THE IMPACT OF BANK'S RISK-TAKING ON PROFITABILITY

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ABSTRACT

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Abstract

This paper studies the relationship between bank risk-taking and profitability focusing on the impact of credit risk on profitability. The sample consist of European banks' balance sheet information and some macroeconomic and banking industry specific indicators. The panel data set covers years 2005-2021.

The banking environment has changed radically in the past years. Before the year 2022 monetary policy interest rates had been extremely low. Due low interest rates the profitability of banking sector was under pressure during the period of expansive monetary policy. Because of the shrunken interest income margins banking sector had to search yield from other sources. This effect could have increased bank's credit risk-taking. This study combines previous literature and empirical analysis to observe the impact of increased risk-taking on bank profitability. The empirical analysis studies the impact using three different profitability variables that are return on assets, return on risk-weighted assets and net interest margins. In the empirical analysis credit risk is described as loan loss reserves to total loans. The sample of banks used in the analysis is divided into groups that represent banks with either the smallest or the highest ratio of loan loss reserves.

The results of the study suggest that the impact of risk-taking on profitability is complex. The evidence shows that increased risk-taking has positive impact on net interest margin. Based on the results of other profitability variables used in the analysis the results suggest that increase in credit risk-taking would decrease bank profitability. However, the results suggest that when the credit risk variable is lagged, the impact of risk-taking turns to the opposite direction. The evidence indicates that in the long-run risk-taking increases profitability. This study brings a new extension compared to previous studies investigating bank profitability. The extension is that the analysis includes lagged periods of credit risk-taking in the empirical model.

Key words
Credit risk, risk-taking, profitability, monetary policy

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Tiivistelmä

Pro gradu -tutkielma käsittelee pankkien luottoriskin ja kannattavuuden välistä yhteyttä. Tutkielmassa mitataan miten pankkien riskinotto vaikuttaa pankkien kannattavuuteen kolmen eri kannattavuusmuuttujan kautta mitattuna. Tutkielma sisältää empiirisen osion, jossa mitataan eurooppalaisten pankkien riskinoton vaikutuksia kannattavuuteen. Pankeista kerätty otos käsittää paneelihavainnot vuodesta 2005 vuoteen 2021.

Pankkien toimintaympäristö on muuttunut viime aikoina merkittävästi. Ennen vuotta 2022 Euroopan keskuspankin harjoittama rahapolitiikka oli erittäin elvyttävää. Elvyttävää rahapolitiikkaa on harjoitettu muun muassa asettamalla Euroopan keskuspankin ohjauskorko erittäin matalalle, jopa negatiiviseksi. Matalat korot kaventavat pankkien korkomarginaaleja, mikä vaikuttaa pankkien kannattavuuteen laskevasti. Pankit ovat joutuneet reagoimaan kannattavuuden laskuun matalan korkotason ympäristössä esimerkiksi kasvattamalla luottoriskiä sekä korottamalla palvelumaksuja.

Pankkien riskinottoa ja kannattavuutta käsitellään tutkielmassa kirjallisuuskatsauksella sekä empiirisellä analyysilla, jossa mitataan pankin luottoriskin kasvun vaikutusta kannattavuuteen. Empiirinen analyysi sisältää kolme eri kannattavuusmuuttujaa, jotka ovat pääoman tuotto, riskipainotettujen omaisuuserien tuotto sekä nettokorkomarginaali. Luottoriskiä kuvaa pankin kirjaamat luottotappiovaraukset suhteessa lainojen kokonaismäärään. Tutkimuksen otos pankeista jaetaan ryhmiin perustuen luottotappiovarausten määrään, ja tutkimuksessa vertaillaan vaikutuksia näiden pankkiryhmien välillä.

Tulosten mukaan luottoriskin kasvu nostaa pankin nettokorkomarginaalia. Lisäksi tulokset osoittavat, että analyysin muilla kannattavuusmuuttujilla mitattuna kasvanut riskinotto pienentää pankkien kannattavuutta. Toisaalta, kun malliin lisätään viivästetty luottoriskinmuuttuja, vaikutus on päinvastainen ja kasvanut riskinotto kasvattaa pankkien kannattavuusmuuttujia osoittaen, että lisääntynyt luottoriski kasvattaa pankin tuottoja. Tutkielman empiirisessä mallissa käytetty useamman periodin viivästetty luottoriskimuuttuja voidaan nähdä laajennuksena aikaisempaan pankkien kannattavuutta tutkivaan kirjallisuuteen verrattuna.

Asiasanat
Luottoriski, riskinotto, kannattavuus, rahapolitiikka

Säilytyspaikka
Jyväskylän yliopiston kirjasto

CONTENTS

1 INTRODUCTION

The direction of monetary policy in Europe had been extremely expansive after the financial crisis of 2008. However, a sharp increase in inflation changed the course of monetary policy during the year 2022. The increase in inflation has been caused by multiple different sources. The most extensive reasons are market shocks created by pandemic, Russian invasion of Ukraine on February 24, and the long expansive monetary policy period experienced in Europe after the financial crisis.

Net interest margins are one of the most traditional sources of income for retail banks. The previous expansive period of monetary policy compressed the net interest margins because of the extended period of low interest rates. The previous studies show that negative interest rates have a decreasing impact on bank profitability (e.g. Lopez, Rose & Spiegel, 2020). Also, low interest rates create loss in net interest margins (e.g. Lopez et al., 2020). Shrinking net interest margins and decreased profitability create losses to banks. To compensate the losses, banks need to implement new sources of income. Increasing service fees has been a favored response to cover weakened interest margins but alone increasing service fees can not cover the lost profits. Empirical results suggest that decreasing profitability increases bank's risk-taking appetite (e.g. Bikker & Vervliet, 2017). Increased risk-taking can be seen as other favored option to cover weakened interest margins to some banks. This study focuses on measuring the effects of increased risk-taking on bank's profitability. The aim of this study is to investigate whether increased credit risk-taking would increase bank's profitability.

The investigation of this study contains two parts. The first part presents and analyses the most relevant studies regarding to the relationship between bank's risk-taking and profitability as well as the determinants of bank profitability. The second part of the investigation contains empirical analysis that investigates the impact of risk-taking on profitability. The empirical analysis contains two different regression models for three different profitability variables. The first model contains loan loss reserves to total loans representing credit risk. In the second model loan loss reserves to total loans also represent credit risk, but

the variable is lagged for one, two and three periods. The profitability variables used in this study are returns on average assets, return on risk-weighted assets and finally net interest margin.

Using lagged periods of credit risk variable is an extension compared to the previous literature that investigates the relationship between credit risk and profitability. Also, this study divides the sample of banks into two groups based on the ratio of credit risk. This study is able to offer some new insights regarding to the impact of increased risk-taking on bank profitability. The methodology of this study follows the models used in previous literature and continues with a new perspective by adding lagged periods of risk-taking to the model and dividing the sample into groups based on the ratio of risk-taking.

The panel data set used in the empirical investigation contains observations from 619 European banks between the years 2005 to 2021. The methodology applies the conventional models used in many previous research papers studying the bank profitability. The model used in the empirical analysis contain bank specific variables, banking industry-based variables and macroeconomic variables. The models are design to describe the drivers of bank profitability and take into consideration of different perspectives of these drivers.

The structure of this paper is as follows. The following Chapter 2 includes theoretical background of the relationship of risk and profitability along with description of the banking environment. In Chapter 3 the most relevant and current previous studies are introduced and presented. Chapter 4 contains the introduction of data used in the empirical analysis including the introduction of methodology of the empirical estimation. In Chapter 5 the results of the study are thoroughly presented and compared to the previous literature. Finally, Chapter 6 contains the final conclusions of this study.

2 DRIVERS OF BANK RISK-TAKING

2.1 Banking environment

When investigating the determinants of bank profitability, the previous literature usually divides the determinant into macroeconomic, bank-specific and banking-industry specific variables. This study uses the same separation. Macroeconomic variables represent the main economic situation such as current inflation, gross-domestic growth or unemployment rate. Banking industry specific variables describe the interest rate level and in this study government bond yields. Bank specific variables are typically collected from the bank balance sheets and describe the financial status of an individual bank. Multiple different market operators and public sector produce market analysis from financial market and the key indicators of the economy. These sources enable essential data for the empirical analysis regarding financial market. Accounting and banks' public balance sheets offer important data for bank-specific related investigation. This study uses market information service Refinitiv Datastream. The bank specific data is collected from Bankfocus.

The banking sector environment differs quite strongly from other business environments. The reason for this is that the financial market is based on trust and the industry is extremely dependent between the market participants. Globalization has increased the interdependence of the financial market. Financial sector has large entry cost which effects on the competition of the market. Also, the costs of possible bankruptcies are huge. There is a high chance that the costs of bankruptcies could fall for taxpayers. Also, the effect and costs on economies through a slowdown in financial intermediation or lack of trust on banking sector or even banking crises could be enormous. In addition to the fact

that cost of failure of market participant could be huge and should be in everyone's interest to avoid, well-functioning banking sector is highly important to all other business sectors, households, private institutions, and countries' economies. Because of the nature of the market, there are public resources which are allocated to the market to guarantee the functionality and prevent the failures.

Because of the importance and possible costs in case of the worst-case scenario, the banking sector is highly regulated. Regulation covers for example the level of capital puffers, interest rates and other typical banking regulation. Further, the stage of financial market and possible risks of financial sector are constantly measured and reported by banking authorities as well as individual banks. Because of the changed and transformation of the financial market, the regulation needs to be constantly updated and evaluated. Besides country's national banking supervisor, in European Union there are shared European banking authority (EBA).

There are multiple politics and political tools targeting to impact on the stability of financial market. In the European Monetary Union monetary policy is operated via European Central Bank and the most effective tool of monetary policy is interest rates. It is cyclical policy tool which is designed to control inflation. After the financial crisis of 2008 inflation had been low and interest rates were kept low to boost inflation. Figure 1 illustrates movements of inflation between 2011 – 2022. In 2021 inflation increased rapidly and European Central Bank quickly changed the course of monetary policy. Interest rates have been increasing sharply since 2022 which can be seen in figure 2. Figure 2 represents Euribor 3-month which is one of the average interest rates that banks of euro area charge each other. Based on the public statements of European Central Bank Executive interest rates will not decline until the rise in inflation is tamed. European Central Bank has an inflation target of 2 %.

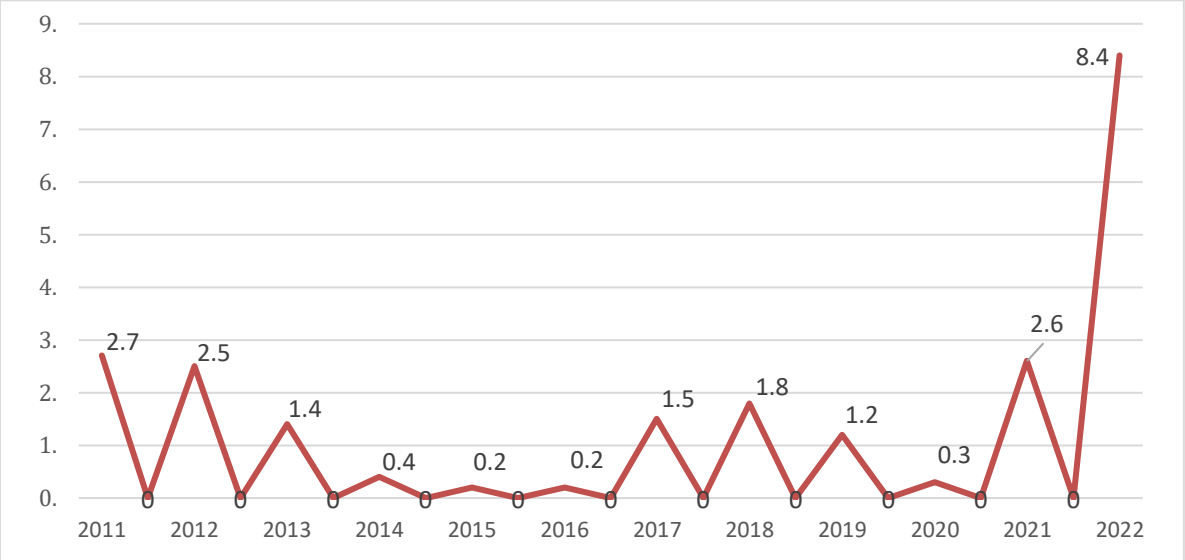
European Central Bank interest rate decisions basically change the price of money. Further, macroprudential policy is one quite new policy option that targets the banking sector. Macroprudential policy is applied in national and in EU level. An example of macroprudential policy instrument is deciding the level of capital puffer with targets to control the risk-taking of individual bank. Another example of macroprudential policy tool is loan-to-value ratio, which controls the amount of loan compared to the collateral.

In banking, the responsibility regarding bank's credit risk is quite complex topic. Some previous literature discusses about the "too big to fail" hypothesis. The banking-industry and market participants are extremely interconnected which means that failures spread easily and quickly. In addition, like in many other economic areas, in Europe banking is well concentrated. This creates oligopolistic features to the market, because relatively small number of large banks dominate the market. There are multiple cases in the history that government or other institution has bailed out large banks. One of the most recent cases that has happened in Europe is Credit Suisse in April 2023. These kinds of actions have an impact on banks' risk-taking appetite whenever there is a possibility of transferring responsibility of risk-taking.

The history of bail outs and bank collapses has taught that the larger the bank, the more likely it is bailed out by the government. At least the greater incentives to bail out are associated with larger banks. This could mean that banks which are more vital or critical for the stability of financial market have incentive to take excessive risk. Based on this market position, many previous studies such as Naili and Lahrichi (2022) investigate the impact of bank size on credit risk. In many previous studies, bank size is estimated by the natural logarithm of a bank total assets. Even though larger banks might have higher risk-taking appetite, commonly larger institutions also have better ability to collect information and make risk analysis of their customers. Nonetheless, these kinds of market participants have more resources for risk management and this kind of resource builds advantages to manage risk-taking.

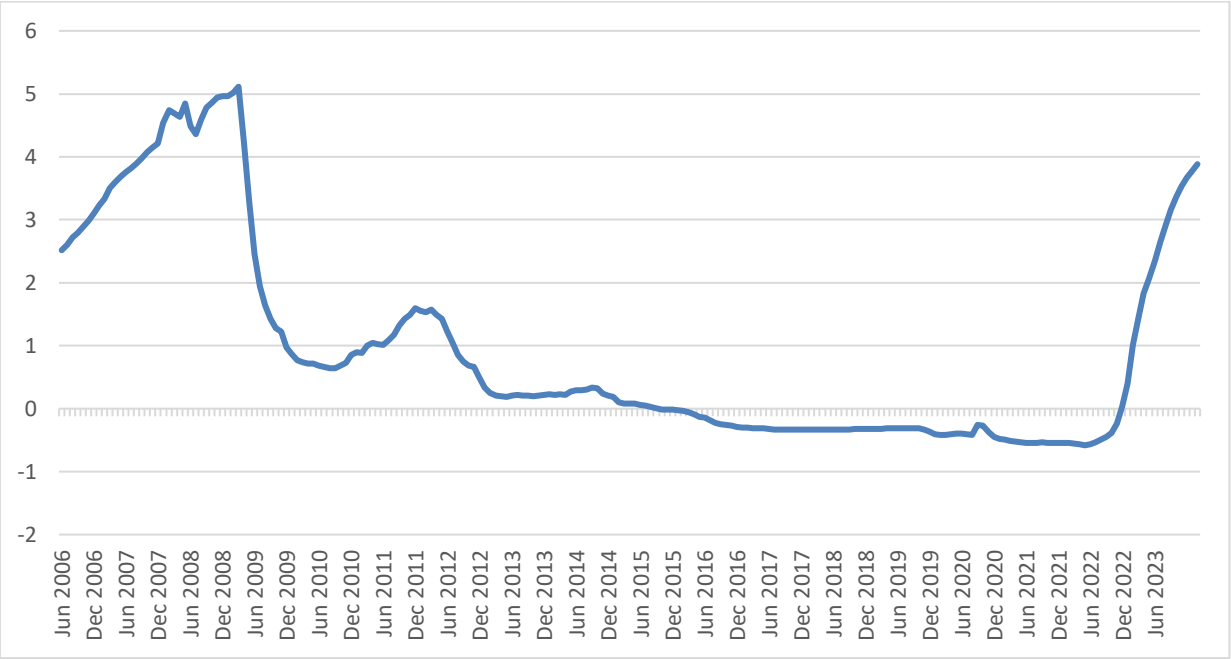
Besides bank size, this paper analyses the impact of other bank-specific characters as well. The other aspects are bank efficiency, capitalization level, deposit growth and the diversification of income sources. The capitalization level is measured by Capital Adequacy Ratio (CAR). CAR measures the bank risk and compares capital to risk-weighted assets. This ratio is used to follow that banks hold enough capital against risk-weighted assets. If a bank invests in riskier assets, the minimum capital requirement of the bank increases. The minimum capital requirements are regulated by central banks. The idea is to control bank's risk-taking and improve the stability of financial system.

Figure 1 Annual average rate of harmonized index of consumer prices in euro area 2011-2022



(Data: Eurostat, 2023)

Figure 2 Euribor 3-month from January 2006 to June 2023



(Data: ECB Data Portal, 2023)

2.2 Search for yield

Expansive monetary policy might create challenges to bank's profitability. These challenges create pressure to find additional ways to make the business more profitable. One of the growing trends among banks has been increasing service fees. Besides this option, some banks have changed their risk-taking behaviour during the low interest rate period. According to Jimenez, Ongena, Peydro and Saurina (2014) the most recent theoretical literature argues that expansionary monetary policy and short-term low interest rates might lead to search for yield and risk-shifting in banks' lending. In low interest rate environment, the riskless assets are less attractive. This impact is stronger in banks with lower capital amounts at stake. (Jimenez et al. 2014.)

Changes in interest rates have a significant impact on the allocation of investments of financial institutions. Whenever interest rates change from high to low institutions that have long term fixed interest liabilities might have to lean on search of yield and choose higher risk-taking to expand lending. As the low interest rate environment expands the institutions that compensate the basis of nominal return will take more risk to search for yield. (Rajan, 2005.) This effect

explains why some market participants need to increase risk-taking during low interest rate period.

Banks have some options to compensate income losses that are induced by negative interest rates. Banks could lower deposit expenses and attempt to increase earnings in non-interest income. Banks with small and low deposit-ratio tend to perform the best in low interest rate environment compared to others. (Lopez et al., 2020.) However, all the banks do not have the ability to benefit from low interest rates or cheap funding. Especially small individual banks do not typically have chance to advantage from wholesale funding or access to the European interbank market (Junttila, Perttunen and Raatikainen, 2021).

Because expansive monetary policy and low interest rates could decline banks' profitability, there is a chance than banks have increased risk-taking appetite during low interest rate period. Risk-taking channel of monetary policy is a mechanism which describes the increased risk-taking appetite in the environment of low interest rate (Abbate & Thaler, 2023). Typically, the empirical evidence suggest that lower rates motivate banks to reach higher risk. Further, empirical evidence imply that increased risk-taking might be economically inefficient, and for that reason the central banks should take this effect in consideration before adjusting interest rates. (Abbate & Thaler, 2023.)

Financial struggles in the market cause banks' inducements to deform and creating an incentive for excessive risk-taking. Investing in riskier investments and other market distortions become more critical if real interest rates decline. This impact indicates that aggregate productivity falls and investments are less efficient. (Abbate & Thaler, 2013.)

2.3 Profitability

This paper investigates how banks' risk-taking is affecting banks' profitability. Banks operate in a business environment that has multiple possible sources of risk. Examples of these kinds of risks are political risk, market risk, credit risk and liquidity risk. This study focuses on banks' credit risk, and it is measured by loan loss reserves to total loans. Credit risk is the potential loss of a given loan when a borrower fails to repay the loan to the bank. Loan loss reserve is a portion that is set aside to grant for defaulted loan payments and uncollated loans. Loan loss provisions is an example of how banks can control credit risk and practice risk management. Regulation regarding risk management has been tightened after the 2008 financial crisis.

After the financial crisis 2008 the banking regulation has been focused on risk taking behavior and bank provisioning. Loan loss provisions are designed to ensure that banks consider credit risk taking decisions. (Ozili, 2017). Ozili (2017) argues that discretionary provisioning can be driven by both credit risk considerations and income smoothing inducements. Ozili (2017) investigated the drivers of bank provisioning among Western European banks in the post-

financial crisis period. Ozili (2017) claims that income smoothing as the driver of discretionary provisioning is evidenced especially among listed banks.

Traditional individual retail bank is delicate to changes in credit risk. The reason for this is the fact that typically 85 % of banks' liabilities are deposits from depositors. Usually, the main basis of banks' income is the lending activity, which makes the non-performing loans one of the main reasons of failure. (Saleh & Afifa, 2020.) However, risk-taking also creates more possibilities and a chance for a higher yield. In order to control risk, banks would need an efficient risk management. Because of the importance of risk management, it is constantly being developed by financial institutions, banks, and banking regulators.

Many former research articles argue that banks' profitability has been declining during the period of low interest rates. Profitability is positively related to the level of interest rates and the slope of the yield curve (Claessens, Coleman & Donelly, 2018). This proves that banks have challenges to maintain the level of income during a longer period of low interest rate environment. The declining profits are due to shrinking net interest margin. The traditional idea on bank's business model is to collect deposits and grant loans. Decline in net interest margins impacts the core of primary business model of traditional retail banks. The majority of banks has had to develop its business model less dependent to net interest margins. Most banks have increased their service fees but there are other resources as well. One of the assumptions of this study is that banks have increased credit risk-taking in order to cover a decline in profitability measurements such as net interest margin.

The financial market as society knows it today could be seen as a quite new improvement in historical terms. The market is constantly forming and experiences new challenges that are being managed by legislation. However, the legislative process can be heavy and slow, and the innovations of today can be fast. The banking sector is constantly trying to improve banks' business operations and develop new innovations to enhance the industry. For example, one of the most recent innovations in the banking industry is Fintech, which transforms the system by including digital and online technologies in financial service industry. Fintech not only makes traditional activities more efficient but also produces new sources of income (Li, Feng, Zhao & Carter, 2021). This is an example of many new innovations that are aiming to improve the profitability of banking sector.

3 PREVIOUS RESEARCH LITERATURE

3.1 Overview of previous literature

There are several articles investigating the factors that determine bank profitability. The purpose of this section is to present a comprehensive review of the previous studies regarding the topic of this paper. These articles focus on different kinds of bank business models and regulatory environments all over the world but mainly concentrating the banking sector in the US and Europe.

All the previous studies use panel data, to estimate the impact of the underlying factors on bank performance. The data samples of the previous studies mostly consist of annual observations from the 1990's to the end of 2010's. This period carries multiple cyclical fluctuations in world's economy, but also a few large financial crises and diverse selection of monetary policy actions.

Most commonly, when investigating the profitability, the previous articles use return on assets as the measure of profitability. The other common profitability variables used are return on equity and net interest margin. Similarly, this paper is using return on average assets, return of risk-weighted assets and finally net interest margin.

This paper targets to investigate the effect of bank risk-taking on profitability and the previous articles are selected considering this target. Typically, in the previous research determinants of profitability is divided into three categories. These are macroeconomic, bank-specific and banking-industry specific determinants. Furthermore, in the previous literature when modelling the determinants of profitability, the model often formed by using bank specific variables, industry specific variables and macroeconomic variables. Commonly the Generalized Method of Moments is the most popular method to investigate the determinants of bank's profitability.

The following section presents several different kinds of results. The results might vary because of the differences in different banking sectors and because of

the quality of the data set collected. In the following section, the first part focuses on the relationship between risk-taking and profitability as well as other determinants of profitability. The second section concentrates on risk-taking during a negative or low interest rates and the impact of increased risk-taking on profitability. At the end of this section there is a table that summarizes the main points of the studies presented in the following sections.

3.2 Related literature

3.2.1 Impact of Risk on Profitability

Risk measurements have not always been prioritized when investigating performance of a business. Liang (1989) investigates whether the results of previous structure-performance paradigm are biased because the risk is excluded. The structure-performance paradigm is aiming to determine performance. The results of structure-performance paradigm generally states that banks operating in highly concentrated market earn higher profits. The study of Liang (1989) argues that the endogeneity of bank risk is neglected in structure-performance paradigm. This study highlights the importance of risk-taking measurements when investigating the performance of business.

Liang (1989) states that bank risk reduces bank's profits. The study defines bank risk as a standard deviation of profits, and it is associated with risk-taking behavior and local market uncertainty. According to the study, when a bank maximizes expected profits, it also considers expected costs, such as higher premiums on uncovered deposits claimed by the risk-averse investors. Liang (1989) states that these kinds of higher premiums are associated with high risk since instability in profits increases. The study highlights that according to the profit equations of the investigation, bank profits have declined because of local market uncertainty which is exogenous to bank managers.

Trujillo-Ponce (2013) investigates the factors that determinate profitability of Spanish banks in 1999-2009. The investigation separates the factors into two groups. The first group consist of bank specific or internal factors, that are asset structure and quality, capitalization, financial structure, efficiency, size, and revenue diversification. The other group includes external factors related to industry structure and macroeconomic factors such as economic growth, interest rates and inflation. The study uses return on assets and return on equity as dependent variables.

The results of Trujillo-Ponce (2013) proves that a minor number of poor-quality assets have a positive effect on bank profitability. With some simplification the results of Trujillo-Ponce conclude that increasing risk-taking would not have favorable impact on profitability. The evidence shows that well capitalized banks are more profitable, but because of the fall in leverage, increase in the equity-to-total-assets reduces return on equity. Based on the finding, in

Spanish banking sector, efficiency seems to be critical factor to determine profitability.

Menicucci and Paolucci (2015) discover the internal factors that could be forming high profitability in banks and examine the connection between profitability and bank-specific characteristics. The study views that the main characteristics of the banking sector regarding the success of European banks are competitiveness, profitability, and efficiency. Menicucci and Paolucci (2015) argue that the main targets of banking regulation should be cherishing these characteristics. When studying the profitability, most often the data includes both internal and external determinants. Menicucci and Paolucci (2015) mention that in many previous studies the primary internal bank-specific variables affecting the profitability are risk, capital ratio, size, loans, and deposits. These internal factors are influenced by bank's management decisions and strategies. However, the external determinants are not influenced by bank management. The external determinants reflect on legal and economic environment.

The study of Menicucci and Paolucci (2015) analyzes data consisting of European banking sector over 2009-2013. The profitability variables of the study are return on equity, return on assets and net interest margin. The findings indicate that the main determinants of European bank profitability are capital ratio and bank size. Capital ratio is represented as equity to total assets and bank size is represented as total assets. The discovery of well-capitalized banks receiving higher profitability could be explained by lower costs of external funding. As for declining profitability levels of European banks, the main determinant is revealed to be high loan loss provisions. The evidence also reveals some nuances that higher deposits and loan ratio indicate higher profitability.

Rakshit and Bardhan (2022) study the effect of bank risk-taking behavior, bank competition, and efficiency on bank performance. More specifically, the investigation measures whether a higher degree of competition improves profitability and whether increasing credit risk would have an effect on banks profitability. The study focuses on Indian banking industry between the years 1996-2016 and the dataset includes 70 Indian commercial banks.

In the study of Rakshit and Bardhan (2022) the efficiency sources are defined as cost, revenue, and profit efficiency. Risk-taking behavior is measured via loan loss provisions to total assets which is similar to the credit risk measurement of this study. Rakshit and Bardhan (2022) find that in general Indian banks operate under a competitive market condition and a high degree of competition decreases bank profitability. Rakshit and Bardhan (2022) reason that high degree of competition results lower interest rates on loans and deposits. This prevents banks from placing the price of marginal interest above the market price, which reduces banks profitability. However, the findings prove that cost, revenue, and profit efficiency have a positive effect on profitability of Indian banks.

Tan (2016) studies the impact of risk and competition on bank profitability. However, unlike many other articles, such as Rakshit & Bardhan (2022), Tan (2016) does not find evidence that risk or competition have impacts on bank's

profitability. It is noteworthy that the results might be affected by the fact that Chinese government provides strong influence and capital injections to the Chinese banking industry. This is one example that the conditions and data should be taken into account when comparing research results.

Khan, Scheule and Wu (2017) investigate the association between funding liquidity and bank risk-taking behavior. The study finds that the banks with higher deposit ratio tend to take more risk. The evidence proves that higher capital reserves and bank size tend to limit the risk-taking whenever the bank has lower funding liquidity risk. In addition, the findings illustrate that increase in bank deposits increases risk-weighted assets as well as liquidity creation. At this time banks lend more aggressively, whenever the rates are lower, as a rection to higher level of deposits. According to Khan et al. (2017) well-capitalized banks take less risk. Also, the study argues that bank size is negatively related to risk and banks with lower funding liquidity risk take less risk.

Detragiache, Tressel and Turk-Ariss (2018) analyze the changes of EU bank profitability levels in different phases of financial cycle. According to the evidence banks have better profit performance in post-crisis years if the banks have been able to control the rise in non-performing loans, reduce operating costs and lower the bank's assets aggressively during the years of crisis. Also, the findings suggest that decline in a bank's reliance on wholesale funding is associated with improved profit performance. However, the study does not find evidence that diversification of income sources would have an impact on improving bank's profit performance after the crisis. The overall conclusion is that the banks associated with best profit performance have ability to improve cost efficiency and contain worsening in loan quality.

The former literature reveals that positive credit shocks might lead to poor performance of banks. Fahlenbrach, Prilmeier and Stulz (2018) argue that high credit growth leads to poor performance, that is caused by overoptimistic expectations. According to Fahlenbrach et al. (2018) high credit growth leads to decreased quality of loans, since the credit boom could perform because of the risks are not correctly calculated. Once the neglected risks are exposed, the quality of these loans are reevaluated, and the banks are underperforming. The study shows that the effect is caused by aggregate credit booms and also bank-level credit booms.

Saleh and Afifa (2020) research the impact of credit risk, liquidity risk and bank capital on bank's profitability. The empirical evidence of the study includes observations from the banking sector of emerging market. The results reveal that credit risk has a negative impact on two profitability variables, ROAA and NIM. ROAA describes the net income to average total assets and NIM describes the net interest income to earning assets. However, based on the results, credit risk does not have impact on the third profitability variable ROEA, which describes the net income to average total equity. The study also finds that liquidity risk has a negative impact on profitability and bank capital has a positive influence on profitability.

The traditional proposal is that banks with higher profitability have reduced risk-taking incentives. However, there are some disagreements regarding the effects of empirical research regarding the effect of bank's profitability on bank risk-taking. The findings of Martynova, Ratnovski and Vlahu (2020) suggest that higher profitability increases the incentive for higher risk-taking as later presented. Martynova et al. (2020) approaches risk-taking from the opposite perspective than the topic of this paper. Martynova et al. (2020) investigates the impact of a strong core profitability on banks' risk-taking. The evidence argues that higher profitability offers banks a possibility to take more risk. Whenever a bank has a stable and profitable core, the leverage constrains are looser and the bank is able to borrow more and engage in riskier investments in larger scale.

Martynova et al. (2020) build a model, which indicates that the basic business model of banks is organized around a stable core business and the banks take risk through market-based side investments. The variable describing core profitability is bank's net income to total asset ratio and the risk variable is banks' equity losses. Their evidence illustrates a risk-taking channel that resembles the activities before the financial crisis of 2008, when large banks with high profitability took enormous risk. They conclude that monetary policy actions increase the stability and safeness of bank's core activities but also makes the side activities riskier. They suggest that this effect should be recognized by the regulators.

Mujtaba, Akhtar, Ashfaq, Jadoon and Hina (2021) study the link between Basel capital requirements, risk-taking and profitability of banks. The investigation focuses on Asian emerging markets and the data includes time period 2004 - 2017. The research method is dynamic panel GMM. The study implies that monetary policy decisions and regulatory capital has positive impact on banks' risk taking. This finding is consistent with the evidence of Martynova et al. (2021) and most of the other previous literature about this subject.

Further, Mujtaba et al. (2021) argue that more profitable banks take less risk, meaning that the relationship between profitability and risk-taking is negatively related. This evidence is inconsistent with the findings of Martynova et al. (2020). Mujtaba et al. (2021) suggest that increased profits reduce bank risk-taking, which is an opposite result than Martynova et al. (2020). Furthermore, Mujtaba et al. (2021) expresses that bank's ownership structure has an influence on profitability. Mujtaba et al. (2021) views that managerial ownership has a positive relation while foreign ownership has a negative relation on banks risk-taking.

3.2.2 Negative Interest Rates, Risk and Profitability

Dietrich and Wanzenried (2011) examine the main factors that determine the profitability of Swiss banks. The estimation model includes bank-specific characters, industry-specific and macroeconomic factors. The data includes 372 commercial banks for the period of 1998 – 2009. This time period is divided into

subperiods so the estimation can be delivered to years before and during the financial crisis of 2008. In the model of Dietrich and Wanzenried (2011) the crisis years are defined as 2007, 2008 and 2009.

Dietrich and Wanzenried (2011) are able to find multiple critical factors that determine bank profitability. Yet the results of the estimation are not surprising, since they are consistent with the prior studies regarding bank profitability. The main results of Dietrich and Wanzenried (2011) indicate that there are five main factors that explain the Swiss banks profitability. These factors are an operational efficiency, a functional business model, low funding costs, a growth of total loans and an effective tax policy. Also, as expected, the results prove that operationally efficient banks beat those that are less operationally efficient.

The evidence of Dietrich and Wanzenried (2011) show that more profitable banks are less dependent on interest income. This means that banks whose income is more diversified are more profitable. The evidence of interest income can be explained by the uncertainty of interest rate movement. Basically, changes in interest rate policy have influence on bank profits such widely. Also, the findings of the study suggest that growth in loan volume that is above-average has positive impact on banks profitability.

The observations of the study suggest that state-owned banks survive better than privately owned banks during the financial crisis. The study believes that the public reason state-owned banks safer during financially disturbing time period. The study also finds that the Swiss banking sector significantly grew the loan loss provisions during the crisis and this action actually created negative impact on banks profitability. Further, the increased amount of deposit liabilities had a negative impact on banks profitability during the financial crisis, since the banks were not able to convert deposits into higher income earnings.

There are a few empirical findings suggesting that the capital structure of a bank has an impact on bank risk-taking when the interest rate is declining. The findings of Delis and Kouretas (2011) highlight that low interest rates increase the risk-taking behavior. Commonly, the reaction is softened lending standards, raised level of risky assets, and worsening the equilibrium risk of failure. The evidence of Delis and Kouretas (2011) suggests that there is a strong negative relationship between interest rates and bank risk-taking. However, the empirical evidence is stronger in poorly capitalized banks and weaker in well capitalized banks. The findings suggest that the effect is due to increased appetite of search of yield.

Dell'Ariccia, Laeven and Marquez (2014) report evidence that a decline in real rates leads to banks' higher risk taking and greater leverage. Their findings suggest that the effect can be controlled via bank's capital structure. Whenever interest rates fall, the findings imply that well capitalized banks increase risk. However, during reduced interest rate period if loan demand is linear or concave risk-taking might be decreased in banks that are highly levered. Decline in risk-free rates drive banks to extend leverage. Also, reduction in risk-free rate signifies increase in risk-taking in well capitalized banks because of reduced bank

monitoring. Further, the results illustrate that the stage of capitalization of an individual bank depends on the degree of competition.

The findings of Jimenez et al. (2014) suggest that low interest rates encourage banks to more risk-taking behavior. This result is consistent with the findings of Delis and Kouretas (2011) and the findings of Dell'Ariccia et al. (2014). Jimenez et al. (2014) investigates whether expansionary monetary policy motivates banks into risky lending. The results indicate that banks grant more credit to riskier firms whenever the overnight interest rate decreases. This means that these banks are increasing their credit risk. This effect is strengthened in lowly capitalized banks. Delis and Kouretas (2011) argue that central banks should take into account more carefully the impact of low interest rate environment on banking sector risks and on financial market stability. The results suggest that the granted loans in low interest rate environment are found to be more likely to default in the future and the amount of these kind of loans tend to be larger.

Bikker and Vervliet (2017) investigate the effect of compressed net interest margins on bank's profitability. They find that banks do not increase the risk exposure of the trading activities to maintain the level of profits. However, the results show that the banks lower the level of provisioning for credit losses. The provisions describe the bank's attitude toward credit risk. At the low interest rate environment this is justified because of lower default probabilities. Bikker and Vervliet (2017) argue that because of that banks' buffers against credit risk may be too low when interest rates start to rise again.

Dell'Ariccia, Laeven and Suarez (2017) study the relationship between low short-term interest rates, bank leverage and bank risk-taking. Their finding suggests that low short-term interest rates increase bank risk-taking. The empirical analysis propose that a one standard deviation decrease in the interest rate level increases the risk rating of a new loan for 0.11. Their study focuses on the riskiness of new loans. The main findings of Dell'Ariccia et al. (2017) are consistent to the findings of Jimenez et al. (2014). However, these studies have various results between the banks with different capitalization levels. The study of Dell'Ariccia et al. (2017) suggest that the effect of interest rates on bank risk-taking is weakening among poorly capitalized banks, when Jimenez et al. (2014) find stronger risk-taking in banks with lowly capitalized banks.

Paligorova and Santos (2017) investigate how monetary policy actions effect on corporate loan pricing and loan spreads in banking sector. The intention of the study is to measure the possible underpricing of corporate loan risk during the easing monetary policy period. The study suggests that during a period of easing monetary policy the loan spreads on riskier firms decreases compared to a period of tightening monetary policy actions. This means that banks offer loans to riskier firms with discount during the easing period, rather than would raise the price of loan. The evidence shows that for riskier borrowers the loan rates are lower in banks which are more risk tolerant.

Paligorova and Santos (2017) highlight that the described effect is only evidenced during times of easing. The evidence of Paligorova and Santos (2017)

is consistent with the previous literature which suggest that during the period of low interest rates and easing monetary policy increases banks' appetite for risk. This effect might increase the overall risk in the banking sector during loosened monetary policy period.

Lopez et al. (2020) investigate how the negative rate affects the bank's profitability. They divide the data into two groups, high-deposit (HD) and low-deposit (LD) counterparts. They find that in the negative interest rate environment, the banks suffer from statistically significant loss in net interest income. However, their results show also that the overall income effect creased by low interest rate environment is weak and the banks are managing well under negative nominal interest rates.

The empirical evidence of Lopez et al. (2020) suggest that banks respond to low interest rate by increasing the lending activity. This kind of behavior might increase credit risks according to the results of Fahlenbrach et al. (2018). However, the impact is different to each group of their study. The HD banks tend to increase their lending activity while the group LD tend to lower their lending activity.

Banks can improve the profitability through funding strategy. Junttila et al. (2021) analyze the profitability of Finnish cooperative banks during a period of a negative nominal interest rate. According to the research some banks are able to benefit from low interest rates by exploiting wholesale funding. They state that banks that lean on deposit funding are suffering from the higher decline of NIM. However, the banks that are able to borrow from interbank market and benefit from negative interest rates can enhance NIM. According to Junttila et al. (2021) the conditions for wholesale funding depend on bank size and other obligations that are not reachable for all banks. The study of Junttila et al. (2021) illustrates that bank size has advantages regarding bank profitability via flexible funding options and possibilities. This finding is consistent with the results of Khan et al. (2017).

Angori, Aristei and Gallo (2019) study the determinants of net interest margin in the Euro Area. The study covers the period 2008-2014. The study uses the ratio of net interest income to total assets as a variable describing bank profitability. The research method is a dynamic regression model.

The results of Angori et al. (2019) suggest that bank profitability is one of the most important factors of financial stability. After the Global Financial crisis, the weak performance of net interest income has caused vulnerabilities to the financial stability. The study points that although the low interest rates were used to recover the economy after the crisis negative interest rates might prevent the sustainable development of bank profitability in the long term. The findings of Angori et al. (2019) highlight that extended period of low interest rates combined with flattening of the yield curve can shrink the net interest margins.

The evidence of Angori et al. (2019) also suggest that increased credit risk and larger loan loss reserves to total assets ratio results higher interest margins. The results indicate that the higher volatility in market interest rates and higher exposure to credit default results lower effect on net interest margins.

More recent literature is focused on investigating the effects of the COVID-19 pandemic in banking sector. Li et al. (2021) investigates whether the tightened credit standard and reduced demand for loans caused by COVID-19 pandemic have an impact on banks' revenue source diversification. The evidence shows that non-interest revenue sources increase the profit performance of banks. This evidence is consistent with the principle of diversification, which states that unsystemic risk could be controlled through diversification. However, their finding suggest that non-interest revenue streams are inversely related to risk. The study concludes that the reason behind the captured results is Fintech, which uses digital and online technologies in financial services industry.

3.3 Summary

The following tables include a summary of the previous literature presented in Chapter 3. Table 1 presents the previous research focused on the impact of risk on bank profitability or profits. Table 1 also includes literature that consider the other prior determinants of bank profitability. Table 2 presents the previous research focused on the impact of negative or low interest rates on bank profitability or profits.

Based on the previous literature, it could be concluded that there are not many studies to evidence that increased risk-taking would increase the profitability of banks. Another conclusion is that there are many studies which evidence that profitability might encourage banks to take more risk (e.g. Martynova et al., 2020).

Negative or low interest rates shrink bank's net interest margin. This effect decreases the profitability of banks. The previous research suggest that less interest depend banks are performing during low interest rate period better than banks that are more depended on interest margin. Because low interest rate is a tool of expansionary monetary policy it can encourage banks to take more risk (Jimenez et al., 2014).

Table 1 Summary of the main points of previous literature on risk-taking and profitability

References	Banking sector investigated	Data period	Research method	Empirical results
Liang (1989)	US banking sector	1976 - 1985	OLS	Bank risk reduces bank profits.
Menicucci & Paolucci (2015)	European banking sector	2009 - 2013	Regression analysis	The main determinants of European bank profitability are capital ratio and bank size.
Tan (2016)	Chinese banking sector	2003 - 2011	GMM	Risk and competition do not have an impact on profitability.
Khan, Scheule & Wu (2017)	US banking sector	1986 – 2014	Regression analysis	An increase in bank deposits increases risk-weighted assets and liquidity creation.
Detragiache, Tressel and Turk-Ariss (2018)	European banking sector	2000 - 2016	Regression analysis	During crisis, the best profit performance is reached with ability to improve cost efficiency and contain worsening of loan quality.
Fahlenbrach, Prilmeier and Stulz (2018)	US banking sector	1972 - 2014	Regression analysis	A high credit growth leads to decreased quality of loans.
Saleh & Afifa (2020)	Emerging market banking sector	2010 - 2018	Fixed effects regression model and GMM	Credit risk has a negative effect on profitability.
Martynova, Ratnovski and Vlahu (2020)	US and European banking sector	1995 - 2009	Formed a new risk model	Higher profitability offers banks an incentive to take more risk.
Mujtaba, Akhtar, Ashfaq, Jadoon & Hina (2021)	Emerging Asian banking sector	2004 - 2017	Panel GMM	An increase in profits and profitability reduce bank risk-taking.
Rakshit & Bardhan (2022)	Indian banking sector	1996 - 2016	GMM	A high degree of competition decreases bank profitability.

Table 2 Summary of the main point of previous literature on negative interest rates, risk and profitability

References	Banking sector investigated	Data period	Research method	Empirical results
Dietrich & Wanzenried (2011)	Swiss banking sector	1998 – 2009	GMM	More profitable banks are less dependent on interest income.
Delis & Kouretas (2011)	Euro area banking sector	2001 - 2008	Regression analysis	Low interest rates increase the risk-taking in banks.
Trujillo-Ponce (2013)	Spanish banking sector	1999 - 2009	GMM	Well capitalized banks are more profitable.
Dell'Ariccia, Laeven and Marquez (2014)	US banking sector	1997-2009	Financial intermediation model	Declining real rates leads to higher risk-taking and greater leverage in well capitalized banks.
Jimenez, Ongena, Peydro & Saurina (2014)	Spanish baking sector	2002 - 2008	Interaction regression model	Expansionary monetary policy encourages risk-taking.
Bikker & Vervliet (2017)	US banking sector	2001 - 2015	OLS and GMM	Compressed net margins lead to more risk taking.
Dell'Ariccia, Laeven and Suarez (2017)	US banking sector	1997 - 2011	OLS	Low short-term interest rates increase bank risk-taking.
Paligorova & Santos (2017)	US banking sector	1990-2008	Regression analysis	Low interest rates and easing monetary policy increases banks' appetite for risk.
Lopez, Rose & Spiegel (2020)	European and Asian banking sector	2010 - 2017	Regression analysis	Negative interest rates create loss in net interest income.
Junttila, Perttunen and Raatikainen (2021)	Finnish banking sector	2009 - 2018	Regression analysis	During negative rates, banks can improve NIM via wholesale funding.
Angori, Aristei and Gallo (2019)	Banking sector of Euro Area	2008 – 2014	Dynamic model	Increased credit risk is associated with higher interest margins.
Li, Feng, Zhao, and Carter (2021)	US banking sector	2020	Regression analysis	Non-interest revenue sources increase the profit performance of banks during pandemic.

4 DATA AND METHODOLOGY

4.1 Description of Data

In this chapter the data and the variables used in the empirical analysis is thoroughly introduced. The sample consists of 619 European banks. The panel data set covers years 2005 to 2021. This time period includes multiple significant financial crises and range of different economic fluctuations. The source of bank specific data is Bankfocus and macroeconomic data is collected from refinitiv Datastream.

The sample has numerous variables that describes an individual bank, banking sector as well as macroeconomic market situation. These profitability determinants include bank-specific, industry-specific, and macroeconomic factors. This study uses three main indicators to describe bank profitability. The first one is return on average assets (ROAA). The second one is return of risk-weighted assets (RoRWA) and the third one is net interest margin (NIM).

In the selection of variables this study follows the general practice of the previous literature (e.g. Detragiache et al., 2018; Bikker & Vervliet, 2017; Lopez et al., 2020). The variables of this study are closely presented in table 3. The aim of this study is to measure the impact of credit risk on bank profitability. Loan loss reserves to total loans represent credit risk in the empirical analysis. Loan loss provisions are used to balance different kinds of credit risks or cover unpaid loan payments. Banking authorities set requirements on banks to calculate and evaluate the potential losses to guard financial stability. Unlike the other previous studies, this study uses lagged loan loss reserves to total loans to calculate the effect of credit risk during postponed periods. The empirical analysis contains three lagged periods of loan loss reserves. This is one of the main extensions of this study compared to the previous research.

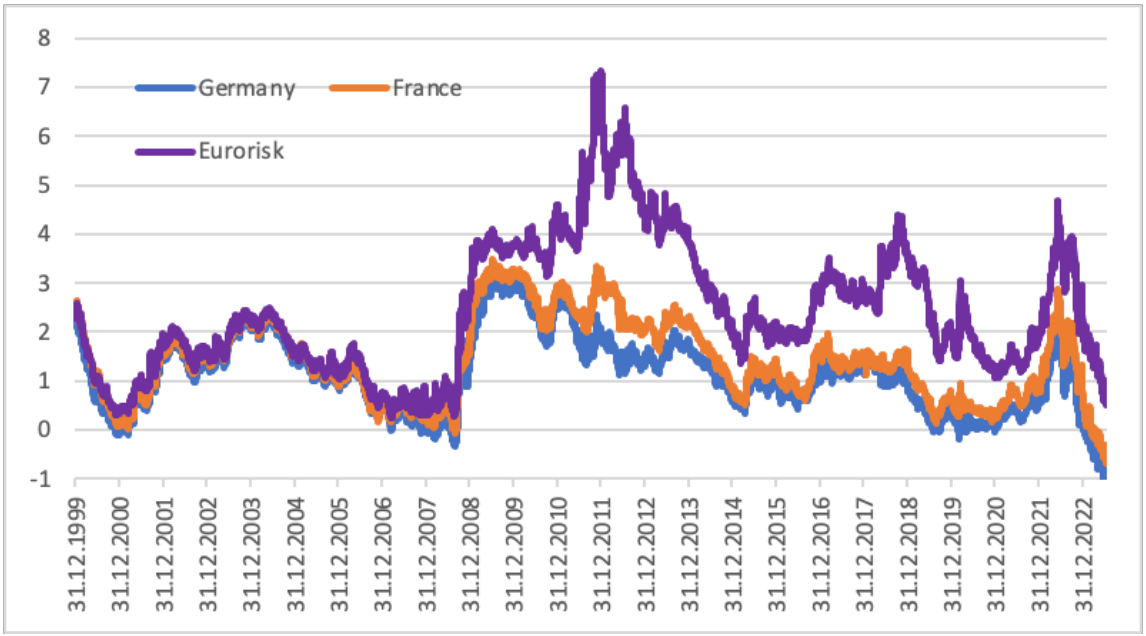
Bank size is often described as natural logarithm of assets in most previous literature (e.g. Naili & Lahrichi, 2022). Bank size is used as an explanatory variable in this study. Besides bank size, the size of loan loss reserves is controlled via dividing the bank sample into quartiles based on the size of the loan loss reserves. The lowest loan loss reserves are in a group Q1 and the highest loan loss reserves are in the group Q4.

Bank specific variables are measurements collected from the bank's balance sheets. Deposits to assets describes the structure of bank's funding. Large number of deposits reduce the need for other funding sources such as market funding or wholesale funding. Deposits are typically short-term funding. Non-interest income to operating revenue describes the other sources of income that are not depended on interest rates. An example of non-interest income could be service fees. Capital Adequacy ratio is the relationship between bank's capital and bank's risk weighted assets. Efficiency is the non-interest expenses to revenues. Efficiency describes the relationship between other than funding expenses to revenues.

Industry specific variables describe the movements of interest rates and European government bond yields. Figure 3 contains three graphs that describe the movements of government bond yields. The purple graph is Eurorisk which is a gap between Italy 10-year government bond and Germany 10-year government bond. Historically the rate of Italy 10-year government bond is high since the investors are expecting higher yield for more risky investment. The rate of Germany 10-year government bond has been historically one of the lowest in Europe, since Germany government bonds are valued to contain a smaller amount of risk. Eurorisk is aiming to describe the gap between high risk and low risk government bonds in Europe. The value of Eurorisk increased significantly during the financial crisis and again during the European debt crisis.

In Figure 3 the blue graph describes the gap between Germany 10-year government bond and Germany 3-months government bond. The orange gap describes the gap between France 10-year government bond and France 3-months government bond. Eurorisk and the bond yields of Germany and France are slightly correlating towards each other. Although, the correlation is far from perfect, this detail might be evidenced somehow in the results of empirical analysis.

Figure 3 Government bonds of the Euro area from the end of 1999 to 2022



The macroeconomic variables used in this study describe the inflation and the stage of economic growth. Macroeconomic variables are describing the stage of financial market. These variables capture the events that change the market conditions and shapes the banking environment.

The following table 3 contains the explanations and abbreviations of each variable used in the empirical analysis. Each variable used in the empirical model of this paper is described in the table 3. Each variable has an abbreviation to help describing the empirical models represented after the table 3.

Table 3 Description of variables

Name of variable	**Explanation**
Profitability	
ROAA	Return on average assets
RoRWA	Returns on risk-weighted assets
NIM	Net interest margin
Bank-specific variables	
LLR	Loan loss reserves to total loans
Lag1LLR	One lagged period of loan loss reserves to total loans
Lag2LLR	Two lagged periods of loan loss reserves to total loans
Lag3LLR	Three lagged periods of loan loss reserves to total loans
Size	Natural logarithm of assets
Deposits	Deposits to assets ratio
NonInterestIncome	Non-Interest income to operating revenue
CAR	Capital Adequacy Ratio (Basel requirement)
Eff	Efficiency: Non-Interest Expenses to revenues
Industry-specific variables	
Euribor3M	Euribor 3-month
TED	Euribor 3-month – Germany 3-month government bond
ShadowRate	Euro area shadow-rate term
EURORISK	Italy 10-year – Germany 10-year government bond
TERM	Germany 10-year – Germany 3-month government bond
Macroeconomic variables	
CPI	Consumer price index
GDP	Real gross domestic product

4.2 Research Method

This study includes multiple regression models that are explaining the determinants of bank performance. In this chapter all the different regressions are thoroughly described, and the definition of each variable is listed at the end of this chapter. A Hausman test is performed to each regression when selecting between within and random effect models.

The first regression model describes the components of return on average assets (ROAA).

$$ROAA_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Eff_{i,t} + \beta_7 * Euribor3M_{i,t} + \beta_8 * TED_{i,t} + \beta_9 * ShadowRate_{i,t} + \beta_{10} * EuroRisk_{i,t} + \beta_{11} * TERM_{i,t} + \beta_{12} * CPI_{i,t} + \beta_{13} * GDP_{i,t} + \varepsilon_{i,t} \quad (1)$$

The second regression model describes the components of return on risk-weighted assets (RoRWA).

$$RoRWA_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Eff_{i,t} + \beta_7 * Euribor3M_{i,t} + \beta_8 * TED_{i,t} + \beta_9 * ShadowRate_{i,t} + \beta_{10} * EuroRisk_{i,t} + \beta_{11} * TERM_{i,t} + \beta_{12} * CPI_{i,t} + \beta_{13} * GDP_{i,t} + \varepsilon_{i,t} \quad (2)$$

The third regression model describes the components of return on average assets (ROAA) including the lagged loan loss reserve to total loans variables.

$$ROAA_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Lag1LLR_{i,t} + \beta_7 * Lag2LLR_{i,t} + \beta_8 * Lag3LLR_{i,t} + \beta_9 * Eff_{i,t} + \beta_{10} * Euribor3M_{i,t} + \beta_{11} * TED_{i,t} + \beta_{12} * ShadowRate_{i,t} + \beta_{13} * EuroRisk_{i,t} + \beta_{14} * TERM_{i,t} + \beta_{15} * CPI_{i,t} + \beta_{16} * GDP_{i,t} + \varepsilon_{i,t} \quad (3)$$

The fourth regression model describes the components of return on risk-weighted assets (RoRWA) including the lagged loan loss reserve to total loans variables.

$$RoRWA_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Lag1LLR_{i,t} + \beta_7 * Lag2LLR_{i,t} + \beta_8 * Lag3LLR_{i,t} + \beta_9 * Eff_{i,t} + \beta_{10} * Euribor3M_{i,t} + \beta_{11} * TED_{i,t} + \beta_{12} * ShadowRate_{i,t} + \beta_{13} * EuroRisk_{i,t} + \beta_{14} * TERM_{i,t} + \beta_{15} * CPI_{i,t} + \beta_{16} * GDP_{i,t} + \varepsilon_{i,t} \quad (4)$$

The fifth regression model describes the components of net interest margin (NIM).

$$NIM_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Eff_{i,t} + \beta_7 * Euribor3M_{i,t} + \beta_8 * TED_{i,t} + \beta_9 * ShadowRate_{i,t} + \beta_{10} * EuroRisk_{i,t} + \beta_{11} * TERM_{i,t} + \beta_{12} * CPI_{i,t} + \beta_{13} * GDP_{i,t} + \varepsilon_{i,t} \quad (5)$$

The sixth regression model describes the components of net interest margin (NIM) including the lagged loan loss reserve to total loans variables.

$$NIM_{i,t} = \alpha_0 + \beta_0 * Size_{i,t} + \beta_1 * Deposits_{i,t} + \beta_3 * NonInterestIncome_{i,t} + \beta_4 * CAR_{i,t} + \beta_5 * LLR_{i,t} + \beta_6 * Lag1LLR_{i,t} + \beta_7 * Lag2LLR_{i,t} + \beta_8 * Lag3LLR_{i,t} + \beta_9 * Eff_{i,t} + \beta_{10} * Euribor3M_{i,t} + \beta_{11} * TED_{i,t} + \beta_{12} * ShadowRate_{i,t} + \beta_{13} * EuroRisk_{i,t} + \beta_{14} * TERM_{i,t} + \beta_{15} * CPI_{i,t} + \beta_{16} * GDP_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where
ROAA = Return on average assets
RoRWA = Return on risk weighted assets
NIM = Net interest margin
i = individual bank
t = time
α = intercept coefficient
b = coefficient of explanatory variable
Size = Natural logarithm of a bank total asset
Deposits = Deposits to Assets ratio
NonInterestIncome = Noninterest income to operating revenue
CAR = Capital Adequacy Ratio (Basel requirement)
LLR = Loan loss reserves to total loans
Lag1LLR = one lagged period of Loan loss reserves to total loans
Lag2LLR = two lagged periods of Loan loss reserves to total loans
Lag3LLR = three lagged periods of Loan loss reserves to total loans

Eff = Efficiency
Euribor3M =Euribor 3-month
TED = Euribor 3-month minus Germany 3-month government bond
ShadowRate = Euro area shadow-rate term
EURORISK = Italy 10-year minus Germany 10-year government bond
TERM = Germany 10-year minus Germany 3-month government bond
CPI = Consumer Price Index
GDP = Gross domestic product

5 RESULTS AND ANALYSIS

5.1 Regression results

This chapter presents the results of this study and analyzes the results comparing them to the results of previous literature. At the beginning of this chapter tables 4, 5 and 6 summarizes the results of the equations introduced in chapter 4. Table 4 contain results from equation 1 and equation 2 that are closely shown in section 4.2. These equations do not include lagged periods of loan loss reserves. Table 5 includes the results based on equation 3 and equation 4 that are also shown in section 4.2. These equations involve lagged periods of loan loss reserves. Table 6 includes the results based on the equation 5 and equation 6. At the end of each table there are explanations of the significance levels of the coefficients.

The following tables are showing dependent variables that are representing profitability in columns and independent variables in rows. The dependent variables include different quartiles that are expressed as Q1 and Q4. Q1 symbolizes observations that include the first quartile of the variable LLR. Furthermore, Q4 symbolizes observation that include the fourth quartile of the variable LLR.

TABLE 4 Results of regression analysis on ROAA and RoRWA without lagged periods of loan loss reserves to total loans

Variables	ROAA	RoRWA	ROAA (Q1)	RoRWA (Q1)	ROAA (Q4)	RoRWA (Q4)
Size	**0.20** ***	-34.46	**0.36** ***	**1.60** *	**1.91** ***	9.49
Deposits to Assets	**1.37** ***	630.66	**1.05** ***	**13.18** *	**5.38** ***	-4.62
Noninterest Income	**-0.00** ***	-0.00	**-0.00** *	-0.00	0.00	0.17
CAR	**0.01** ***	-0.98	0.00	0.04	**0.07** ***	0.62
Loan loss reserves	**-0.08** ***	3.10	0.08	4.75	**-0.03** **	-0.04
Efficiency	**-0.00** ***	-0.02	**-0.00** *	-0.00	**-0.01** ***	-0.07
Euribor3M	**0.10** **	167.01	**0.14** **	-0.88	0.00	7.52
TED	-0.05	-33.78	**-0.30** **	2.70	0.26	31.36
ShadowRate	0.02	-7.64	0.01	0.46	0.08	-1.18
EURORISK	-0.02	9.86	**0.08** *	0.05	-0.18	-0.71
TERM	-0.09	-37.81	**-0.30** ***	0.86	0.15	39.88
CPI	**-0.14** ***	-53.23	**-0.20** ***	-0.59	0.03	-6.85
GDP	**0.06** ***	11.64	**0.05** ***	-0.03	0.03	1.30
R^2	0.11	0.01	0.09	0.01	0.20	0.01

*** denotes 1% significant level, ** denotes 5% significant level and * denotes 10% significant level.

TABLE 5 Results of regression analysis on ROAA and RoRWA including lagged periods of loan loss reserves to total loans

Variables	ROAA	RoRWA	ROAA (Q1)	RoRWA (Q1)	ROAA (Q4)	RoRWA (Q4)
Size	0.08	-0.13	**-0.06** ***	0.09	0.21	0.12
Deposits to Assets	**1.65** ***	3.79	0.21	**1.82** ***	**4.11** ***	**8.16** ***
Noninterest Income	**-0.00** ***	**-0.01** ***	-0.00	0.00	**-0.02** ***	**-0.05** ***
CAR	**0.01** ***	**-0.02** **	0.00	**0.02** ***	**0.09** ***	**0.12** ***
Loan loss reserves	**-0.15** ***	**-0.24** ***	0.06	-0.35	**-0.13** ***	**-0.18** ***
Lag1 Loan loss reserves	**0.06** ***	0.07	-0.03	0.01	**0.10** ***	**0.13** **
Lag2 Loan loss reserves	**0.06** ***	**0.12** **	0.02	-0.03	**0.05** **	0.09
Lag3 Loan loss reserves	0.01	0.01	-0.01	-0.00	0.01	0.05
Efficiency	**-0.00** ***	**-0.00** ***	-0.00	-0.00	**-0.03** ***	**-0.05** ***
Euribor3M	**0.18** ***	-0.22	-0.08	-0.15	**0.50** **	0.95
TED	-0.16	-0.28	-0.11	-0.18	**-0.83** **	**-1.71** *
ShadowRate	0.00	0.00	0.03	-0.05	0.00	-0.02
EURORISK	-0.01	-0.22	-0.04	-0.19	0.17	0.38
TERM	-0.10	0.41	0.14	-0.14	**-0.81** **	**-1.69** *
CPI	**-0.10** ***	-0.09	-0.05	-0.12	**-0.24** *	-0.51
GDP	**0.05** ***	**0.09** **	**0.02** **	**0.11** ***	**0.09** *	**0.19** *
R^2	0.18	0.07	0.10	0.13	0.34	0.23

*** denotes 1% significant level, ** denotes 5% significant level and * denotes 10% significant level.

TABLE 6 Results of regression analysis on net interest margin including lagged periods of loan loss reserves to total loans

Variables	NIM	NIM (Q1)	NIM (Q4)	NIM	NIM (Q1)	NIM (Q4)
Size	**-0.15** ***	**-0.15** ***	-0.05	**-0.22** ***	**-0.10** ***	**-0.20** ***
Deposits to Assets	**1.04** ***	**0.86** ***	**1.35** ***	**1.05** ***	**1.29** ***	**0.99** ***
Noninterest Income	**-0.00** ***	**-0.00** ***	**-0.01** ***	**-0.00** ***	**-0.00** ***	**-0.01** ***
CAR	-0.00	**-0.01** ***	**0.01** ***	**-0.00** ***	**-0.00** ***	-0.00
Loan loss reserves	-0.00	**0.32** ***	0.00	0.00	**0.31** ***	-0.00
Lag1 Loan loss reserves	**-**	-	-	-0.01	**0.04** *	0.00
Lag2 Loan loss reserves	**-**	**-**	-	0.01	-0.01	0.01
Lag3 Loan loss reserves	-	-	-	0.01	0.01	0.00
Efficiency	**-0.00** ***	**-0.00** ***	**-0.00** ***	**-0.00** ***	**-0.00** *	**-0.01** ***
Euribor3M	**0.13** ***	**-0.04** *	**0.09** *	**0.22** ***	0.05	**0.16** **
TED	**-0.11** ***	**0.13** **	-0.13	**-0.25** ***	**0.22** **	-0.09
ShadowRate	-0.00	0.01	0.02	0.00	0.01	0.01
EURORISK	**0.05** ***	-0.03	**0.07** *	**0.06** ***	**-0.06** **	0.00
TERM	-0.01	**0.12** *	0.01	**-0.20** ***	**0.23** **	0.00
CPI	**-0.07** ***	-0.01	**-0.09** **	**-0.01** ***	-0.00	-0.03
GDP	0.01	0.02	0.00	**0.01** ***	-0.01	-0.00
R^2	0.1	0.18	0.10	0.14	0.28	0.15

The first three sections in table 6 includes results of regressions which does not include lagged periods of loan loss reserves to total loans. The first three sections include – to represent that lagged periods of LLR are not included to the regression. *** denotes 1% significant level, ** denotes 5% significant level and * denotes 10% significant level.

5.2 Review of Regression Results

The results of each regression model are presented in the three tables in previous section. In table 4 and table 5, the second and third columns, right after the column of description of variables, present the results of returns of assets (ROAA) or returns of risk-weighted assets (RoRWA) as an explanatory variable for the whole sample. The fourth, fifth, sixth and seventh columns show the results for restricted group. In table 6 the profitability variable is net interest margin (NIM). The three columns after the column of description of variables presents the regression results that does not include the lagged periods of LLR. The results of the last three columns involve lagged periods of LLR as a control variable.

In these tables Q1 represents the observations that include the first quartile of the variable loan loss reserves to total loans (LLR). Likewise, Q4 represents the observation that include the fourth quartile of the variable LLR. Therefore, Q1 includes the group which has the smallest ratio of loan loss reserves compared to total loans and Q4 includes the group which has the largest loan loss reserves to total loans. Basically, the banks that are in Q4 has the most credit risk based on their balance sheet information.

The difference between table 4 and table 5 is the lagged periods of loan loss reserve to total loans as one of the response variables. In table 6 the lagged periods of LLR are presented in the last three columns of the table. These variables describe the effect when shifting the response variable one, two or three periods. This act offers information of the credit risk effect after delaying one to three periods.

This chapter discusses the impacts of each variable in the terms of profitability. In the following section firstly, the results of bank-specific response variables on profitability are reviewed. Then the effect of industry-specific variables on profitability is analyzed and lastly the impact of macroeconomic variables on profitability is discussed.

5.2.1 Impact of credit risk

In this study, the bank credit risk is measured via loan loss reserves to total loans (LLR). Based on the results of regression analysis presented in table 4, LLR is able to reach statistically significant results in columns ROAA and ROAA (Q4). For ROAA, the impact of LLR is -0.08 and for ROAA(Q4) the impact of LLR is -0.03. For the group that includes the largest loan loss reserves which is Q4, the impact is slightly smaller than for the group than includes all the banks of the sample. For both groups the impact of LLR is negative, meaning that based on these results, an increase in bank's loan loss reserves would decrease the return on average assets.

In table 5 LLR can reach statistically significant results in columns ROAA, ROAA(Q4), RoRWA and RoRWA(Q4). For ROAA the impact of LLR is -0.15 and

for ROAA(Q4) the impact is -0.13. For RoRWA the impact of LLR is -0.24 and for RoRWA(Q4) the impact is -0.18. Again, like in the results of table 4, the impact of LLR is slightly smaller for ROAA(Q4) and RoRWA(Q4) which includes the largest loan loss reserves. For the return of risk-weighted assets, the impact is slightly stronger than the impact on return on average assets since the value of LLR estimates are more negative. However, for all the groups the effect is negative. This means that an increase in loan loss reserves would reduce both return on average assets and return on risk weighted assets.

Based on the results of lagged loan loss reserves, the direction of statistically significant results is positive. One lagged period of LLR results statistically significant impact on group of ROAA, ROAA(Q4) and RoRWA(Q4). The numeric effect of this response variable is 0.06 for ROAA, 0.10 for ROAA(Q4) and 0.13 for RoRWA(Q4). For return on risk weighted assets the effect is a bit larger, since the value of coefficient is higher.

Two lagged periods of LLR results statistically significant coefficient values in the groups ROAA, ROAA(Q4) and RoRWA. The estimated value of two lagged periods of LLR for the group ROAA is 0.06. Also, the value of two lagged periods of LLR for the group ROAA(Q4) is 0.05. For the group ROAA the estimated value of two lagged periods of LLR is exactly the same as the estimated value of one lagged period of LLR. However, for the group ROAA(Q4) the estimated value is quite more less than the value of one lagged period. For RoRWA, the estimated value is 0.12. Three lagged periods of LLR does not results statistically significant impact in any groups.

What is interesting, is that all the statistically significant coefficients of lagged LLR are positive unlike the estimated values of not lagged LLR that are all negative. This would mean that an increase in LLR causes decrease in profitability variables ROAA and RoRWA. However, when LLR is lagged one or two periods, an increase in LLR is increasing both profitability variables ROAA and RoRWA. The summed total effect of lagged LLR is 0.12 for ROAA and RoRWA, 0.15 for ROAA(Q4) and 0.13 for RoRWA(Q4).

Table 6 describes the results of net interest margin (NIM) as a profitability variable. The predictor variables are the same as in table 5. Table 6 contains an equation that includes only LLR without any lagged periods as well as an equation that includes the lagged periods of LLR.

The results of table 6 differs from the tendency that table 4 and table 5 has considering the negative values of LLR and positive values of lagged LLR on ROAA, RoRWA, ROAA(Q4) and RoRWA(Q4). Risk variable has statistically significant results only in NIM(Q1), which illustrates the banks which have the lowest loan loss reserves meaning the smallest amount of credit risk. The estimated impact of LLR on NIM(Q1) in the equation without lagged periods is 0.32 and the impact of LLR on NIM(Q1) in the equation with lagged periods of LLR is 0.31. This result suggests that increased risk-taking increases the net interest margin. This result differs from the risk-taking result in table 4 and table 5. However, the impact of one lagged period of LLR on NIM is consistent with the positive impact of lagged periods of risk-taking in table 5. In table 6 the

statistically significant impact of one lagged period of LLR on NIM is 0.04. The impact is approximately as strong in the results of table 6 and of table 5.

To investigate the reliability of the results regarding credit risk the estimation is repeated to each group including only lagged LLR variables and excluding the contemporaneous LLR variable. In this estimation ROAA, RoRWA and NIM(Q1) has statistically significant results on lagged LLR variables, and the direction of coefficients are similar to the other results. Also, the explanatory power of each model is close to the previous models.

5.2.2 Impact of other bank-specific variables

This section presents the estimated results of other bank-specific variables apart from loan loss reserves to total loans. Basically, this section covers the results of other bank-specific variables than credit risk. According to table 4 the impact of bank size is statistically significant in equations of ROAA, ROAA(Q1), ROAA(Q4) and RoRWA(Q1). All these estimated values are positive, which suggest that the return on assets would increase if the bank size increased. Bank size is measured by the natural logarithm of bank assets.

The estimated value of bank size for ROAA is 0.20, for ROAA(Q1) the value is 0.36 and for ROAA(Q4) the value is 1.91. For the return of risk weighted assets group RoRWA(Q1) the estimated impact of bank size is 1.60. These numbers could possibly demonstrate that bank size could have quite sizable impact on bank's return on assets.

On the other hand, results in table 5 suggest that the only equation to have statistically significant estimation of bank size is ROAA(Q1) and the estimated value of bank size is -0.06. This result is inconsistent with the results of table 4. This distinction could implement conflicting conclusions.

In table 6, which presents the results on net interest margin (NIM), all the estimated impacts of bank size on NIM which are statistically significant are negative. Almost all the equations of NIM are showing statistically significant coefficients. For the equations without lagged periods of LLR the estimated coefficients are -0.15 for NIM and -0.15 for NIM(Q1). The impact of bank size on NIM(Q4) is not statistically significant. The estimated coefficients of bank size in the equations that include lagged periods of LLR are -0.22 for NIM, -0.10 for NIM(Q1) and -0.20 for NIM(Q4). This result suggests that increase in bank size would have a decreasing impact on bank's net interest margin.

In table 4, deposits to assets ratio estimates statistically significant results in ROAA, ROAA(Q1), ROAA(Q4) along with RoRWA(Q1). All the estimated values are positive, meaning that increase in deposits to assets ratio would influence an increase in bank's returns on assets. The estimated values are 1.37 for ROAA, 1.05 for ROAA(Q1), 5.38 for ROAA(Q4) and finally 13.18 for RoRWA(Q1). In table 5, this response variable results statistically significant values in ROAA and ROAA(Q1) as well as RoRWA(Q1) and RoRWA(Q4). All the values are positive and consistent with the results of table 4. The estimated values are 1.65 for ROAA, 4.11 for ROAA(Q4), 1.82 for RoRWA(Q1) and finally 8.16 for RoRWA(Q4).

In table 6, deposit to asset ratio has a statistically significant positive impact on NIM in every equation. The impact is consistent with the estimated values of table 4 and table 5. The equations without lagged periods of LLR results 1.04 for NIM, 0.86 for NIM(Q1) and 1.35 for NIM(Q4). The equations with lagged periods of LLR results 1.05 for NIM, 1.29 for NIM(Q1) and 0.99 for NIM(Q4). The results propose that increased number of deposits to assets increases the net interest margin of a bank.

Noninterest income to operating revenue results statistically significant results in ROAA and ROAA(Q1) in table 4. However, the estimated value is -0,00 in both estimated groups. The effect of this variable is extremely low yet statistically significant and negative. In table 5, the groups ROAA, ROAA(Q4), RoRWA and RoRWA(Q4) indicate statistically significant coefficients. The estimated values are -0,00 for ROAA, -0.02 for ROAA(Q4), -0,01 for RoRWA and -0.05 for RoRWa(Q4). All the estimated values are negative in both table 4 and table 5. This signals that an increase in noninterest income would decrease the return on assets.

In table 6 noninterest income to operating revenue results statistically significant impact in every column of NIM. The coefficient is -0.00 for NIM and NIM(Q1) in both kind of equations, the one that does not include lagged periods of LLR and the one that contain lagged periods of LLR. The coefficient is -0.01 for NIM(Q4) in both equations. These impacts described in table 6 are consistent with the impacts described in table 4 and table 5. The impacts indicates that an increase noninterest income has a small negative impact on bank profitability.

The estimated values of capital adequacy ratio are mainly positive with one exception. This control variable results statistically significant estimates in ROAA and ROAA(Q4) in table 4. The estimated values are 0.01 for ROAA and 0.07 for ROAA(Q4). In table 5, the statistically significant results are shown in ROAA, ROAA(Q4), RoRWA, RoRWA(Q1) and RoRWA(Q4). The estimated values are 0.01 for ROAA, 0.12 for ROAA(Q4), -0,02 for RoRWA, 0.02 for RoRWA(Q1) and finally 0.12 for RoRWA(Q4). Seems like the negative value of RoRWA, which includes all banks of data is not consistent with the other results. However, most of these estimated values indicate that increase in capital adequacy ratio would increase the return on assets and risk-weighted assets.

The results of table 6 vary from the results of table 4 and table 5 regarding capital adequacy ratio. The equation that does not contain lagged periods of LLR results statistically significant value of -0.01 in NIM(Q1) and 0.01 in NIM(Q4). In the equation that includes lagged periods of LLR results statistically significant value of -0.00 in NIM and -0.0 in NIM(Q1). There is a bit variation between the impact of capital adequacy ratio on net interest margin. Nonetheless, the impact is rather small in every group of NIM.

The last bank specific variable is efficiency, which is defined as noninterest expenses divided by revenues. Efficiency provides low estimated values, so the effect seems to be small. Efficiency provides statistically significant values in ROAA, ROAA(Q1) and ROAA(Q4) in table 4. The estimated values are -0.00 for ROAA, -0.00 for ROAA(Q1) and -0.01 for ROAA(Q4). Efficiency does not result

any statistically significant estimation values in returns of risk-weighted assets in table 4. However, in table 5, efficiency variable reveals statistically significant results in ROAA, ROAA(Q4), RoRWA and RoRWA(Q4). The estimated values are -0.00 for ROAA, -0.03 for ROAA(Q4), -0.00 for RoRWA and -0.05 for RoRWA(Q4).

In table 6, all the columns show statistically significant results of the impact of efficiency. All the values of the impact of efficiency are negative. For NIM(Q4) the impact is -0.01 and for the rest the impact is -0.00. All the estimated coefficients are negative which implies that increase in efficiency would decrease bank profitability.

5.2.3 Impact of industry specific variables

In this study industry specific control variables consist of interest rate or government bond yield related variables. The used variables of this category are Euribor 3-months, TED, Shadow rate, EURORISK and lastly TERM. This chapter presents the estimated results of these interest related variables on bank profitability.

In table 4 Euribor 3-months provides statistically significant results in profitability variables ROAA and ROAA(Q1). The estimated values are 0.10 for ROAA and 0.14 for ROAA(Q1). In table 5 the results are statistically significant in ROAA and ROAA(Q4). The estimated coefficients are 0.18 for ROAA and 0.50 for ROAA(Q4). All of the values are strongly positive. The results suggest that if central bank increases the level of interest rates the returns on assets and risk-weighted assets would increase. The estimated values could be seen as quite high, especially for the group ROAA(Q4).

In table 6 Euribor 3-months results statistically significant values of 0.13 in NIM, -0.04 in NIM(Q1) and 0.09 in NIM(Q4). These numbers are in equations without lagged periods of LLR. Euribor 3-months results statistically significant values of 0.22 in NIM and 0.16 in NIM(Q4) in equations with lagged periods of LLR. All the estimated values are positive except for NIM(Q1) in equation without lagged periods of LLR. A positive impact of Euribor 3 months on net interest margin suggests that an increase in Euribor increases net interest margin.

In table 4 TED reveals statistically significant results for ROAA(Q1) and in table 5 for ROAA(Q4) and RoRWA(Q4). The estimates values are -0.30 for ROAA(Q1), -0.83 for ROAA(Q4) and -1.71 for RoRWA(Q4). All the values are strongly negative, which indicates then increase in this interest variable would generate decrease in bank profitability.

In table 6 variable TED results statistically significant value -0.11 in NIM and 0.13 in NIM(Q1) in equations which does not contain lagged periods of LLR. In equations which include lagged periods of LLR the variable TED results -0.25 in NIM and 0.22 in NIM(Q1). The results imply that banks with smaller loan loss reserves would experience increased net interest margin if the gap between Euribor 3 months and Germany 3-month government bond would increase. This

effect can be seen only in banks with the smallest loan loss reserves. In group including the whole sample of banks the impact is negative meaning that increased gap between Euribor 3 months and Germany 3-month government bond would decrease net interest margin.

Shadow rate is a tool that measures the effect of quantitative easing policy. Shadow rate is not able to reach statistically significant results in any estimation models of this paper.

EURORISK measures the movements of long-term European government bond yield by measuring the relation between Italy 10-year government bond rate and Germany 10-year government bond rate. This industry specific control variable results statistically significant results in ROAA(Q1) in table 4. The estimated value is 0.08. This value indicates the increase in EURORISK could implement increase in return on assets. Increase in EURORISK means an increase in gap between Italy 10-year government bond rates and Germany 10-year government bond rates. In table 6 EURORISK results statistically significant values in NIM and NIM(Q4) in equations without lagged periods of LLR. The estimated values are 0.05 in NIM and 0.07 in NIM(Q4). EURORISK results significant results also NIM and NIM(Q1) in equations with lagged periods of LLR. The estimated values are 0.06 in NIM and -0.06 in NIM(Q4). NIM(Q4) has the only statistically significant negative value resulted via EURORISK. Besides this one negative value which would indicate a decrease in net interest margin if EURORISK increased all the other values indicate an increase in net interest margin if the gap between Italy 10-year government bond rate and Germany 10-year government bond rate.

TERM measures the movements of Germany government bond yield. TERM variable estimates statistically significant results in ROAA(Q1) in table 4 besides ROAA(Q4) and RoRWA(Q4) in table 5. The estimated values are -0.30 for ROAA(Q1), -0.81 for ROAA(Q4) and -1.69 for RoRWA(Q4). All the values are negative, which estimates that if TERM increases bank return on assets and risk-weighted assets decreases.

Based on the results presented in table 6 TERM indicates a statistically significant increase in net interest margin in NIM(Q1) in equation without lagged periods of LLR. The estimated value is 0.12. Increase in TERM means an increase in gap between Germany 10-year government bond rates and Germany 3-months government bond rates. Also, TERM indicates an increase in NIM(Q1) in equation with lagged periods of LLR. The statistically significant value is 0.23. On the contrary, TERM results statistically significant negative value -0.20 in NIM in equation with lagged periods of LLR. This result suggests that if TERM increases meaning that gap between Germany 10-year government bond rate and Germany 3-months government bond rate widens the effect on NIM would be decreasing.

5.2.4 Impact of macroeconomic variables

The macroeconomic variables include gross domestic product (GDP) and consumer price index (CPI). The idea of macroeconomic variables is to illustrate the banking environment. GDP represents the economic growth and CPI is a tool to measure inflation level.

CPI is revealing statistically significant results in ROAA and ROAA(Q1) in table 4. The estimated values are -0.14 for ROAA and -0.20 for ROAA(Q1). In table 5, CPI is showing statistically significant results in ROAA and ROAA(Q4). The estimated results are -0.10 for ROAA and -0.24 for ROAA(Q4). CPI results statistically significant negative impact on NIM and NIM(Q4) in equations without lagged periods of LLR. The value is -0.07 for NIM and -0.09 for NIM(Q4). In equations with lagged periods of LLR the impact of efficiency on NIM is -0.01. The negative values implement that an increase in inflation would cause reduction in bank profitability.

GDP is reaching statistically significant results in equations of ROAA and ROAA(Q1) in table 4. The estimated values are 0.06 for ROAA and 0.05 for ROAA(Q1). Besides these results, GDP provides statistically significant estimations in every group in table 5. The estimated values are 0.05 for ROAA, 0.02 for ROAA(Q1), 0.09 for ROAA(Q4), 0.09 for RoRWA, 0.11 for RoRWA(Q1) and finally 0.19 for RoRWA(Q4). In table 6 the impact of GDP is statistically significant only in equation with lagged periods in column NIM. The impact is 0.01 for NIM. All the estimated values of GDP on profitability are positive. The largest impact is in group RoRWA(Q4) where the value is 0.19. The positive values of each estimation predicts that if economic growth is positive, the bank profitability increases. Both results of CPI and GDP of this study are logical.

5.3 Interpretation of Results

This chapter compares the results of this paper to the previous literature introduced in Chapter 3. The aim of this study is to investigate the impact of bank risk-taking on bank's profitability. In this paper the main variable describing credit risk is loan loss reserves to total loans (LLR) and the lagged variables of LLR. In previous literature also some other measures of risk have been applied. In the following sections the results of LLR on bank profitability is compared to results of previous literature regarding bank risk discussing, when necessary, differences in applied measured of bank risk. This chapter includes an interpretation of other results of the empirical model.

5.3.1 ROAA and RoRWA

Based on table 4 the results of LLR are statistically significant on ROAA and ROAA(Q4). The result suggests that an increase in LLR would decrease ROAA by 0.08 and ROAA(Q4) by 0.03. This result indicates that increased risk-taking

would not be favorable for bank's profitability since the impact would be decreasing. This result is consistent with Liang (1989) as well as Saleh and Afifa (2020). In the study of Liang (1989) bank risk is measured via standard deviation of profits, risk-taking behavior, and local market uncertainty. The result of Liang (1989) suggest that risk reduces bank profits.

In the study of Saleh and Afifa (2020) the risk variable is similar to this study. Saleh and Afifa (2020) measure credit risk via loan loss provisions to loans ratio. The results of Saleh and Afifa (2020) indicates that risk has a negative impact on profitability variables ROAA and NIM. These profitability variables are also similar to this study.

The results presented in table 5 indicate an interesting aspect compared to the results presented in table 4. The result of risk-taking in table 4 suggests that the impact of increased risk is negative on bank profitability. However, the results in table 5 imply that increased risk-taking has a positive impact on bank profitability when the lagged periods of risk are measured. The statistically significant impact of one lagged period of LLR is 0.06 for ROAA and 0.10 for ROAA(Q4). At the same time the result of LLR is – 0.15 for ROAA and -0.13 for ROAA(Q4). These results imply that in the long-run risk taking has increased profitability and only the most recent LLR observation indicates realization of losses caused by credit risk.

The similar trend between LLR and one lagged period of LLR continues even when LLR is lagged for two periods. The statistically significant coefficient of two lagged periods of LLR is 0.06 for ROAA and 0.05 for ROAA(Q4). The coefficient is identical for ROAA in both one and two lagged periods of LLR. For ROAA(Q4) the coefficient is a half lower, so the increasing impact is smaller.

For RoRWA, the impact of LLR is statistically significant and results -0.24. RoRWA does not have statistically significant result in one lagged period of LLR. However, there are statistically significant impact in two lagged periods of LLR. This positive coefficient is 0.12 meaning that increased risk causes positive impact on RoRWA after two periods. This effect is similar to the impact between the lagged periods of LLR in ROAA.

RoRWA(Q4) also results statistically significant coefficients from the impact of LLR and one lagged period of LLR. For RoRWA(Q4) the coefficient of LLR is -0.18 and the coefficient of one lagged period of LLR is 0.13. These effects are similar compared to other relationships between profitability and risk in table 5.

In table 5 the trend between profitability and risk variable as well as lagged risk variable is consistent. All the statistically significant results perform similarly. At first the effect of risk is negative to profitability variable, but whenever the risk variable is lagged, the effect changes the direction, and the impact is positive. This result is completely new and there is no previous empirical research equal to this empirical estimation. According to the evidence of this empirical research risk-taking is beneficial for a bank's profitability.

The relationship between bank size and profitability maximation has been studied quite much in previous literature. In table 4 the coefficients of bank size indicate positive effect on bank profitability whenever bank assets increase. In

table 5 ROAA(Q1) has the only statistically significant result and it is slightly negative. The result of bank size increasing the profitability is consistent with Menicucci and Paolucci (2015). There are numerous reasons for this positive impact. Menicucci and Paolucci (2015) state that large bank might benefit from smaller risks, loan and product diversification, and possibilities that smaller banks do not have, such as entering to market that small banks cannot enter. Also, like stated in Chaper 2, larger banks have more resources to have better risk management. Manicucci and Paolucci (2015) use the exact same profitability variables as used in the empirical analysis of this study.

The results considering bank size is also consistent with Fahlenbrach et al. (2018). The evidence of Fahlenbrach at al. (2018) suggest that bank-level credit booms as well as aggregate credit booms creates poor performance of banks. The study concludes that poor performance is due to investors excessively optimism.

An increase in deposits to assets ratio results statistically significant positive impact on profitability in both table 4 and table 5. Based on the results, multiple profitability variables and different quartiles of these variables are experiencing statistically significant results. This result is consistent with the study of Khan et al. (2017), which suggest that an increase in deposits to total assets causes increase in risk-weighted assets and liquidity creation. Khan et al. (2017) also find that banks with higher capital buffers take less risk. The evidence of Khan et al. (2017) results that larger banks take less risk than smaller banks whenever larger banks have more deposits.

The impact of non-interest income to operating revenue on profitability is statistically significant on profitability variables. The coefficient is negative in all statistically significant groups, but the coefficients are either zero or at least very close to zero. Still, the evidence suggests that increase in non-interest income to operating revenue is decreasing the return on average assets and return on risk weighted assets. This result is not completely consistent with previous literature. Dietrich and Wanzenried (2011) argue that more profitable banks are less dependent on interest income. Also, Li et al. (2021) argue that non-interest revenue sources increase the profit performance of banks. Non-interest income is a relevant option to interest-based income source and can help cover losses that low interest rates might create. However, the study of Li et al. (2021) also evidences that non-interest revenue streams are inversely related to risk.

Capital Adequacy Ratio (CAR) has multiple statistically significant results in different quartiles of profitability variables. These results are mostly positive, except for one RoRWA equation. Basically, CAR characterizes how much capital a bank holds accessible. This result is consistent with the results of Trujillo-Ponce (2013), which evidence that well capitalized banks are more profitable. Based on the results of Trujillo-Ponce (2013) higher capital ratio increase only return on assets variable. The result of this study concerning capital ratio is also consistent with the result of Menicucci and Paolucci (2015). The result suggest that well capitalized banks are able to have lower costs of external financing which can be converted into increased profitability.

Based on the results, Euribor 3 months has a positively related impact on ROAA variable. Increased interest rate increase bank's return on assets. This result is logical since the yield of investment increases whenever interest rates rise. There are multiple studies that evidence challenges in bank's profitability whenever interest rate stays low for a longer period. Lopez et al. (2020) evidence that negative interest rate create loss in bank profits. The study of Lopez et al. (2020) finds decreasing effect in net interest income.

The result concerning Euribor 3 months could also imply concerns that if interest rate would decrease, the impact could be decreasing to bank's profits. There are multiple studies which evidence that low interest rate increases bank's risk-taking appetite (Paligorova & Santos, 2017; Dell'Ariccia et al., 2017; Bikker & Vervliet, 2017; Jimenez et al., 2014).

Consumer price index which is a macroeconomic variable describes inflation. Based on the results an increase in CPI would decrease the ROAA variable in every equation that has a statistically significant impact. This indicates that if inflation increases the return of assets would decrease. However, the other macroeconomic variable GDP has statistically positive impacts in most equations in table 4 and in table 5. The increasing effect variates between 0.02 to 0.19. These results indicate that whenever there is economic growth profitability of banks tends to increase. This result is commonly recognized in previous literature as well.

5.3.2 Net Interest Margin

In this chapter the results presented in table 6 are discussed and compared to the previous literature regarding to the determinants of net interest margin. Since the empirical estimation considering net interest margin is most closely related to Angori et al. (2019) it is beneficial to compare the results primarily between these studies. Although the estimation models between the studies have some common variables, Angori et al. (2019) used dynamic econometric model which differs from the model of this study.

The risk variable loan loss reserves imply a positive impact on net interest margin in all statistically significant results. This result is consistent with the empirical results of Angori et al. (2019) since the results suggest that loan loss reserves have a positive impact on net interest margin in every empirical model that is able to reach statistically significant results. Based on the results of this study the positive impact is statistically significant only in models containing NIM(Q1) which is the group with the smallest loan loss reserves. Other models are not showing statistically significant impact.

The lagged loan loss reserves are implying statistically significant positive impact on NIM(Q1). There does not exist any previous studies to model the lagged periods of loan loss reserves. This result indicates that risk taking could increase the profitability even on later periods in the lowest LLR quartile. The impacts of loan loss reserves on NIM are suggesting an increase in profitability.

Based on the results, bank size has a negative impact on NIM. The impact is larger in the models that include lagged periods of loan loss reserves. The result suggests that increase in bank size would have decreasing impact on net interest margin. This effect differs from the impact of bank size on the other profitability variables which are return of average assets and return of risk-weighted assets. This result is in consistent with the results of Menicucci and Paolucci (2015) since the coefficient of bank size on NIM model is also negative.

The impact of deposits to assets on net interest margin is positive in every model of NIM. The result suggests that increase in deposits to assets would have a substantial increase in net interest margin. The direction of Capital Adequacy Ratio (CAR) has variation between the different models of NIM, but all the impacts are yet small and close to zero.

The impact of efficiency on NIM is statistically significant in every model of NIM but the effect is rather small and close to zero as well. The result variates between -0.01 and 0.00. This result is not fully consistent with Angori et al. (2019) since the direction of the impact is positive. The coefficients of Angori et al. (2019) are 0.01.

The direction of the effect of interest rates on net interest margin variates between the different groups. Euribor 3-months has a positive impact on most groups of NIM. However, the equation of NIM(Q1) that does not include lagged periods of loan loss reserves has statistically significant coefficient -0.04. The positive coefficients of other groups of NIM suggest that increase in Euribor-3-month interest rate would increase the net interest margin. The interest rate decisions are a part of central bank monetary policy. It can be concluded that tightening interest rate policy would increase the profitability of banks.

Multiple previous studies (e.g. Dell'Ariccia et al., 2017; Delis & Kouretas, 2011; Jimenez et al., 2014) suggest that low short-term interest rates increase bank risk-taking. Also, the study of Dell'Ariccia et al. (2014) suggest that declining interest rates lead higher risk-taking in banks that are well capitalized. However, the results of Dell'Ariccia et al. (2014) also suggest that highly levered banks might decrease risk-taking during low interest rates. Based on the empirical analysis of this study the increase in short-term interest rate would increase profitability. This result could possibly indicate that a decrease in short-term interest rate could decrease profitability and create pressure to compensate the lost profitability.

The direction of the impact of TED on net interest margin is variate as well. The group of NIM that includes the whole sample indicates negative results, which suggest that increase between the gap of Germany 10-year minus Germany 3-month government bond would decrease the net interest margin. However, the other equations of NIM result positive impact which suggest that an increase between the gap of Germany 10-year minus Germany 3-month government bond would increase the net interest margin.

The direction of the impact of EURORISK on NIM is mainly positive expect for NIM(Q1) from the model that includes lagged periods of loan loss reserves. Also, the direction of the impact of TERM on NIM is mainly positive expect for

NIM which describes the whole sample in the model that includes the lagged periods of loan loss reserves.

An increase in consumer price index would have a negative impact on net interest margin based on every statistically significant result. The impact if more negative in models that do not include lagged periods of loan loss reserves. The result is consistent with the results of Angori et al. (2019) regarding the impact of inflation variable on NIM. The numeric values of the coefficient are also close to each other between Angori et al. (2019) and this study.

Based on the result of gross domestic product on net interest margin, the statistically significant impact is slightly positive. This result is not fully consistent with the results of Angori et al. (2019) since the results suggest that increase in GDP would have negative impact on NIM. However, the positive impact of GDP on NIM measured in this study is consistent with the results seen in table 4 and in table 5. The overall results of this study suggest that an increase of GDP would have a positive impact on bank profitability.

6 CONCLUSIONS

This study investigates the impact of bank risk-taking on bank profitability. The investigation consists of two parts. The first part presents previous literature regarding to the subject of this study. The second part contains an empirical analysis, which examines the impact of bank risk-taking on bank profitability and the determinants of bank profitability. The panel data set used in the empirical analysis contains observations from 619 European banks. Besides the balance sheet information of individual European banks, the data set contains banking industry-based information regarding to the interest rates and macroeconomic variables. The panel data set covers periods from 2005 to 2021.

The empirical estimation is operated via regression models. The estimation measures the impact of risk-taking on profitability via three profitability variables. The first profitability variable is return on average assets (ROAA). The second profitability variable is return on risk-weighted assets (RoRWA) and the third one is net interest margins (NIM). The estimation models are designed to describe the drivers of bank profitability. The estimation covers the whole sample of banks, and the banks are also divided into quartiles based on the ratio of loan loss reserves to total loans. In this study loan loss reserves to total loans describes credit risk in the estimation. Banks with the smallest ratio of loan loss reserves to total loans is represented as Q1. Banks with the largest ratio of loan loss reserves to total loans is represented as Q4. The banks with higher ratio of loan loss reserves to total loans are the ones that have the highest level of credit risk-taking.

The results of the study are presented and discussed closely in Chapter 5. Based on the results the impact of interest rates on profitability is significant. The impact of central bank interest rates on profitability is positive on ROAA and NIM variables. The result is also consistent with the previous literature. An increase in central bank interest rates, which is described as Euribor 3-month in this analysis, has an increasing impact on bank profitability. This is logical especially since NIM is interest-based income source. Based on previous evidence increasing interest rates typically increase bank profitability.

The relationship of EURORISK is positive on NIM profitability variable. EURORISK describes the gap between the riskiest government bond yield and

the government bond yield which has the smallest risk. These countries are Germany which typically has the smallest yield and Italy which suffers from financial challenges and for that reason has the highest yield. The result indicates that increased yields on government bonds increase the net income-based profitability. Although an increase in EURORISK might increase profitability, increase in EURORISK would also indicate that either Italy's government bond is valued as riskier, or Germany's government bond is valued containing less risk. In either way if the gap between these government bond yields is increasing it means that EURORISK variable increases.

An increase in deposits to assets ratio indicates an increase in every profitability variable of this study. Deposits to assets ratio describes the capital structure of an individual bank. The impact is largest on RoRWA profitability variable. However, the impact is also quite large on ROAA especially in the group that contains the largest number of loan loss reserves. The group with largest number of loan loss reserves to total loan represents the group of banks which has the highest level of credit risk measured in this study. The impact of increase in deposits to assets ratio is also increasing in NIM profitability variable. The impact is also larges in the group that has the largest loan loss reserves. The evidence suggests that higher deposits to assets ratio increases profitability. The effect is larger in banks that hold higher level of credit risk.

Credit risk is described as loan loss reserves to total loans in the empirical model. Loan loss reserves is generally used credit risk measurement and the most widely available proxy of the credit risk concentration of bank's portfolio. Loan loss reserves are designed to increase banks' ability to cover possible loan losses or non-performing loans and decreasing loan loss reserves to total loans ratio would increase the level of credit risk. Although loan loss reserves are generally used credit risk measurement in literature considering bank risk taking analysis it is still proxy variable. However, loan loss reserves are widely available credit risk measure and therefore a relevant risk variable.

The model is designed to measure the influence of lagged credit risk on profitability via delaying loan loss reserves variable for one, two and three periods. Based on the results of the study, increase in loan loss reserves to total loans has increasing association on net interest margin. Typically, if loan volume increases bank's loan loss provisions need to be increased. Increase in loan volume might create increase in interest-based income. Empirical evidence shows that increase in credit risk variable has statistically positive effect only in NIM group which includes the smallest loan loss reserves to total loans. The result suggests that increase of credit risk in the group that has the smallest ratio of credit risk reserves would create increasing impact in net interest margins. Although the coefficient is smaller when compared to lagged period of loan loss reserves, yet the result is still positive in group NIM(Q1). This evidence indicates that increase in credit risk-taking would increase profitability.

The effect of credit risk differs between the different profitability variables. Where the influence of credit risk is clearly positive on NIM(Q1) the effect is negative on ROAA and RoRWA. The link of credit risk is the most negative in

group that include the whole sample of banks. The association is slightly less negative in groups that include the banks with highest ratio of loan loss reserves. The most interesting result is the different direction of impact whenever credit risk is lagged. The impact turns positive in both profitability variables ROAA and RoRWA. One lagged period of credit risk impacts more positive effect on group that includes the highest ratio of loan loss reserves. However, two lagged periods of credit risk decrease the impact. Two lagged periods of credit risk results more positive effect in ROAA group that includes the whole sample of banks. Between these profitability variables, the impact of credit risk is always stronger in RoRWA meaning that the coefficient is either more negative or more positive than the coefficient of ROAA.

The evidence suggests that increased credit risk seem to decrease the bank profitability in short period. However, after one or two lagged periods the effect is increasing towards bank profitability. This evidence suggests that increased credit risk-taking is increasing profitability in longer period. The empirical analysis does not show statistically significant results in the group that includes the smallest ratio of loan loss reserves to total loans. Also, the impact is stronger on the return on risk-weighted assets. The results also evidence that the influence of credit risk is increasing on net interest margin.

The evidence of this study could have effect on bank's risk-taking behaviour and encourage banks to take more risk whenever banks have challenges to maintain certain level of profitability. Banks have multiple different ways to increase credit risk such as softening lending standards or increasing lending volume. Furthermore, there are evidence that loan loss reserves are used as income smoothing when considering discretionary provisioning (Ozili, 2017).

Banking authorities have interest in controlling the risk-taking of banks. This motivation is more thoroughly defined and explained in Chapter 2 of this study. The empirical results that are found in this study shows evidence that via risk-taking decisions banks can control profitability especially in longer period. Banking authorities follow closely the financial statements of banks in order to assess and make decisions regarding to bank regulation. The evidence of this study suggest that banks' credit risk decisions and risk-taking behavior have impact on bank profitability.

It is beneficial to investigate bank's profitability because the stability of financial market is extremely important. The empirical analysis regarding bank's credit risk-taking could be developed by extending lagged periods of risk-taking. It would be valuable to measure the impact of risk-taking on profitability in long term. These studies could support finding the optimal amount of banks' credit risk in long term. This exact analysis could be extended by considering different measurements and sources of banks' risk-taking behavior. Most likely bank supervisors have more sources to collect specific data regarding bank's credit risk and risk-taking behavior. The empirical analysis of this study is limited with data that is collected from public market information and public financial statements of banks.

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