	Max	1 800 000 000	62.361	16.808	331.836	16.182	224.196	10.152	9.2	2.161	0.131	0.357	3 187 392
France	N	100	100	100	100	100	100	90	100	100	100	100	100
	Mean	187 000 000	5.712	3.060	1 286 970	4.715	0.004	2.414	2	0.977	-0.226	-0.078	2 309 777
	SD	416 000 000	9.448	7.212	5 879 492	1.098	0.019	3.133	2.795	0.528	0.257	0.325	9 992 075
	p25	10 642.07	1.202	0.151	0	3.873	0	1.54	0.3	0.542	-0.403	-0.329	0
	p50	287 327	4.319	0.317	514.399	4.365	0	2.543	1.2	0.982	-0.354	-0.143	0
	p75	738 998.2	8.124	5.901	12 521.73	5.870	0	3.145	1.5	1.221	0.094	0.221	0
	Min	3 086.587	-33.572	-28.997	-3 281 193	3.405	-0.079	-4.915	-0.3	0.176	-0.561	-0.549	-40 200 000
	Max	1 490 000 000	44.652	32.132	42 300 000	6.404	0.095	7.951	9.2	2.161	0.131	0.357	45 900 000
Greece	N	80	80	80	80	80	80	72	80	80	80	80	80
	Mean	30 300 000	1.761	0.6369	3.726	38.043	-1.181	1.129	2	0.977	-0.226	-0.078	-16 282.4
	SD	40 200 000	15.498	6.889	18.286	15.556	10.419	6.452	2.799	0.528	0.257	0.326	49 155.39
	p25	240 663.2	-2.238	-0.223	0	31.047	0	-1.472	0.3	0.542	-0.403	-0.329	0
	p50	1 141 548	3.485	0.212	0	44.747	0	0.446	1.2	0.982	-0.354	-0.143	0
	p75	67 100 000	10.429	0.894	0	51.361	0	2.112	1.5	1.221	0.094	0.221	0
	Min	396.28	-44.794	-36.735	-2.548	9.291	-93.203	-10	-0.3	0.176	-0.561	-0.549	-162 824
	Max	115 000 000	45.833	36.809	131.001	53.884	0	13.84	9.2	2.161	0.131	0.357	0
Hungary	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	108 487.6	3.308	3.401	5 343.621	13.238	0	8.699	2	0.977	-0.226	-0.078	0
	SD	28 636.08	9.674	9.4704	15 655.17	11.149	0	5.291	2.931	0.554	0.269	0.341	0
	p25	93 861.24	-0.075	-0.075	-297.378	4.167	0	4.674	0.3	0.542	-0.403	-0.329	0
	p50	107 877.2	0.48	0.3995	355.957	6.966	0	8.278	1.2	0.982	-0.354	-0.143	0
	p75	134 197.2	1.911	1.908	717.468	21.691	0	10.47	1.5	1.221	0.094	0.221	0
	Min	58 516.04	-2.953	-1.562	-1 169.087	3.563	0	1.576	-0.3	0.176	-0.561	-0.549	0
	Max	149 778.3	30.516	30.149	49 705.07	30.743	0	19.704	9.2	2.161	0.131	0.357	0
Ireland	N	30	30	30	30	30	30	27	30	30	30	30	30
	Mean	42 500 000	5.922	0.639	769 747.4	15.418	0.051	11.532	2	0.977	-0.226	-0.078	128 633.8
	SD	59 600 000	8.547	0.763	1 763 276	11.982	0.098	9.156	2.829	0.535	0.259	0.329	151 794.7
	p25	1 492 663	2.255	0.279	276	7.571	0.0002	5.302	0.3	0.542	-0.403	-0.329	14 651
	p50	6 931 931	4.627	0.735	5 517.203	8.074	0.0051	9.356	1.2	0.982	-0.354	-0.143	58 084.5
	p75	91 100 000	11.36	1.237	34 299.2	21.362	0.048	15.675	1.5	1.221	0.094	0.221	305 821
	Min	436 874.6	-20.591	-1.417	-7 963.231	3.987	0	2.322	-0.3	0.176	-0.561	-0.549	0
	Max	179 000 000	20.671	1.641	5 355 094	40.291	0.409	34.807	9.2	2.161	0.131	0.357	401 796

Table 9: Summary Statistics of the variables by country (cont.)

		TotalAssets	ROE	ROA	FinancialProfitLoss	GDP	HICP	NPL	RealEABenchGovBond	EURIBOR1M	EURIBOR3M	EURIBOR1Y	FVchangesHedging
Italy	N	1910	1910	1910	1910	1910	1910	1719	1910	1910	1910	1910	1910
	Mean	1 956 818	3.389	0.373	-0.886	15.385	17.876	1.916	2	0.977	-0.226	-0.078	1 978 842
	SD	7 106 025	6.359	1.785	15.178	8.104	550.272	4.275	2.782	0.526	0.256	0.324	8 564 118
	p25	235 158	1.852	0.172	0	7.778	2.037	0.909	0.3	0.542	-0.403	-0.329	3 092 520
	p50	602 852	3.405	0.329	0	14.278	6.209	1.861	1.2	0.982	-0.354	-0.143	3 848 646
	p75	1 452 807	5.425	0.558	0	24.035	17.116	2.442	1.5	1.221	0.094	0.221	5 667 578
	Min	1 144.03	-78.949	-28.474	-468.272	4.409	-20 162.37	-7.537	-0.3	0.176	-0.561	-0.549	-23 100 000
	Max	152 000 000	85.749	57.914	95.645	25.816	4587.33	9.698	9.2	2.161	0.131	0.357	9 002 089
Lithuania	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	289 517	0.026	0.048	78.362	8.991	0	7.389	2	0.977	-0.226	-0.078	0
	SD	151 529.9	1.013	0.319	57.852	5.045	0	5.409	2.931	0.554	0.269	0.341	0
	p25	160 861.7	0.008	0.006	40.413	6.115	0	4.134	0.3	0.542	-0.403	-0.329	0
	p50	239 223.3	0.035	0.017	54.709	7.928	0	6.223	1.2	0.982	-0.354	-0.143	0
	p75	445 775.1	0.762	0.267	87.9	9.722	0	8.707	1.5	1.221	0.094	0.221	0
	Min	103 945.2	-2.44	-0.656	21.432	3.224	0	1.867	-0.3	0.176	-0.561	-0.549	0
	Max	492 553.9	1.118	0.562	211.204	18.039	0	19.337	9.2	2.161	0.131	0.357	0
Luxembourg	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	3 894 930	8.583	0.019	12 000.8	3.715	0.025	5.269	2	0.977	-0.226	-0.078	110 344.3
	SD	1 475 008	7.133	0.008	3 613.981	0.752	0.117	2.709	2.931	0.554	0.269	0.341	259 220.7
	p25	2 661 165	0 .07	0.012	8 664	3.063	0.013	3.489	0.3	0.542	-0.403	-0.329	69 327
	p50	3 613 367	10.774	0.022	13 218	3.428	0.029	4.192	1.2	0.982	-0.354	-0.143	126 334.5
	p75	5 501 022	13.431	0.025	14 985	4.193	0.088	5.522	1.5	1.221	0.094	0.221	219 606
	Min	1 957 994	0.067	0.003	5 784.97	2.970	-0.268	3.351	-0.3	0.176	-0.561	-0.549	-524 068
	Max	5 977 142	18.171	0.029	15 347	5.211	0.189	12.146	9.2	2.161	0.131	0.357	503 357
Malta	N	40	40	40	40	40	40	36	40	40	40	40	40
	Mean	1 771 183	4.563	1.239	14 791.19	9.413	0	9.029	2	0.977	-0.226	-0.078	0
	SD	8 153 639	8.562	2.108	81 057.17	3.408	0	5.948	2.816	0.532	0.259	0.328	0
	p25	171 463.9	0	0	0	7.677	0	7.874	0.3	0.542	-0.403	-0.329	0
	p50	443 144.9	4.721	0.634	0	8.472	0	9.837	1.2	0.982	-0.354	-0.143	0
	p75	794 149.5	7.739	1.776	1 989.082	9.169	0	13.238	1.5	1.221	0.094	0.221	0
	Min	171.528	-19.341	-3.021	-16 646	5.126	0	-6.523	-0.3	0.176	-0.561	-0.549	0
	Max	52 000 000	44.689	7.477	512 458.7	16.527	0	14.519	9.2	2.161	0.131	0.357	0
Netherlands	N	30	30	30	30	30	30	27	30	30	30	30	30
	Mean	297 000 000	6.746	0.479	7 419.852	4.662	1.799	3.971	2	0.977	-0.226	-0.078	14 100 000
	SD	405 000 000	2.891	0.194	22 968.36	0.894	4.436	3.530	2.829	0.535	0.259	0.329	25 100 000
	p25	9 066 961	3.927	0.342	0	4.383	0	1.68	0.3	0.542	-0.403	-0.329	0
	p50	22 700 000	6.766	0.429	0	4.841	0.038	3.478	1.2	0.982	-0.354	-0.143	24 600 000
	p75	827 000 000	9.416	0.543	0	5.294	1.4	5.048	1.5	1.221	0.094	0.221	32 300 000
	Min	1 892 868	3.024	0.238	0	3.211	-4.212	-2.032	-0.3	0.176	-0.561	-0.549	-45 600 000
	Max	948 000 000	11.31	1.055	88 926.26	6.171	16.841	10.104	9.2	2.161	0.131	0.357	40 100 000

Table 9: Summary Statistics of the variables by country (cont.)

		TotalAssets	ROE	ROA	FinancialProfitLoss	GDP	HICP	NPL	RealEABenchGovBond	EURIBOR1M	EURIBOR3M	EURIBOR1Y	FVchangesHedging
Portugal	N	260	260	260	260	260	260	234	260	260	260	260	260
	Mean	19 100 000	3.464	0.454	0	20.695	0.152	3.814	2	0.977	-0.226	-0.078	52 730.7
	SD	38 700 000	14.882	2.08	0	9.446	0.749	4.540	2.786	0.527	0.256	0.324	177 415.1
	p25	358 365.5	0.358	0.044	0	11.409	0.002	1.502	0.3	0.542	-0.403	-0.329	79 937
	p50	806 274.5	4.712	0.43	0	22.223	0.096	4.164	1.2	0.982	-0.354	-0.143	110 500
	p75	7 174 358	9.87	1.098	0	29.543	0.312	5.071	1.5	1.221	0.094	0.221	123 658
	Min	61 275	-58.788	-11.442	0	7.384	-7.53	-6.463	-0.3	0.176	-0.561	-0.549	-472 978
	Max	219 000 000	58.566	14.74	0	31.641	2.407	12.167	9.2	2.161	0.131	0.357	162 936
Sweden	N	70	70	70	70	70	70	63	70	70	70	70	70
	Mean	28 600 000	20.206	5.422	375 591.1	1.228	47.569	4.8301	2	0.977	-0.226	-0.078	-242 636.3
	SD	66 700 000	25.202	14.441	1 140 774	0.530	274.966	2.701	2.801	0.529	0.257	0.326	1 400 362
	p25	24 656.16	6.98	0.371	-25.946	0.859	0	3.628	0.3	0.542	-0.403	-0.329	0
	p50	245 744.4	17.225	0.733	0	1.078	0.036	4.517	1.2	0.982	-0.354	-0.143	199 619
	p75	7 164 476	36.856	3.698	261.168	1.772	1.765	6.706	1.5	1.221	0.094	0.221	435 552
	Min	373.177	-75.949	-24.261	-186 942.4	0.389	-789.819	-0.219	-0.3	0.176	-0.561	-0.549	-4 333 767
	Max	297 000 000	95.839	94.319	6 469 867	1.880	1 564.881	8.983	9.2	2.161	0.131	0.357	645 244
Slovakia	N	10	10	10	10	10	10	9	10	10	10	10	10
	Mean	1 212.917	6.504	1.068	-0.849	10.249	-9.204	4.102	2	0.977	-0.226	-0.078	-12 897.8
	SD	286.759	9.225	1.462	0.634	4.987	104.378	3.139	2.931	0.554	0.269	0.341	151 474.1
	p25	944.135	2.95	0.426	-1.38	8.783	0.0455	1.422	0.3	0.542	-0.403	-0.329	43
	p50	1 320.273	4.072	0.71	-0.729	9.452	2.254	4.565	1.2	0.982	-0.354	-0.143	3 315.5
	p75	1 463.749	11.734	2.16	-0.319	13.246	8.405	6.147	1.5	1.221	0.094	0.221	7 740
	Min	716.436	-4.353	-0.683	-1.822	0	-278.822	-1.044	-0.3	0.176	-0.561	-0.549	-400 399
	Max	1 509.647	27.092	4.197	-0.125	17.541	142.977	9.366	9.2	2.161	0.131	0.357	215 844

Table 9: Summary Statistics of the variables by country (cont.)

Bibliography

Abdymomunov, A., Gerlach, J. Sakurai, Y. (2023). Interest Rate Risk in the U.S. Banking Sector. Federal Reserve Bank of Richmond.

Altavilla, C., Boucinha, M. and Peydró, J. (2018). Monetary policy and bank profitability in a low interest rate environment. European Central Bank.

Altavilla, C., Andreeva, D., Boucinha, M. and Holton, S. (2019). Monetary policy, credit institutions and the bank lending channel in the euro area. ECB Occasional Paper Series No 222 / May 2019

Anginer, D., Bertay. A., Cull, R., Demirguç-Kunt, A. and Mare, D. (2019). Bank Regulation and Supervision Ten Years after the Global Financial Crisis. World Bank Group, Development Economics, Development Research Group.

Beck, T. (2008). Bank Competition and Financial Stability: Friends or Foes?. The World Bank, Development Research Group, Finance and Private Sector Team.

Beltratti, A. and Stulz, R. (2012). The credit crisis around the globe: Why did some banks perform better? Journal of Financial Economics. 10.1016/j.fineco.2011.12.005.

Borio, C., Gambacorta, L. and Hofman, B. (2017). The influence of monetary policy on bank profitability. John Wiley and Sons, Ltd. 10.1111/infi.12104.

Campmas, A. (2018). How do European banks portray the effect of policy interest rates and prudential behavior on profitability? Elsevier B.V. 10/1016/j.ribaf.2018.09.001

Chaudron, R. (2018). Bank's interest rate risk and profitability in a prolonged environment of low interest rates. Journal of Banking and Finance 89 (2018) 94-104.

Chortareas, G., Girardone, C. and Ventouri, A. (2011). Financial Frictions, Bank Efficiency and Risk: Evidence from the Eurozone. Journal of Business Finance and Accounting. 10.1111/j.1468-5957.2010.02226.x

Chortareas, G., Girardone, C. and Ventouri, A. (2012). Financial Freedom and Bank Efficiency: Evidence from the European Union. Economics and Finance Working Paper Series, Working Paper No. 12-12. Department of Economics and Finance, Brunel University London.

Cordeiro, A. (2019). Profitability and risk of European banks – a comparison between fixed and floating rates. Universidade Católica Portuguesa.

Dahlhaus, T. (2016). Conventional Monetary Policy Transmission During Financial Crises: an Empirical Analysis. Journal of Applied Econometrics, Wiley Online Library.

English, W. (2002). Interest rate risk and bank net interest margins. BIS Quarterly Review, December 2002, Bank for International Settlements.

Filardo, A. and Nakajima, J. (2018). Effectiveness of unconventional monetary policies in a low interest rate environment. BIS Working Paper No 691, Bank for International Settlements.

Fiordelisi, F. Marqués-Ibañez, D. and Molyneux, P. (2010). Efficiency and risk in european banking. ECB Working Paper, Nº 1211. European Central Bank.

Hancock, D. (1985). Bank Profitability, Interest Rates and Monetary Policy. Journal of Money, Credit and Banking

Hao, F., Lu, Y. and Su, C. (2012). Impact of Subprime Crisis on Commercial Banks' Financial Performance. Panoeconomicus. 10.2298/PAN1305593F.

López-Penabad, M., Inglesias-Casal, A. and Neto, J. (2021). Effects of a negative interest rate policy in bank profitability and risk taking: Evidence from European banks. Research in International Business and Finance. 0275-5319/© 2021.

Maudos, J. and Guevara, J. (2003). Factors explaining the Interest Margin in the Banking Sectors of the European Union. *Instituto Valenciano de Investigaciones Económicas, Universitat de Valencia*.

Salachas, E., Laopodis, N. and Kouretas, G. (2018). Assessing monetary policies in the Eurozone, U.S., U.K. and Japan: new evidence from the post-crisis period. Routledge Taylor and Francis Group. 10.1080/00036846.2018.1486026.

Teixeira, J., Silva, F., Costa, F., Martins, D. and Batista, M. (2019). Banks' profitability, institutions and regulation in the context of the financial crisis. John Wiley & Sons, Ltd.

Tuskan, B. and Stojanovic, A. (2016). Measurement of cost efficiency in the European banking industry. Faculty of Economics and Business, University of Zagreb. 10.17535/crorr.2016.0004.

Zimmermann, K. (2019). Monetary Policy and Bank Profitability, 1870 – 2015. Leibniz Institute for Financial Research SAFE