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# The Impact of Liquidity Risk on Bank Profitability: Some Evidence from European Banking Sector

Bachelor's Thesis


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## Declaration of Authorship

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In Prague on 1.8.2023 Tomo Ivovič

# Abstract

This thesis examines the effect of liquidity risk on the profitability of European commercial banks following the full implementation of the Liquidity Coverage Ratio. The aim is to analyse and compare this effect on banks in two different regions of the European Union. Therefore, three countries were chosen to represent the Southern European region, and six were chosen to represent the Northwestern European region. Data from 34 banks were collected for 2018-2022 and split into two datasets. Panel regression methods were utilized, and robustness tests were performed to improve the reliability of the results. This study uses two different measures as proxies for liquidity risk to obtain a more comprehensive understanding of the relationship. Both proxies, the Liquidity coverage ratio, and the Financing gap ratio, were found to be insignificant determinants of profitability in both regions. We also found that the Cost-to-income ratio negatively and significantly impacts banks' profitability in both regions. At the same time, credit risk and bank size showed a significant effect on the profitability of banks in the Southern European region.



**JEL Classification**

C12, C33, G21, G28, G32

**Keywords**

banks, liquidity risk, liquidity, profitability, panel regression


**Title**

The impact of liquidity risk on bank profitability: some evidence from European banking sector

# Abstrakt

Táto práca skúma vplyv rizika likvidity na ziskovosť európskych komerčných bánk po plnom zavedení ukazovateľa krytia likvidity. Cieľom je analyzovať a porovnať tento vplyv na banky v dvoch rôznych regiónoch Európskej únie. Preto boli vybrané tri krajiny, ktoré reprezentujú región južnej Európy, a šesť krajín, ktoré reprezentujú región severozápadnej Európy. Zozbierané boli dáta z 34 bánk za roky 2018 - 2022 a rozdelené do dvoch dátových sád. Využili sa metódy panelovej regresie a na zvýšenie spoľahlivosti výsledkov sa vykonali testy robustnosti. Táto štúdia využíva dve rôzne premenné ako ukazovatele rizika likvidity s cieľom získať komplexnejšie pochopenie vzťahu. Zistilo sa, že obidva ukazovatele, ukazovateľ krytia likvidity a ukazovateľ finančnej medzery, sú nevýznamnými determinantmi ziskovosti v oboch regiónoch. Zistili sme tiež, že pomer nákladov k výnosom negatívne a významne ovplyvňuje banky v oboch regiónoch. Zároveň úverové riziko a veľkosť banky vykazovali významný vplyv na ziskovosť bánk v juhoeurópskom regióne.



**Klasifikace JEL**

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**Klíčová slová**

banky, riziko likvidity, likvidita, ziskovosť, panelová regresia


**Title**

Vliv rizika likvidity na ziskovost bank: evropský bankovní sektor

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## References

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# Acronyms

| | |
|---|---|
| BIS | Bank for International Settlements |
| EBA | European Banking Authority |
| EBITDA | Earnings Before Interest, Taxes, Depreciation, and Amortization |
| ECB | European Central Bank |
| FGR | Financing gap ratio |
| HQLA | High-quality liquid assets |
| LCR | Liquidity Coverage Ratio |
| LLP | Loan loss provision |
| NIM | Net interest margin |
| NSFR | Net Stable Funding Ratio |
| NWE | Northwestern Europe |
| ROA | Return on average assets |
| ROE | Return on equity |
| SE | Southern Europe |

# Introduction

Commercial banks play a vital role in the financial system. They act as intermediaries between depositors and borrowers and facilitate the flow of capital throughout the economy. Since a sound and profitable banking sector significantly contributes to economic prosperity and stability, extensive research has focused on studying bank profitability determinants. Besides capitalization, bank size, operational efficiency or credit risk, liquidity risk and market factors have also been considered potential factors impacting bank profitability. Banking liquidity is defined as the ability to meet short-term financial obligations in a timely manner. In contrast, liquidity risk can be defined as the probability that a bank will not have enough liquid assets available to meet its short-term liabilities. For example, already Bourke (1989), in their study, analysed the impact of liquidity on bank profitability and found it to be positive, while Molyneux & Thornton (1992) found the relationship to be inverse.

The significance of liquidity risk in the financial system and the importance of liquidity risk management was emphasized by the financial crises of 2007-08, where liquidity (or rather illiquidity) was one of the leading causes. Numerous large banking groups, such as Northern Rock in the UK or Washington Mutual in the US, failed during the crisis due to liquidity issues. In the case of Washington Mutual, the failure was also triggered by the high default rates on mortgages and the bursting of the housing bubble. Consequently, the bank encountered considerable liquidity difficulties, even worsened by the bank run caused, i.a., by the failure of another prominent bank, the Lehman Brothers. The inability to raise enough cash to meet the demands eventually led to the failure of Washington Mutual in September 2008.

In response to the crisis, the Basel Committee on Banking Supervision introduced the Basel III Accords, intended to strengthen risk management and regulation in the banking industry. Two of the primary measures introduced were the Liquidity coverage ratio (LCR) and Net Stable Funding Ratio (NSFR), aimed at measuring, managing, and in the end, decreasing liquidity risk. Although the regulations are designed to impact the banks positively, other implications must also be considered. Fulfilling the requirements may limit banks' ability to perform the maturity transformation or may make them hold more liquid assets and limit lending capacity. In theory, liquid assets are associated with lower profits than illiquid ones, and thus the regulations may negatively impact profitability. However, this does not always hold, as

the relationship between liquidity risk and profitability is complex and multidimensional and requires thorough examination.

The reviewed literature on the topic showed mixed results. For example, Trujillo-Ponce (2013) and Claeys & Vander Vennet (2008) showed a positive relationship between liquidity risk and profitability, while Marozva (2015) and Hakimi & Zaghdoudi (2017) found the opposite result. However, most of the existing research covers the period before implementing the new liquidity risk requirements. The LCR was fully implemented in the European Union in 2018, while the NSFR was in 2021.

This thesis focuses on analysing the effect of liquidity risk on the profitability of commercial banks while targeting the European banks directly regulated by European Central Bank. This thesis's main contribution is using the LCR as a proxy for liquidity risk in the period following its full implementation in 2018. It also uses the Financing Gap ratio as an alternative liquidity risk measure to obtain a more comprehensive understanding of the relationship. Consequently, considering the conflicting results of prior research, this study attempts to provide more precise results on the relationship between liquidity risk and profitability while also considering the effect of other potential determinants of bank profitability and thus supporting other findings from prior research.

Acknowledging the fact that the liquidity risk may impact banks of various regions differently, this thesis focuses separately on commercial banks in Southern Europe (Italy, Spain, and Greece) and banks in Western and Northern European countries (Germany, France, Belgium, the Netherlands, Austria, and Finland) and compare the results from these separate analyses. Panel data analysis was employed to analyse the data from these two groups between 2018 and 2022. The selection of other determinants of profitability utilized as explanatory variables in the linear model was mainly based on existing research, for example, by Athanasoglou et al. (2008), Chen et al. (2018) or Golubeva et al. (2019).

The thesis is structured into four main chapters and a conclusion. Chapter 1 provides the theoretical background of the topic. Firstly, the study explores bank profitability and provides an overview of the primary measures used. It follows with a description of the critical bank risks, emphasizing liquidity risk. The chapter is concluded with a description of the two new liquidity requirements. Chapter 2 includes a review of the existing literature on bank profitability determinants while focusing on the relationship between liquidity risk and profitability. It also contains a section with a

formulation of the research hypothesis. Chapter 3 provides the selection criteria and source of the data. Furthermore, it describes the selected variables for the linear model and the data analysis methods. Chapter 4 contains the summary statistics of the data but mainly provides the regression results and their interpretation. The final section of this thesis is the conclusion, where the key findings are summarized while also containing contributions, limitations, and suggestions for further research.

# 1. Theoretical background

## 1.1 Overview of the banking system: role, profitability, and measures

### 1.1.1 The role of banks in the economy

The role of commercial banks in today's economy is crucial, as they are the key components of the financial system. Commercial banks primarily serve as intermediaries between depositors and borrowers and facilitate the redistribution and flow of funds throughout the economy as they channel available resources (deposits) towards economically productive activities of the borrowers. Thus, accepting deposits and granting loans leads to credit and liquidity creation, significantly contributing to economic growth and development. A profitable and efficient banking sector positively impacts not only individual nations but also the global economy as it creates a more resilient financial system. Since the soundness of the banking sector is an essential prerequisite for economic stability and growth, the banking industry has drawn significant attention over the past decades as experts seek to comprehend the factors influencing its profitability.

### 1.1.2 Bank profitability

Banks are profitable when they are able to generate positive earnings over a specific period. A bank's profits are influenced by numerous factors or determinants, which can be classified as internal and external. The main difference is that the internal or bank-specific factors are affected by management decisions while the external factors are not. The internal factors contributing to bank profitability can be defined as those shaped by management decisions and policy objectives (Staikouras & Wood, 2004). These can include risk management practices, capital adequacy, or bank size. Variables classified as external determinants of profitability are independent of bank management and instead reflect the economic and legal environment (Athanasoglou et al., 2008). Such factors are inflation, GDP growth, interest rate levels, or prudential regulations. For example, regulations may affect bank profitability by imposing limits on lending and investment activities or requiring higher capital reserves. Furthermore, a rise in interest rates can increase bank's interest income, but on the other hand, it can also increase its borrowing costs. Higher interest rate levels may also imply decreased demand for credit. The overall impact of the interest rate change is thus ambiguous.

Since numerous factors impact the profitability of a bank in various ways (different significance or nature of the relationship), bank profitability can be defined as a function of these internal and external factors.

### 1.1.3 Measures of bank profitability

There are several metrics and financial ratios used to measure profitability. Those that are the most applicable to the banking industry include, for example, Return on assets (ROA), Return on equity (ROE) and Net interest margin (NIM).

#### 1.1.3.1 Return-on-Assets ratio (ROA)

ROA is one of the most commonly used metrics for measuring the profitability of banks. This ratio provides insight into how much profit a company earns from its assets by comparing net income to the value of company's total assets. In other words, it indicates how efficient a company is in utilizing its assets to generate profits. This financial metric is particularly useful in banking industry as the assets primarily consists of the resources the bank lends out. Hence, it shows how effective the bank management is in utilizing the funds it loans. ROA is calculated by dividing company's earnings by its total (average) assets. In general, higher ratio suggests better performance than a lower one. However, since banks are usually highly leveraged and thus can have large asset base, even a low ROA may still represent significant profit for the bank.

#### 1.1.3.2 Return-on-Equity ratio (ROE)

ROE is a financial metric that evaluates investment returns by measuring the net profits generated for each dollar of equity. It can be calculated by dividing net income by the average shareholder's equity. This ratio can also be used to evaluate bank management as it indicates how efficiently it allocates equity capital into profitable projects. The higher the ROE, the more efficient the bank's management is at converting shareholders' funds into net income.

#### 1.1.3.3 Net interest margin (NIM)

Net Interest Margin is one of the most frequently utilized profitability ratios in evaluating banks, as it measures the efficiency of a bank's core lending activities. It is calculated as the difference between interest income (a profit generated on interest-earning assets like loans and mortgages) and interest expenses (interest accumulated on

outstanding liabilities like the interest paid to the holders of savings accounts); this difference is then divided by the average earnings assets. NIM is an important metric for evaluating a bank's overall profitability as it indicates its ability to generate profit on interest-earning assets, its primary source of revenue.

## 1.2 Bank risk

The goal for banks, like any other profit-making business, is to maximize the net income through their core operations, i.e., granting loans and accepting deposits. However, banks operate in a risk business, and higher profits are usually associated with higher risk.

Risk is inherent to the nature of the banking industry and the bank's business model. This inherent risk stems from the high leverage (the majority of banks' assets is financed by debt) and the nature of banks' operations. Banks, as financial intermediaries, utilize their balance sheets to facilitate transactions and take on the associated risks. These include the possibility that savers will suddenly withdraw their deposits (liquidity risk), that borrowers may fail to repay their loans (credit risk), that interest rates may change (interest-rate risk), and that the bank's securities trading activities will yield poor results (trading risk). There are also other risks that the banks face, such as operational risk, foreign exchange risk, or legal risk.

Hence, the bank management has to focus not only on profit maximization but also on prudent risk management in order to decrease the possibility of failures or potential losses. The techniques and strategies used to mitigate the bank risk and ensure stability depend on its type. Credit and liquidity risks stand out as the most significant risks confronting the banks and are also directly tied to their core operations and the reasons for their failures (Ghenimi et al., 2017). These risks can have significant implications for the bank's profitability and stability, which often depend on proper risk management.

### 1.2.1 Credit risk

The Basel Committee on Banking Supervision (BCBS, 2000) defines credit risk as "the potential that a bank borrower or counterparty will fail to meet its obligations in accordance with agreed terms" (p.1). The credit risk arises from the difference between the actual loan returns and their predicted value. Since the interest the banks earn on the

granted loans is their primary revenue source, this represents a major threat to commercial banks and their profits.

There are several strategies and techniques used to measure and mitigate credit risk. A commonly utilized strategy is the analysis of the borrower's creditworthiness, where the bank assesses and quantifies the credit risk on the loan and the probability of default of the particular borrower. This analysis can be done by looking at the "five Cs of credit": capacity, capital, collateral, conditions, and character (Casu et al., 2006, p. 288). Credit risk can also be partially mitigated through practices such as diversification of loan portfolio, i.e., spreading the investments across different sectors or geographical regions or credit structuring techniques.

Credit risk is often referred to as the most significant risk influencing bank profitability. In theory, the relationship between credit risk and bank profitability could be seen as multidimensional. Excessive credit risk exposure in the form of high-risk loans can lead to a large portion of defaulted loans and, thus, significant losses. On the other hand, conservative credit policies can also hurt bank profitability by limiting their lending activities.

### 1.2.2 Liquidity risk

Liquidity is generally defined as the ease or speed with which an asset or collateral can be converted into ready cash without a significant loss in its monetary value. There are different liquidity levels of assets based on how efficiently the asset can be liquidated, with cash itself being the most liquid one. Other liquid assets include cash-like equivalents (highly liquid assets with short maturity periods), central bank reserves, or marketable securities. Liquidity plays a crucial role in banking as banking operations are based on liquidity. It allows banks to meet their short-term obligations (such as deposit withdrawals) and handle daily transactions. Banking or funding liquidity can be defined as the ability of a bank to meet its obligations immediately at some specific point in the future (Drehmann & Nikolaou, 2013).

Liquidity risk, however, is the possibility that a bank will not have enough cash or liquid assets to settle financial commitments when they come due or will be unable to do so without incurring significant losses. It incorporates a range of potential outcomes related to the ability to settle obligations in the future (Drehmann & Nikolaou, 2013). Liquidity risk is fundamental to the nature of banking activities as the process of transforming liquid liabilities (deposits) into illiquid assets (loans) inevitably subjects

banks to such risk. There are various, often interconnected, reasons for liquidity risk. The most common ones are the maturity mismatch between assets and liabilities, unexpected deposit withdrawals, or changes in market conditions. The maturity mismatch is a misalignment between the maturities of assets and liabilities and a result of one of the core functions of the banks - the maturity transformation. Banks often use deposits or short-term borrowings to finance long-term loans and investments, creating a situation where their assets have longer maturities than liabilities.

The bank management needs to correctly forecast the maturities of assets and liabilities in order to avoid a liquidity crunch. If a bank is not able to meet the demands of depositors on time, it can seriously hurt its reputation and eventually lead to the failure of the particular bank or even the whole banking system due to the contagion effect (Diamond & Rajan, 2005). Meeting the deposit demands can be a considerable challenge when a significant number of clients withdraw their deposits unexpectedly and at the same time, as it can put pressure on the bank's liquid assets and may even force the bank to "fire sale" its assets, significantly affecting the financial performance. Some of the reasons that can cause a so-called "bank run", i.e., a situation when a large number of customers of a bank withdraw their funds simultaneously, are recessionary economic conditions or depositors' loss of confidence in a bank. One recent example of a bank run happened in March 2023 and led to the failure of Silicon Valley Bank based in California. Intensive deposit withdrawals forced the bank to sell its assets at a substantial loss (increased interest rate level decreased the value of its bond holdings), resulting in even more deposit withdrawals and eventually bankruptcy.

Considering the reasons for liquidity risk outlined previously, liquidity risk management (in conjunction with other risks, esp. credit risk and interest rate risk) is a fundamental requirement for all financial institutions, including commercial banks. Banks implement various procedures and controls to identify and measure this risk in order to be able to mitigate it and prevent potential large losses. A prerequisite for efficient liquidity risk management is correctly evaluating the liquidity position and measuring the associated risk. This can be done i.a. by conducting financial ratio analysis, using ratios such as liquid assets-to-total assets or loan-to-deposit ratio which can provide some assessments of a bank's liquidity position. Sound risk management needs to be able to forecast its cash flow (inflows and outflows), and funding needs to be able to meet the financial obligations in the future (both under normal and stressed conditions). Banks often conduct stress tests to assess the impact of possible crises or

adverse shocks on the liquidity position. The stress tests help them analyse whether they have enough funds to survive unfavourable economic conditions and identify potential vulnerabilities. The banks should also maintain sufficient cash reserves and amount of high liquid assets to avoid risks arising from maturity mismatch and to have a cushion to withstand a liquidity squeeze. This may, however, come at a high opportunity cost, as the more liquid assets usually yield lower returns, negatively impacting profitability. Therefore, effective risk management must correctly assess the risk to find the optimal level of liquid assets the bank holds.

### 1.2.3 Basel III

The 2007-2008 financial crises revealed the deficiencies of the prior liquidity management practices and highlighted the importance of effective liquidity risk management. The crisis originated in the U.S. following the subprime mortgage market's collapse, where even borrowers with poor credit histories could obtain loans. It triggered a chain reaction in the financial market, as the credit crises, caused i.a. by the high default rates on the subprime mortgages, led to substantial losses for financial institutions and consequently to a liquidity crisis as the institutions experienced difficulties in obtaining funds to meet their commitments. The financial crises of 2007-2008 resulted in a collapse of several financial institutions, global contagion, and an economic recession. It also caused a sovereign debt crisis in several European countries, such as Greece, Portugal, Ireland, Italy, and Spain (Moro, 2014). The worsened economic situation in these countries led to severe problems and many years of instability in the banking industry. High levels of public debt in Italy, Spain, Greece, and Portugal have persisted until the present, negatively impacting the performance of the local banks.

As a consequence of the 2007-2008 crisis, risk management practices were subject to numerous regulatory reforms to improve the stability of the financial system. To prevent potential liquidity crises, regulatory bodies generally implement various measures to ensure that banks maintain specific levels of liquidity. In response to the 2007-08 crises, where insufficient monitoring and management of liquidity risk played a major role, The Basel Committee on Banking Supervision (BCBS) created the international Basel III regulatory accord, replacing Basel II. It introduced new liquidity and capital requirements, as well as new measures to improve risk management practices designed to strengthen the financial system's stability. The key takeaway from

Basel III are the two complementary liquidity rules - Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR).

The European Banking Authority (EBA) adopted and implemented these regulatory measures in the EU. The EBA, a regulatory body for banks in European Union, plays, together with the European Central Bank (ECB), a key role in the regulation and supervision of banks in the EU. The ECB, which oversees the monetary policy and financial stability of the Eurozone, utilizes the European Banking Union (EBU) for regulation and supervision. Furthermore, the EBU consists of three pillars: Single Supervisory Mechanism (SSM), Single Resolution Mechanism (SRM), and European Deposit Insurance Scheme (EDIS), which collaborate closely with the EBA.

#### 1.2.3.1 Liquidity coverage ratio (LCR)

The LCR is a regulatory standard under Basel III, which requires banks to hold an amount of high-quality liquid assets (HQLA) at least equal to the expected net cash outflows for 30 days. It aims to ensure that banks are able to meet their short-term obligations over a 30-day stress period by maintaining adequate reserves of HQLA (e.g., cash, central bank reserves, marketable securities). In other words, banks need to back up their short-term borrowings with liquid assets and thus tie up more funds in HQLA that could have been otherwise invested in illiquid, generally higher profit-yielding assets.

LCR is used to measure and manage the short-term liquidity risk of banks and can be calculated by dividing a bank's HQLA by its projected total net cash flows over a stress period of 30 days. High-quality liquid assets are defined as assets that can be readily converted into cash without significant loss in value (BIS, 2010). Estimated total net cash outflows are calculated by subtracting total expected cash inflows from total expected cash outflows (retail deposits or wholesale funding run-off). Total cash outflows are calculated by multiplying the outstanding balances of liabilities by respective supervisory rates, while total cash inflows are determined by multiplying the outstanding balances of contractual receivables by inflow rates (Regulation EU 2015/61). It is worth noting that the LCR's reliance on predetermined rates may be seen as arbitrary and may not accurately depict the true liquidity risk in real stress scenarios.

Although LCR is primarily designed to evaluate banks‘ ability to survive liquidity stress scenarios, it can also be used as a liquidity risk indicator. It is generally expressed as a percentage, with higher LCR suggesting a stronger liquidity position and

lower liquidity risk as the bank maintains a higher amount of HQLA relative to the estimated cash outflows. The requirement was at first set to 60% in 2015, but after increasing by 10% annually, it finally reached full 100% on the 1st of January 2019. However, in the EU, the 100% minimum requirement was put into effect already on the 1st of January 2018 (Regulation EU 2015/61).

#### 1.2.3.2 Net stable funding ratio (NSFR)

The NSFR is a liquidity standard specifically designed to address the risk stemming from liquidity mismatch by ensuring that banks do not perform excessive maturity transformation. It urges banks to avoid over-dependence on short-term funding and maintain sufficient stable funding with regard to their long-term assets. Unlike the LCR, which is primarily focused on short-term risk, the NSFR is intended to enhance a bank's long-term stability and liquidity position. It can be calculated by dividing the Available Stable Funding (ASF) by Required Stable Funding (RSF). ASF includes the bank's capital and liabilities considered to be reliable over a one-year horizon. On the other hand, RSF refers to the amount of funding needed to cover a non-monetizable portion of the bank's assets over a one-year horizon. To satisfy this requirement, banks have to maintain a ratio of at least 100%. Since 28th June 2021, the 100% NSFR requirement has become applicable and binding for banks regulated by the ECB.

### 1.2.4 Liquidity risk and bank profitability

The relationship between liquidity risk and bank profitability is multidimensional and complex. It is essential to find a balance between profit maximization and keeping adequate levels of liquidity, as both excess liquidity and illiquidity could hurt the profitability of a bank.

Banks holding small amounts of liquid assets face high liquidity risk, which can negatively affect profitability in multiple ways or even cause banks to collapse. A low liquidity profile may lead to problems in meeting short-term obligations and may force banks to obtain funding at a higher cost. In case of increased liquidity demands, banks might be forced to borrow at a higher interest rate or sell their assets below their market value to meet these demands and financial commitments. Additionally, a high liquidity risk may decrease the depositors' confidence, as they would be more reluctant to deposit their funds in a particular bank, potentially negatively impacting profitability. However, this issue is partially offset by the deposit insurance schemes that are specific for each

country and protect the depositors from losses resulting from banks' inability to meet their debt obligations on time.

On the other hand, the common belief is that holding liquid assets, especially when mandated by the government, negatively affects profitability. After the implementation of Basel III, the banks have to comply with new regulations, including the two new liquidity standards - the LCR and the NSFR. Although they are primarily designed to enhance liquidity risk management and improve the stability of the financial system, the new requirements may also negatively impact banks' profitability. Complying with NSFR leads to an increase in long-term funding, which in general, is more costly and thus may decrease profitability (Dietrich et al., 2014). Satisfying the LCR requirement generally leads to banks tying up more funds in liquid assets, which are usually less profitable. It may limit banks' lending capacity and thus also increase the opportunity cost. This may, however, not always be the case. For example, as liquid assets, government bonds sometimes yield higher returns than mortgage loans.

# 2. Literature summary and research hypothesis development

## 2.1 Literature summary

### 2.1.1 Determinants of bank profitability

The subject of bank profitability has been the focus of numerous studies as scholars try to identify the determinants of bank profitability and examine the relationships between profitability and various internal (bank-specific) and external factors. Bank profitability is generally defined as a function of these factors.

The effect of the internal factors usually varies in different studies. However, some have been found to have a significant impact on profitability in a majority of the reviewed papers. Those are capital (equity), credit risk, operating expenses, and bank size.

The empirical evidence from the majority of studies, for example Bourke (1989) or Kosmidou (2008), indicates that bank capital, measured by capital ratios such as Equity to Assets, impacts the profitability of banks significantly and positively. This outcome is also expected by the theory as equity represents a "free source" of funding (Bourke, 1989) and thus reduces the leverage (external debt) and funding costs. However, as Trujillo-Ponce (2013) disclosed, a higher capital ratio may negatively impact profitability if ROE is used as a profitability proxy - yet this does not necessarily indicate a decrease in profit generated by invested capital, but rather it reflects the decrease in leverage. This explanation is also supported by the fact that Trujillo-Ponce (2013) found capital to impact profitability, when measured as ROA, positively. However, it is important to mention that the new capital requirements implemented as part of the Basel III regulatory accord may limit banks' lending capacity and thus negatively affect their financial performance.

Credit risk is another crucial factor often considered a determinant of bank profitability. Prior studies Athanasoglou et al. (2008) or Ekinci & Poyraz (2019) found the effect of credit risk to be significantly negative, using Loan Loss Provision to Loans and Non-performing loans to total loans ratios respectively as a proxy for credit risk. A recent study of 109 European banks supervised by the ECB by Elekdag et al. (2020) also showed that the NPL ratio negatively and significantly impacts ROA. These findings are consistent with the accounting theory that the increased credit risk, stemming from a higher volume of non-performing loans, leads to banks setting aside

more funds for provisioning, which directly decreases the profits. However, the relationship between credit risk and profitability is seen as complex or multidimensional and may be influenced by various factors such as the banks' business model. Higher credit risk exposure can also be associated with increased profitability because of higher interest income from riskier loans.

When considering bank size (total assets) as the potential determinant of bank profitability, both the theory expectations and the results of prior studies tend to differ. Some scholars, for example Kosmidou (2008), found a positive relationship between size and profitability, supported by the idea that larger banks may benefit from economies of scale. On the contrary, the relationship was found to be negative in a study by Elekdag et al. (2020). According to the theory mentioned by Athanasoglou et al. (2008), the relationship may not be linear, and the positive effect of a bank's increasing size could turn negative beyond a certain threshold (i.a., because of bureaucracy), which was also confirmed in the study by Chen et al. (2018).

Numerous studies have examined the influence of operating expenses (salaries, rent payments…) as a factor affecting bank profitability. These expenses reflect the bank management's efficiency in cost reduction and thus increasing profits. For example, Trujillo-Ponce (2013) and Kosmidou (2008) found the relationship with profitability to be significantly negative (using the Cost-to-income ratio as a proxy for efficiency), in alignment with expectations as increases in expenses directly decrease profits.

Apart from the bank-specific factors, the macroeconomic determinants are also necessary to account for when explaining banks' profitability. The variables most commonly used in prior studies are GDP growth, interest rates, and inflation rate.

The GDP growth rate measures the overall economic growth and indicates the general health of an economy. Consequently, it would positively impact banks' profitability as higher economic activity would increase overall supply and demand for loans and deposits. The positive and significant relationship between GDP growth and bank profitability was validated by most studies (e.g., Trujillo-Ponce (2013) or Elekdag et al. (2020)).

According to Perry (1992), the effect of inflation on bank profitability depends on whether the inflation rate is fully anticipated by the management- should that be true, banks can adjust interest rates, accordingly, allowing them to increase the revenues faster than the costs and thus increase economic profits. Although studies by Molyneux

& Thornton (1992) or more recently by Chen et al. (2018) supported the theory and found a significant and positive effect of inflation on the profitability of the banks, Hakimi & Zaghdoudi (2017) found the relationship between inflation and profitability to be negative.

There are also several other factors that may have an effect on the bank's profitability, such as market concentration or ownership; however, consensus about the significance and nature of the relationship has not been reached in the prior studies yet.

### 2.1.2 Liquidity risk and bank profitability

While credit risk is often seen as the key risk impacting the profitability of banks, liquidity risk, on the other hand, had not always been considered a significant determinant of bank profitability in the past and thus was not examined in many of the original papers within this topic. However, some of the earlier studies that included liquidity-related variables in their models were by Bourke (1989) and Molyneux & Thornton (1992). Both of these studies used the same methodology and focused on banks in Northern America, Australia, and Europe, respectively. However, the results regarding the impact of liquidity (measured as liquid assets-to-total assets) on bank profitability were different, as Bourke (1989) found the relationship to be positive, opposite to the findings of Molyneux & Thornton (1992).

This exemplifies the core issue within this topic, namely, the lack of consensus reached in previous research about the nature and significance of the relationship between liquidity or liquidity risk and bank profitability. Another challenge arises from the varying views on the appropriate metrics used to measure liquidity risk, as there is no defined measure for its assessment. In the following sections, a literature summary provides an overview of these variances.

Liquidity risk has been the subject of an increasing number of studies in recent years. In the majority of the earlier studies, liquidity risk is measured through various liquidity ratios, such as the liquid assets-to-total assets ratio, where higher liquidity implies lower liquidity risk. Instead of the traditional liquidity ratios, one group of scholars used the loans-to-total assets ratio, which should provide a more appropriate measure of the liquidity risk. A higher ratio indicates higher liquidity risk as more funds are allocated to illiquid assets. Trujillo-Ponce (2013) and Claeys & Vander Vennet (2008) found a significant and positive effect on ROA, ROE, and NIM, respectively, while Athanasoglou et al. (2006) showed a positive but insignificant influence.

Marozva (2015) and Hakimi & Zaghdoudi (2017) measured liquidity risk via loan-to-deposit ratio (a higher ratio represents higher liquidity risk) in their studies of South African and Tunisian banks. The observed relationship between liquidity risk and bank profitability measured as NIM was significantly negative. However, Kosmidou (2008), in his study of the Greek banking sector, showed mixed results since the relationship with ROA as a profitability proxy was negative and significant when using only bank-specific variables and positive and insignificant when including external determinants in the profitability equation.

However, as Chen et al. (2018) suggest, banks should adopt a more appropriate approach for assessing liquidity risk than the conventional liquidity ratios. The financing gap (FG) was already suggested as a proxy for liquidity risk in the study by DeYoung & Jang (2016). Generally, positive FG implies higher exposure to liquidity risk as banks use sources other than deposits to finance the loans. This includes using up or selling their liquid assets or borrowing at higher interest rates. The financing gap ratio (FGR), expressed as the difference between a bank's loans and customer deposits divided by its total assets, was used to measure liquidity risk in the study by Chen et al. (2018). The authors found that the relationship between the financing gap ratio and profitability varies with respect to the profitability proxy used – higher liquidity risk decreases ROA and ROE but increases NIM, consistent with the results of the study by Golubeva et al. (2019).

Following the financial crisis of 2007-08 and the introduction of LCR and NSFR as part of the Basel III Accord, there are already some studies using these regulatory requirements as liquidity risk indicators and analysing their impact on bank profitability. Dietrich et al. (2014) analysed in their study the influence of NSFR on ROA, ROE, and NIM using the sample of European banks in the period between 1996 and 2010 (a period before the implementation of NSFR, so the ratios were calculated by the author retrospectively) and found the ratio to be insignificant towards all profitability proxies.

A more recent study by Golubeva et al. (2019) is one of the first that included LCR as the liquidity risk measure in the profitability function. The sample was from the European banking sector, limited to the year 2018 (the first year of the full 100% implementation of LCR in the EU), and found the effect on profitability to be insignificant. Golubeva et al. (2019) also showed that FGR had a positive significant effect on EBITDA as a profitability proxy while having a negative significant effect on ROA, based on the sample from 2014-2017.

Drawing upon the presented empirical evidence, it can be inferred that the consensus on the effect of liquidity risk on bank profitability is yet to be reached. The results vary from having a significant positive or negative effect on profitability to having an insignificant one. The suggested reasons for the deviation of the empirical evidence of prior studies are various: disparities in the measurements of liquidity risk and bank profitability, variations in the variables used for estimation, different sample timelines and geographic regions analysed, and, consequently, different regulatory frameworks. Furthermore, Chen et al. (2018) also imply that liquidity risk may be an endogenous variable, causing disparities in the results of the studies. Additionally, Bordeleau & Graham (2010), based on their study, suggest a non-linear relationship between liquidity and profitability - holding some liquid assets increases profitability, but there is a certain threshold beyond which the increases in liquid assets lead to a decrease in profitability.

## 2.2 Research hypothesis development

The conflicting empirical evidence highlights the need for further research, especially with regard to the recent enforcement of the new liquidity risk requirements LCR and NSFR. This thesis expands the existing research and analyses the effects of liquidity risk on bank profitability in European countries following the recent full implementation of the new liquidity risk requirements– Liquidity Coverage Ratio (2018) and Net Stable Funding Ratio (2021). Since the majority of the research was focused on the period before 2018, this study is able to fill the gap in this topic and explore the relationship between liquidity risk and profitability in a period when banks have started to be regulated with respect to liquidity, with the expectations of providing clearer results compared to the prior studies. This thesis follows up on the work of Golubeva et al. (2019), which was focused on the European banking sector in the post-Basel III period. It was one of the first studies that used LCR as a proxy for liquidity risk, analysing it for the year 2018 and finding it to be an insignificant contributor to bank profitability. This thesis, however, is one of the first studies to use the LCR as the indicator of liquidity risk in an extended time frame (2018-2022) and examine its, so far, scarcely investigated possible effects on profitability. Except for LCR, this thesis also employs an alternative liquidity risk measure – Financing gap ratio (FGR), to obtain a broader understanding of the relationship. This allows us to compare the impact of these two measures that capture different aspects of liquidity risk.

Additionally, other factors that can influence the bank profitability, such as individual characteristics of the banks and macroeconomic factors, are taken into account and their impact analysed. This may provide a more accurate picture of the relationship between liquidity risk and profitability and strengthen the validity of the results.

Furthermore, we acknowledge that the impact of liquidity risk may also vary across different banking sectors. Hence, banks from two regions of the European Union are analysed separately. One region is represented by countries with stable banking environments and sound financial markets where banks have access to reliable funding sources, providing them with flexibility in liquidity risk management. These banks often employ sophisticated liquidity risk management practices that allow them to achieve the optimal balance between liquidity and profitability and meet the new liquidity requirements without significant (negative) effects on profitability. The other region is represented by countries that have faced economic challenges in the past years, including financial crises or high debt levels. These conditions may have negative implications for the banking sector and risk management practices in these countries, and thus the liquidity risk may have more significant effects on the bank profitability. Consequently, this study attempts to provide more evidence about the impact of liquidity risk on profitability by comparing results from two European regions.

Based on the discussion above and the conflicting results of the prior research, we identified that a new analysis was necessary to gain deeper insights into the issue. Consequently, the following primary research hypothesis is formulated:

*Research hypothesis: Liquidity risk is a significant determinant of bank profitability.*

# 3. Data and methodology

## 3.1 Data sources and selection criteria

We decided to focus the research on countries of the EU since the LCR has already been implemented there while narrowing the selection down to the Eurozone countries as they are under the jurisdiction of both EBA and ECB. Additionally, since there are some significant differences in the banking environments across the EU, we are able to compare the results between different regions supervised by the same regulatory bodies. The two selected regions are Northwestern Europe, represented by Germany, The Netherlands, France, Belgium, Austria, and Finland, and Southern Europe, represented by Italy, Spain, and Greece.

The majority of the bank-specific data was obtained from the Refinitiv Eikon database. Since we analyse the institutions at the group level, consolidated banking data were collected. Although these data often included subsidiaries in other countries, this does not represent a major issue as the banks often implement their business model and risk strategies in foreign subsidiaries as well. Additionally, consolidated banking statements may provide a more comprehensive picture of the banks' operations, considering their international presence is part of their business strategy.

A small amount of the required data was missing in the database and was thus collected directly from the official financial statements of the particular banks. As for the LCR, it was gathered from the official Pillar III disclosures or annual reports, where the ratio was reported as part of the EU LIQ1 template. Finally, the macroeconomic data were obtained from the World Development Indicators Databank.

For the Northwestern group, the consolidated banking data were collected altogether for 16 banking institutions in the period between 2018 and 2022, resulting in a balanced panel data set of 80 observations. The Southern Europe sample consists of data representing 18 banks observed again for the same 5-year period. However, four banking institutions in this sample did not publicly report the LCR according to the required template in 2018 (4 observations) and 2019 (3 observations), and we decided to exclude observations of these entities for the particular years, resulting in the unbalanced data set of 83 observations.

Table 1: Dataset overview

| | Number of entities | Number of observations |
|---|---|---|
| Southern Europe Group | 18 | 83 |
| Northwestern Europe Group | 16 | 80 |

Source: Author's calculations in MS Excel

The sample selection of the banking institutions was performed based on specific criteria to obtain a representative sample in alignment with the research scope:

1) The selected entity had to be directly supervised by ECB for the whole period of interest. Thus, only the "significant supervised entities" were considered.
2) The entity had to be based in one of the selected countries.
3) The entity had to operate as a commercial (or a retail bank) for the whole period of 2018-2022.

From the entities that fulfilled the criteria, the largest banks by total assets reported were then selected from each country. Consequently, a targeted subset of banking institutions was identified. From this subset, an entity was added to the sample if the data were available in the Eikon database, which serves as the primary source of the data. This was the case for the vast majority of the banks in the identified subset. We see the absence of the data of particular banks in the Eikon Database as a random factor, and thus we do not consider the exclusion of some banks as selection bias.

Table 2: List of selected banking institutions

| Southern European group (SE) | Northwestern European group (NWE) |
|---|---|
| Intesa Sanpaolo SpA | Deutsche Bank AG |
| UniCredit SpA | Commerzbank AG |
| Banco BPM SpA | Bayerische Landesbank |
| Bper Banca SpA | Landesbank Baden Wuerttemberg |
| Banca Monte dei Paschi di Siena SpA | Kbc Groep NV |
| Mediobanca Banca di Credito Finanziario SpA | ING Groep NV |
| Credito Emiliano SpA | Cooperatieve Rabobank UA |
| Banca Popolare Di Sondrio SpA | ABN Amro Bank NV |
| Banco Santander SA | Nordea Bank Abp |
| Banco Bilbao Vizcaya Argentaria SA | BNP Paribas SA |
| Caixabank SA | Credit Agricole SA |
| Banco de Sabadell SA | Societe Generale SA |
| Bankinter SA | BPCE SA |
| Unicaja Banco SA | Erste Group Bank AG |
| Eurobank Ergasias Services and Holdings SA | Raiffeisen Bank International AG |
| National Bank of Greece SA | BAWAG Group AG |
| Alpha Services and Holdings SA | |
| Piraeus Financial Holdings SA | |

## 3.2 Selected variables

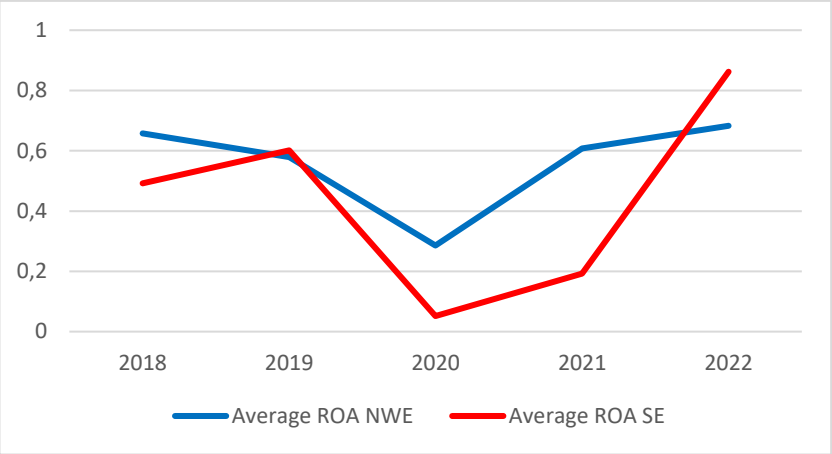
Based on the theory and existing literature within the studied topic, this thesis assumes bank profitability to be a linear function of certain internal and external determinants. In the Chapter 2, some of the most commonly used variables in models of other studies were introduced. Considering the results of prior research and underlying theory, the following variables were selected to be part of the profitability function.

### 3.2.1 Dependent variable

Return on average assets (ROA) was selected as a profitability proxy as it is one of the most widely used measures in the related literature. Athanasoglou et al. (2008) in their study defines ROA as the key metric for assessing a bank's profitability. It

provides a more comprehensive view of the overall profitability and the bank's ability to generate profits from its assets, compared, for example, to Net Interest Margin (NIM), which only considers the interest income. ROA is calculated as pre-tax income divided by average total assets, and this ratio was also used, for example, in the study by Trujillo-Ponce (2013). The data were obtained directly from the Eikon Database. Table 3 provides a comparison of the average ROA between banks in Southern and Northwestern Europe during the period of interest

Figure 1: Means of ROA for both studied groups in 2018-2022




Source: Author's calculations in MS Excel

Figure 1 demonstrates that the Northwestern banks are, on average, more profitable, although the Southern banks (especially the Greek ones) experienced a strong recovery period in 2022. As can be seen from the graph, there was a sharp decline in banks' profitability in both regions in 2022, likely due to the COVID-19 pandemic and the associated disruptions in financial markets.

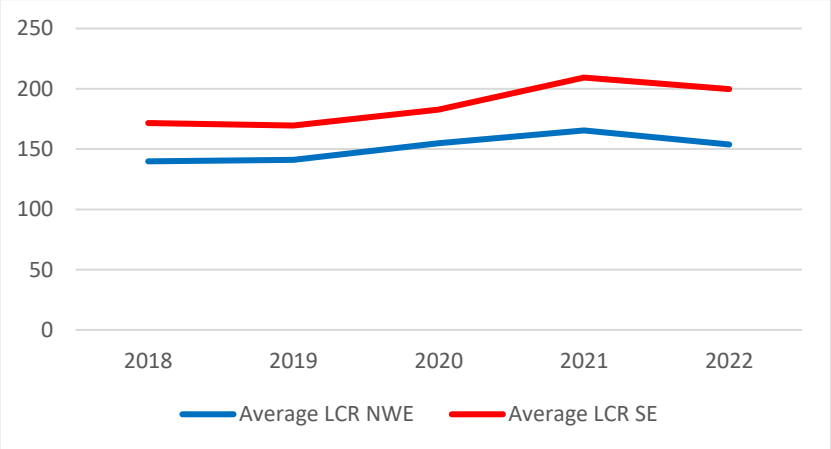
### 3.2.2 Independent variables

*Liquidity coverage ratio (LCR)*: We consider LCR to be a unique measure of liquidity risk that can provide new perspectives on the complex relationship between liquidity risk and bank profitability, and thus we include it in the equation as the central explanatory variable and proxy for liquidity risk. LCR is a scenario-based measure used to evaluate a bank's ability to survive hypothetical short-term stress scenarios. It does not explicitly capture the bank's liquidity position at a specific time, like the other commonly used liquidity ratios.

LCR is calculated as the amount of HQLA divided by expected net cash outflows for 30 days. Thus, it is worth mentioning that a higher LCR does not necessarily mean that the bank holds more liquid assets. It may possibly mean that the bank relies heavily on stable sources of funding, such as customer deposits, and thus the projected cash outflows are lower (due to the lower supervisory rates used in the calculation), resulting in higher LCR. In this case, higher LCR would, ceteris paribus, imply higher profitability due to the lower funding costs. Additionally, banks with higher LCR may appear more reliable, increasing banks' creditworthiness and confidence of investors/customers and potentially decreasing funding costs or increasing demand for debt instruments. Furthermore, in a period of low interest rates, liquid assets such as government bonds may yield higher returns than illiquid loans, resulting in both high LCR and profitability.

On the other hand, considering the commercial banks in EU countries (which have to fulfil the Basel III liquidity requirements), we might expect that the relationship between liquidity risk and bank profitability may be contradictory - since complying with the regulations should provide enough liquidity buffer to survive a liquidity crisis and various shocks without incurring substantial losses, significantly increasing the amount of liquid assets above the required threshold may decrease the bank profitability, as it can limit its lending capacity. Figure 2 shows that the average LCR is indeed well above the 100% threshold for both Southern and Northwestern European countries, providing evidence for the assumption.

Figure 2: Means of LCR for both studied groups in 2018-2022




Source: Author's calculations in MS Excel

In Figure 2, we can also see that the Southern banks in our sample have on average higher LCR and, thus, lower liquidity risk. This can suggest that the banks there hold more liquid assets or relies more on stable funding. One of the possible explanations for the former is that the banks in Southern Europe may have fewer investment opportunities than their Northwestern counterparts. Additionally, institutions in less stable economies may adopt a more risk-averse approach and hold more liquid assets, even well above the required threshold.

Overall, considering the abovementioned assumptions, we expect the relationship between LCR and profitability to be positive. The LCR ratios were obtained directly from the EU LIQ1 template (included in either Pillar III public disclosures or annual reports), where the LCR is calculated as a simple average of 12 monthly observations (as required by ECB) for the particular year.

*Financing gap ratio (FGR)*: This study also utilizes the Financing gap ratio as an alternative liquidity risk measure to capture its complexity better. This ratio was also used as a proxy for liquidity risk in other studies, for example, in the ones by Chen et al. (2018) or Golubeva et al. (2019), and we calculate it as the difference between net loans and total deposits divided by total assets.

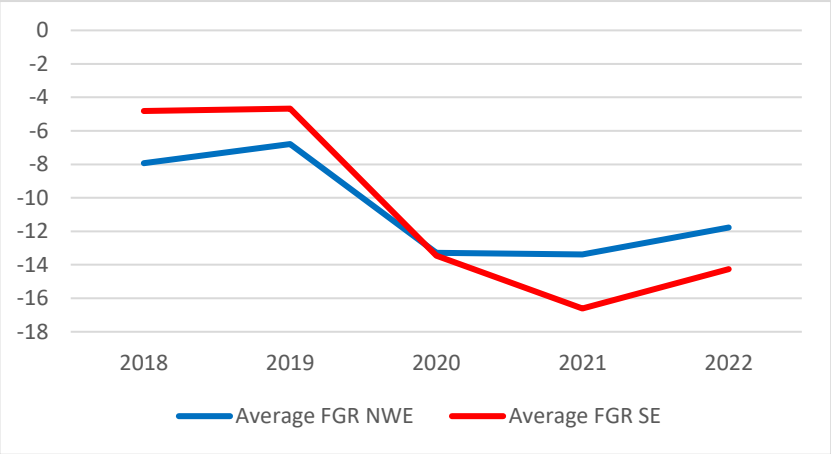
Compared to LCR, which mainly indicates a bank's liquidity resilience during hypothetical stress periods, FGR provides information about the funding sources and potential imbalances between short-term assets and short-term liabilities (maturity mismatch). The financing gap, as suggested by DeYoung & Jang (2016), arises when the amount of loans exceeds the amount of core deposits.

A positive gap indicates that a bank must rely on other funding sources, such as short-term borrowings, or may even opt to sell its liquid assets. Consequently, the overreliance on these short-term funding sources (for example repurchase agreements) to cover the gap causes higher liquidity risk. In this case, the higher liquidity risk would be associated with higher funding costs and lower profitability. However, some banks may be able to efficiently use short-term funding to finance greater amounts of highly profitable loans (illiquid assets). If a bank efficiently manages its risks or has access to profitable investment opportunities, a larger financing gap and, thus, higher risk may be associated with increased net interest margins and higher profit.

A negative financing gap indicates that the bank holds fewer loans than deposits and may indicate excess liquidity. As shown in Figure 3, the banks in our sample have, on average, negative gap for the whole period. Excess liquidity, however, does not

necessarily mean lower profitability, as the bank may invest surplus funds for example into government securities that may sometimes generate higher returns than loans. In our case, the negative gap may indicate that in the period of economic uncertainty following the COVID-19 pandemic, the demand for new loans declined, or the banks might have invested less in loans due to higher credit risk and used other investment opportunities (such as government bonds).

Figure 3: Means of FGR for both studied groups in 2018-2022




Source: Author's calculations in MS Excel

Considering the discussion above, we expect the relationship between FGR and ROA to be negative.

This study does not use the Net Stable Funding Ratio (NFSR) because of the lack of disclosure in the period of interest. However, it would provide valuable perspective as a measure assessing long-term liquidity risk.

*Size*: Since our sample consists of banks of various sizes, including size-related variable in the profitability equation allows us to make more comprehensive interpretations of our findings. To control for bank size, we used a logarithmic form of the total assets, comparable to other studies, for example Trujillo-Ponce (2013). The logarithmic form enables us to reduce the impact of extreme differences and linearize the relationship between size and profitability, which is generally seen as nonlinear. The data were obtained from the Eikon database and then transformed into a natural logarithm by the author.

*Equity to assets ratio*: A common expectation is that higher bank capitalization contributes positively to profitability, as well-capitalized banks generally have lower

funding costs. However, higher capitalization may indicate that the bank has adopted a more conservative and risk-averse approach, potentially decreasing the profits. Although the relationship between capitalization and profitability may be multidimensional, we expect the relationship to be positive. In our model, Equity-to-Assets Ratio was used as a proxy for capitalization, the same as for example Golubeva et al. (2019).

*Cost to income ratio (CI)*: We decided to include the Cost to income ratio as a variable for operational efficiency, the same as Kosmidou (2008). It is calculated as operating expenses divided by operating income, and a lower ratio indicates more efficient bank management. Higher ratios should generally mean decreases in profitability as the operational expenses are directly tied to profit. This was also confirmed by other studies.

*Loan loss provision ratio (LLP)*: Credit risk is seen as the major risk that banks face, and thus, we decided to include Loan Loss Provisions to Average Net Loans ratio as a proxy for credit risk in our equation. A higher ratio indicates that a larger portion of the bank's loans is set aside to account for potential credit losses and suggests a higher risk exposure level. The same ratio was also used in a study by Athanasoglou et al. (2008) or Chen et al. (2018), and the data were obtained directly from the Eikon database.

Higher credit risk is often associated with potential increased profits, especially in the short run, as investors seek risk premium for accepting higher uncertainty in their investments. However, higher risk-taking may also be associated with incurring higher losses and lower profitability. Empirical evidence also suggests a negative relationship between credit risk and profitability.

*GDP growth and inflation:* Since our sample consists of banks from different countries, we consider it appropriate to include variables representing macroeconomic determinants of bank profitability in our model to account for the influence of economic conditions. Specifically, the annual GDP growth rate (GDP) and Inflation rate (INF) were chosen to represent the macroeconomic differences across selected countries, in alignment with the models of Trujillo-Ponce (2013) or Chen et al. (2018). As for the GDP, we may expect a positive influence on profitability for various reasons, such as an increase in demand for loans or loan quality. The level of inflation rate may impact profitability, for example, via increases in operating expenses or indirectly by increasing

the interest rates; however, the relationship with profitability is seen as multidimensional and ambiguous, as mentioned in section 2.1.1.

Table 3: List of selected variables

| Variable | Notation | Calculation | Data source |
|---|---|---|---|
| Return on average assets | ROA | Pretax income/average total assets | Refinitiv Eikon database |
| Liquidity coverage ratio | LCR | High quality liquid assets/total net cash outflows expected over the next 30 days | Pillar III disclosures and annual reports |
| Financing gap ratio | FGR | (Net loans-total deposits)/total assets | Refinitiv Eikon database, calculated by author |
| Size | SIZE | Ln (total assets), natural logarithm of total assets | Refinitiv Eikon database, calculated by author |
| Equity to assets ratio | EQUITY | Equity/total assets | Refinitiv Eikon database, calculated by author |
| Loan loss provision ratio | LLP | Loan loss provision/ average net loans | Refinitiv Eikon database |
| Cost to income ratio | CI | Operating expenses/operating income | Refinitiv Eikon database, calculated by author |
| GDP growth (annual %) | GDP | Annual percentage growth rate of GDP at market prices based on constant local currency | World Development Indicators |
| Inflation, consumer prices (annual %) | INF | Inflation as measured by the consumer price index | World Development Indicators |

Note: All variables are expressed as percentages, except for size.

## 3.3 Model specification

In order to explore the effects of selected variables on profitability, the following linear models were developed:

Model 1:

$$ROA_{i,t} = \beta_0 + \beta_1 LCR_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 EQUITY_{i,t} + \beta_4 LLP_{i,t} + \beta_5 CI_{i,t} + \beta_6 GDP_{i,t} + \beta_7 INF_{i,t}$$

Model 2:

$$ROA_{i,t} = \beta_0 + \beta_1 FGR_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 EQUITY_{i,t} + \beta_4 LLP_{i,t} + \beta_5 CI_{i,t} + \beta_6 GDP_{i,t} + \beta_7 INF_{i,t}$$

Note: *i* and *t* represent, respectively, the individual bank and the particular year

We built one model with LCR as the liquidity risk measure and one with FGR as the liquidity risk measure as we aim to evaluate and compare their individual impact on ROA. In the analysis, two panel datasets were utilized, one for the Southern Europe group and the second for the Northwestern Europe group, both containing data of the same set of variables. To explore the effect of the liquidity risk proxies and other independent variables on ROA in each region, we performed altogether four linear regression analyses to test the specific hypotheses, formulated as follows:

$H_1$: *The LCR is a significant determinant of the profitability of Southern European banks*

$H_2$: *The FGR is a significant determinant of the profitability of Southern European banks*

$H_3$: *The LCR is a significant determinant of the profitability of Northwestern European banks*

$H_4$: *The FGR is a significant determinant of the profitability of Northwestern European banks*

These specific hypotheses are important in assessing the significance of liquidity risk in influencing the bank profitability in each region separately. The findings will allow us to accept or reject the primary research hypothesis.

Given the panel structure of our data, we employ panel regression analysis to estimate the coefficients of the models. The most commonly utilized panel estimation methods include fixed effects (FE) and random effects (RE) models. Both approaches were also used in the existing literature within the research topic, for example, by Athanasoglou et al. (2006) or Hakimi & Zaghdoudi (2017). Another approach that is also used to analyse panel data is Pooled OLS estimation method, which is simply OLS

regression run on panel data, not taking into account the panel structure of the data. However, in the panel data analysis, there is a need to account for unobservable individual-specific and time-invariant effects (unobserved individual heterogeneity), denoted as $\alpha_i$, that are not included in the regression but affect the dependent variable. These unobserved effects are part of the composite error term in each time period and thus result in a serial correlation of the error terms (Wooldridge, 2012, p. 493). Additionally, these unobserved effects $\alpha_i$ may be correlated with the independent variables used in the regression, producing inconsistent regression estimators (Wooldridge, 2012, p. 460). In our case, there is a possibility of the existence of such effects; some examples may be management competence or brand reputation.

We also estimated the Pooled OLS models and performed the Lagrange multiplier test. The null hypothesis was rejected, suggesting the presence of significant individual effects in all our models. Consequently, the fixed and random effects models, as the more appropriate approaches for our panel data, were estimated. Both of these estimation methods account for the unobserved effects but deal with them differently.

The fixed effects model allows for the unobserved effect $\alpha_i$ to be correlated with the independent variables. However, in the fixed effects regression, the unobserved effects $\alpha_i$, together with all time-invariant variables, get wiped out by the fixed effects transformation (within transformation) (Wooldridge, 2012, p. 485), obtaining consistent estimators.

The random effects model assumes exogeneity, i.e., no correlation between $\alpha_i$ and the independent variables. Consequently, the random effects model does not eliminate the unobserved individual effects in the error term. However, the problem of serial correlation in the composite error terms persists. The random effects model thus eliminates the serial correlation using FGLS (Feasible generalized least squares) transformation and obtains more efficient estimates than pooled OLS (Wooldridge, 2012, p. 496).

To choose between Fixed effects and Random effects models, a common practice is to use the Hausman test. This test is based on the difference between the estimators of the Fixed effects model and those of the Random effects model (Baltagi, 2005, p.73). The null hypothesis is rejected if there is a difference between these two estimators, suggesting the presence of omitted individual specifics correlated with the regressors (Baltagi, 2005, p.73).

To decide which approach is the most suitable for our respective models, considering both datasets, we estimated the RE model four times and the FE model four times and compared them via the Hausman test. Accordingly, we opted for the Random effects model estimation for both Model 1 and Model 2 in the Southern Europe dataset. As for the Northwestern Europe dataset, the Random effects model estimation was preferable for Model 1 and the Fixed effects model estimation for Model 2.

To ensure the reliability and validity of results from the selected models, robustness tests for multicollinearity, autocorrelation, and heteroscedasticity were performed.

When multicollinearity is present, it is difficult to distinguish between the effects of the individual explanatory variables. To identify potential multicollinearity between two variables, correlation matrices of Pearson correlation coefficients were calculated for both datasets. Only weak to moderate correlation coefficients were identified in both cases, except for the correlation between the variables SIZE and EQUITY in the Northwestern group (-0.75). EQUITY is statistically significant in both our models (before the calculation of robust standard errors), while SIZE is insignificant. Consequently, we ran another two regressions, once excluding SIZE and once excluding EQUITY from the equation. This process was repeated for both Model 1 and Model 2. In neither of the cases did the statistical significance of these two variables change, while there was also almost no change in the coefficients of the significant variable (EQUITY). Hence, we do not assume the issue of multicollinearity is present in our models and decided to keep both variables in the equation.

To test for autocorrelation, the Breusch-Godfrey Test of serial correlation (for the idiosyncratic component of the errors) in panel models was used. The null hypothesis of no serial correlation was not rejected in either of the models in the Southern Europe Group. As for the Northwestern Group, the null hypothesis was rejected for Model 2, implying the presence of autocorrelation. To account for the autocorrelation, present in Model 2, robust standard errors (SEs) for the estimators were calculated.

Another test utilized to improve the reliability of the regression results was the White's Test for heteroskedasticity. The null hypothesis of homoskedasticity was not rejected for both models of the Southern Group, while the null hypothesis was rejected in the case of Model 1 in the Northwestern Group. To address the issue of

heteroskedasticity, heteroskedasticity robust SEs were estimated for the particular model.

# 4. Research findings and empirical investigation

## 4.1 Descriptive statistics

This section provides a summary of the variables' descriptive statistics. Table 4 presents the summary statistics for the Southern group and Table 5 for the Northwestern group.

Table 4: Descriptive statistics for Southern European group

| Statistic | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| ROA | 0.431 | 0.524 | 0.869 | -4.084 | 2.178 |
| LCR | 187.936 | 171.700 | 58.909 | 26.400 | 475.000 |
| FGR | -11.269 | -12.120 | 14.668 | -45.005 | 25.213 |
| SIZE | 25.924 | 25.513 | 1.110 | 24.440 | 28.182 |
| EQUITY | 6.953 | 6.542 | 2.074 | 3.839 | 13.339 |
| CI | 69.458 | 67.961 | 17.436 | 38.382 | 165.052 |
| LLP | 0.960 | 0.627 | 1.408 | -0.007 | 11.131 |
| GDP | 0.880 | 1.984 | 6.078 | -11.325 | 8.434 |
| INF | 2.548 | 1.137 | 3.353 | -1.248 | 9.645 |

Source: Author's calculations in R

In Table 4, we can observe that the mean value of the ROA% is 0.43%, indicating that, on average, the Southern banks were profitable during the period of interest. However, the standard deviation (SD) is twice as large as the mean, suggesting a large dispersion of the values in our sample. This may be partly a result of the COVID crisis or the high volatility of profitability of the Greek banks in our sample. As for the LCR, it can be seen that, on average, the banks were well above the average (187.9%) with relatively low SD, potentially suggesting that the banks may have sound liquidity risk management practices in place that prevent any significant fluctuations in the value of LCR. It is worth noting that the min value is 26.4%, even though the LCR requirement in the EU has been 100% since January 2018. Subsequent examination revealed that Piraeus Financial Holdings SA did not fulfil the LCR requirement in 2018 (26.4%) and 2019 (87.3%). The -11.27% mean of the Financing gap ratio shows that, on average, the Southern banks hold more deposits than loans. However, its high SD suggests considerable variation in the sample.

As for the other explanatory variables, one of the key observations is that the mean (0.96%) and median (0.63%) of the Loan loss provisions (LLP) ratio are relatively low; however, the large SD suggests that some banks in the sample may have been exposed to notably high credit risk. This finding aligns with expectations, considering challenging economic conditions and the associated increase in the likelihood of loan defaults.

Table 5: Descriptive statistics for Northwestern European group

| Statistic | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| ROA | 0.562 | 0.505 | 0.394 | -0.542 | 2.107 |
| LCR | 150.996 | 142.000 | 24.474 | 117.000 | 250.500 |
| FGR | -10.630 | -11.103 | 12.304 | -34.091 | 20.213 |
| SIZE | 26.992 | 26.993 | 0.997 | 24.523 | 28.611 |
| EQUITY | 5.738 | 5.556 | 1.276 | 2.982 | 8.958 |
| CI | 74.915 | 73.868 | 12.192 | 51.986 | 111.073 |
| LLP | 0.204 | 0.218 | 0.245 | -0.498 | 0.767 |
| GDP | 1.200 | 1.865 | 3.681 | -7.785 | 6.817 |
| INF | 2.822 | 1.732 | 2.602 | 0.145 | 10.001 |

Source: Author's calculations in R

Table 5 reveals that, on average, the banks in the Northwestern sample were profitable throughout the examination period with a mean ROA of 0.56% and a relatively low SD of 0.39%. The mean value of LCR is again well above the required threshold at 151%, and it can be observed that all the banks in the sample fulfilled the requirement in the period between 2018 and 2022, with the minimum value at 117%. Higher SD (12.3%) and consequently greater data variability can be observed for the Financing gap ratio, which has, again, a negative mean. This may indicate that, although some banks in the sample opted for more risk-seeking strategies and consequently held larger portions of loans than deposits, the majority chose a more conservative approach.

One of the key observations from Table 5 is that the Standard deviations in the Northwestern sample are consistently lower than in the Southern one. This suggests greater homogeneity across the sample and may also indicate higher stability in the banking sectors and higher resilience to economic shocks such as the COVID crisis. The data in the tables also show that the Southern banks have both higher LCR and lower FGR. This could mean that, on average, they hold more liquid assets or rely more on

deposits as a funding source. Furthermore, as shown in the tables, the banks in the Southern group are, on average, exposed to higher credit risk, with the mean value of the LLP ratio at 0.96% compared to 0.2%. Considering the higher uncertainty in the financial markets, this finding aligns with the expectations.

## 4.2 Regression results

Table 6: Regression results

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | ROA | | | |
| | Southern Europe Group | | Northwestern Europe Group | |
| | (1) | (2) | (1) | (2) |
| LCR | 0.0001 | | 0.0003 | |
| | (0.001) | | (0.001) | |
| FGR | | -0.004 | | 0.003 |
| | | (0.003) | | (0.003) |
| SIZE | 0.113** | 0.125*** | 0.068 | 0.287 |
| | (0.048) | (0.046) | (0.065) | (0.373) |
| CI | -0.033*** | -0.033*** | -0.018*** | -0.018*** |
| | (0.001) | (0.001) | (0.003) | (0.003) |
| LLP | -0.473*** | -0.479*** | -0.232 | -0.307 |
| | (0.016) | (0.017) | (0.209) | (0.241) |
| EQUITY | 0.032 | 0.042** | 0.152* | 0.179 |
| | (0.020) | (0.020) | (0.079) | (0.125) |
| GDP | -0.001 | -0.001 | 0.014 | 0.010 |
| | (0.003) | (0.003) | (0.009) | (0.009) |
| INF | 0.011 | 0.009 | 0.003 | 0.003 |
| | (0.007) | (0.007) | (0.007) | (0.006) |
| Constant | -0.015 | -0.406 | -0.769 | |
| | (1.326) | (1.258) | (2.017) | |
| Observations | 83 | 83 | 80 | 80 |
| $R^2$ | 0.960 | 0.961 | 0.748 | 0.764 |
| Adjusted $R^2$ | 0.956 | 0.957 | 0.724 | 0.673 |

Note: Standard errors in parentheses. *p<0.1;**p<0.05;***p<0.01

Source: Author's calculations in R

Table 6 presents the empirical results of the four performed regressions. Columns labelled as (1) show estimations of Model 1, and the columns labelled as (2) show the estimations of Model 2 for the particular datasets. The estimated coefficients of all explanatory variables are provided, and their statistical significance is indicated by the asterisks. Notably, the first regression of the Northwestern Europe Group presents heteroskedasticity robust standard errors, while the second one shows autocorrelation and heteroskedasticity robust standard errors in the parentheses

The results of the regressions suggest that our central explanatory variable, LCR, is a statistically insignificant determinant of bank profitability in both studied samples, in line with the findings of Golubeva et al. (2019). Consequently, we reject Hypothesis 1 and Hypothesis 3 of LCR being a significant determinant of bank profitability.

This outcome could be attributed to various potential reasons. Firstly, it is worth mentioning that the LCR has already become a minimum requirement at a 60% level in 2015. Since then, the banks' management might have adopted effective and resilient liquidity risk management practices that mitigate any potential impact that the changes in LCR may have on bank profitability.

Additionally, even the second proxy for liquidity risk, FGR, appears to be statistically insignificant in both regressions, and thus we reject Hypotheses 2 and 4 as well. Hence, liquidity risk seems to be an insignificant determinant of the profitability of the banks in our sample. A potential explanation could be that the analysed banks may have a substantial diversity of business models. While some might have adopted a more conservative approach, others might have preferred more aggressive liquidity risk strategies. Thus, considering the complex and multidimensional relationship between liquidity risk and profitability, the impact of the risk on the profits of particular banks may differ substantially and consequently lead to an insignificant effect when aggregated in a single regression analysis. Furthermore, the insignificance of LCR could also be caused by the higher significance of other explanatory variables in our models, thus suggesting that the impact of liquidity risk on profitability may be negligible compared to other factors.

Consequently, rejecting all specific hypotheses leads us to reject our primary research hypothesis: "The liquidity risk is a significant determinant of bank profitability."

As for the other independent variables, one of the variables that appears to be statistically significant at a 1% significance level in all regressions is, unsurprisingly,

the Cost-to-income ratio. The relationship with profitability is found to be inverse, in alignment with the theoretical expectations and the existing empirical evidence, for example Kosmidou (2008). The coefficient's magnitude, which is almost two times higher for the Southern banks than the Northwestern ones, suggests that every one-percentage-point increase in CI ratio decreases the ROA by 0.033% or 0.018%, respectively. It is worth noting that the CI ratio is the only determinant of bank profitability that was sound to be statistically significant at a 5% level (or lower) in the sample of Northwestern banks after estimating the robust standard errors, suggesting that the efficiency in expenses management plays a crucial role in influencing the financial performance of a bank.

Another variable found to be statistically significant at 1% in the sample of Southern banks is the LLP ratio as a proxy for credit risk. The observed relationship with profitability is negative, confirming the results of prior studies, for example by Athanasoglou et al. (2008) or Golubeva et al. (2019). It suggests that as a bank increases loan loss provisions (expected credit losses), its profit declines.

Except for operational efficiency and credit risk, another statistically significant factor in our SE sample is the bank size, with a positive effect on profitability, consistent with the findings of Kosmidou (2008). This suggests that the Southern banks in our sample benefit significantly from the economies of scale compared to their Northwestern counterparts.

Considering the capital variable EQUITY, its impact on ROA is ambiguous in both our datasets. Although scholars Trujillo-Ponce (2013) or Chen et al. (2018) found the effect of this ratio to be positively and significantly related to profitability, we cannot confirm these results based on the evidence from our analysis. In the dataset of Northwestern banks, the ratio is only marginally significant at the 10% level in Model 1 and statistically insignificant in Model 2. In the dataset of Southern banks, it was found to be insignificant in Model 1 and significant at a 5% level in Model 2. Further analysis of the Southern dataset showed that in a model without the insignificant liquidity risk variables LCR and FGR, the equity appeared statistically insignificant, although with a p-value close to the 10% level. Thus, we cannot conclude that the equity ratio is a significant determinant of banks' profitability in our sample.

The macroeconomic variables GDP growth (GDP) and Inflation rate (INF) are insignificant in any of the regressions, suggesting that the bank-specific factors are more instrumental in influencing banks' profitability in our datasets. While a majority of the

scholars, for example Trujillo-Ponce (2013) or Elekdag et al. (2020) found the impact of GDP growth rate to be positively significant, in the study by Golubeva et al. (2019), the observed impact of GDP and INF on ROA is insignificant as well.

Overall, we cannot conclude that the liquidity risk impacts the banks from the two examined regions differently. However, it can be observed that the banks from the Southern European sample are significantly influenced by more bank-specific factors than the banks from the Northwestern sample, suggesting that there might indeed be some regional differences in determinants of bank profitability.

# Conclusion

In this study, we examined the impact of liquidity risk on the profitability of selected European banks following the full implementation of the Liquidity Coverage Ratio in the EU. We analysed data from 34 commercial banks from the Eurozone countries in 2018-2022, divided into two separate datasets. The first contains data from 18 banks from Southern European countries (Italy, Spain, and Greece), and the other dataset contains 16 banks from Northwestern European countries (Germany, France, the Netherlands, Belgium, Austria, and Finland).

Consequently, two linear models of various internal and external bank profitability determinants were built, each including a different variable as a proxy for liquidity risk. The central explanatory variable was the Liquidity coverage ratio (LCR). At the same time, the Financing gap ratio was also used in a separate model as an alternative measure of liquidity risk to obtain a broader understanding of the relationship between bank profitability and liquidity risk.

A panel data analysis (random and fixed effects models approach) was conducted to examine the relationship between the bank profitability and explanatory variables of both our models and datasets. Robustness tests were performed to improve the reliability of the results. All regressions found both liquidity risk measures to be statistically insignificant factors affecting bank profitability, measured as Return of Average Assets. Consequently, the obtained evidence led us to rejection of the research hypothesis that liquidity risk is a significant determinant of bank profitability. We assume that several possible factors may cause this outcome. Firstly, the banks may employ highly sophisticated risk management practices that do not allow liquidity risk to affect profitability significantly, or there may be substantial heterogeneity in the business models of studied banks that allow for varying effects of liquidity risk on profitability. Although we expected different results, LCR was also found to be insignificant in a prior study by Golubeva et al. (2019).

The regression analysis, however, also showed that the Cost-to-income ratio and credit risk are negatively and significantly impacting the profitability of banks in the Southern European sample, while the size is a positive significant determinant. On the other hand, the banks in the Northwestern sample appear to be significantly and negatively influenced only by the Cost-to-income ratio. None of the macroeconomic determinants (GPD growth rate and Inflation rate) were significant.

Thus, although we found some differences in the factors influencing the profitability of banks of the two studied regions, the liquidity risk appears insignificant for banks in both groups.

This thesis contributes to the existing research on the topic as it provides new evidence regarding the complex relationship between liquidity risk and bank profitability in a period when the EU banks are subject to multiple new regulations while also being one of the first studies using the LCR as a measure of liquidity risk. The obtained evidence may provide valuable information for the regulators and help them evaluate the impact of the imposed regulatory frameworks. Additionally, the research outcome can also be beneficial for investors assessing the risk-return profiles of the banks, as it suggests that liquidity risk does not significantly impact bank profitability.

Furthermore, comparing the factors affecting the profitability between the banks of the two studied groups also provides more accurate implications for the banking institutions operating in the particular regions. This research may offer them additional insight into the drivers of profitability and help them with decision-making strategies or risk management practices employed.

While this thesis has provided some valuable insights into the relationship between liquidity risk and profitability, it is also essential to recognize the study's limitations. One of the fundamental limitations is the relatively small sample size, which may hinder the generalizability of our results. Since we selected banks based on specific criteria and the time frame was maximized regarding the focus of the research, we could not address this issue. However, future research may benefit from the extended time window and obtain more representative results. Another notable limitation is that the research results are specific to European banks and may not directly apply to institutions outside the EU. Thus, further studies may explore other regions to understand the relationship better and identify potential regional differences. Furthermore, since we did not include the Net Stable Funding ratio (NSFR) as a measure of (long-term) liquidity risk due to the lack of disclosure, the analysis was primarily focused on the short-term liquidity risk. Future studies could include NSFR in the analysis and add depth to the understanding.

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