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The Impact of Negative Interest Rate Environment on Bank Profitability

School of Accounting and Finance
Master's Thesis in Finance
Master's Degree Programme in Finance

Vaasa 2023

UNIVERSITY OF VAASA
School of Accounting and Finance

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Topic of the Thesis:	The Impact of Negative Interest Rate Environment on Bank Profitability		
Degree:	Master's Degree in Finance		
Department:	Finance		
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Year:	2023	**Pages:**	67

ABSTRACT:

European banks have undergone a very distinct set of circumstances in recent years. Following the global financial crisis of 2008, interest rates around the world started to decrease. In response to weak economic conditions and the central banks' efforts to achieve their inflation targets, unconventional monetary policies have been implemented in Europe. Negative interest rate policy (NIRP) has been employed by the European Central Bank and central banks in countries such as Sweden and Denmark as a component of their unconventional monetary policy strategies, to stimulate economic growth and maintain price stability. This policy has resulted in nominal interest rates being reduced to levels near zero, and in some cases, even negative levels.

This study investigates the potential effects of negative interest rates on the profitability of commercial banks, with a particular emphasis on banks from Germany, Sweden, and Denmark. The central objective of this research is to identify whether there is a relationship between the (near) negative nominal interest rates and the profitability of commercial banks, as evaluated by metrics such as net interest margin (NIM) and return on assets (ROA). Based on an analysis of a dataset comprising of 50 banks from Denmark, Sweden, and Germany, covering the period 2011 to 2021, the findings suggest that negative nominal interest rates lower banks' net interest margins, that is, the banks' main source of profitability.

KEYWORDS: Bank Profitability, Interest Rate, Central Bank, Monetary Policy

VAASAN YLIOPISTO
Laskentatoimen ja Rahoituksen yksikkö
Tekijä:
Tutkielman nimi: The Impact of Negative Interest Rate Enviroment on Bank Profitability
Tutkinto: Kauppatieteiden maisteri
Oppiaine: Master's Degree in Finance
Työn ohjaaja: John Kihn
Valmistumisvuosi: 2023 **Sivumäärä:** 67

TIIVISTELMÄ:

Eurooppalaiset pankit ovat käyneet läpi hyvin erikoisia olosuhteita viime vuosina. Maailmanlaajuisen finanssikriisin jälkeen korkotasot alkoivat laskea ympäri maailmaa. Parantaakseen heikkoja taloudellisia olosuhteita sekä pyrkimyksenä saavuttaa inflaatio tavoitteensa, keskuspankit ovat ottaneet käyttöönsä hyvin epätavallisia rahapolitiikan keinoja Euroopassa. Euroopan keskuspankki sekä muun muassa Ruotsin ja Tanskan keskuspankit ovat käyttäneet negatiivisia korkoja osana heidän rahapolitiikan strategioitaan stimuloidakseen talouskasvua ja ylläpitääkseen hintavakautta. Tämä politiikka on johtanut nimelliskorkojen laskemiseen lähelle nollaa ja joissain tapauksissa jopa negatiiviselle tasolle.

Tämä tutkimus selvittää negatiivisen korkotason vaikutuksia kaupallisten pankkien kannattavuuteen Saksan, Ruotsin ja Tanskan pankeissa. Tutkimuksen keskeisenä tavoitteena on selvittää, onko (lähes) negatiivisella nimelliskorolla sekä pankkien kannattavuuden mittareilla (korkokate ja oman pääoman tuotto) merkittävää yhteyttä. Analyysi koostuu 50 pankin aineistosta vuosilta 2011-2021. Tulokset viittaava, että negatiiviset nimelliskorot alentavat pankkien korkokatetta, joka on pankkien kannattavuuden pääasiallinen lähde.

AVAINSANAT: Kannattavuus, Korko, Keskuspankki, Rahapolitiikka

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Abbreviations

EA	Equity to assets
ECB	European Central Bank
GDP	Gross Domestic Product
NIM	Net Interest Margin
NIRP	Negative Interest Rate Policy
OECD	The Organization for Economic Cooperation and Development
ROA	Return on Assets
ROE	Return on Equity

1 Introduction

For the last decade, European banks have lived in an exceptional environment. After the 2008 financial crisis, the interest rates began to fall globally. Due to weak economic conditions and Central Banks' efforts to meet their inflation targets, unusual monetary policy has been exercised in the Europe. In order to improve the economic conditions and keep prices stable, the European Central Bank (ECB) and central banks in countries such as Sweden and Denmark, lowered the nominal interest rates to near zero and eventually even to negative levels. Thus, the negative interest rate policy (NIRP) was implemented as a part of unconventional monetary policy.

One of the monetary policy instruments of central banks is the policy rate. The policy rate is the interest rate set by the central bank at which it lends money to commercial banks. Thus, it directly affects market interest rates and the economy. For example, at the euro area the Governing Council of ECB sets the key interest rates. The below figure shows the rate on the deposit facility, i.e., the rate which banks can use to make overnight deposits with the Eurosystem (ECB, 2022). As can be seen, the ECB applied the negative nominal interest rate in 2014.

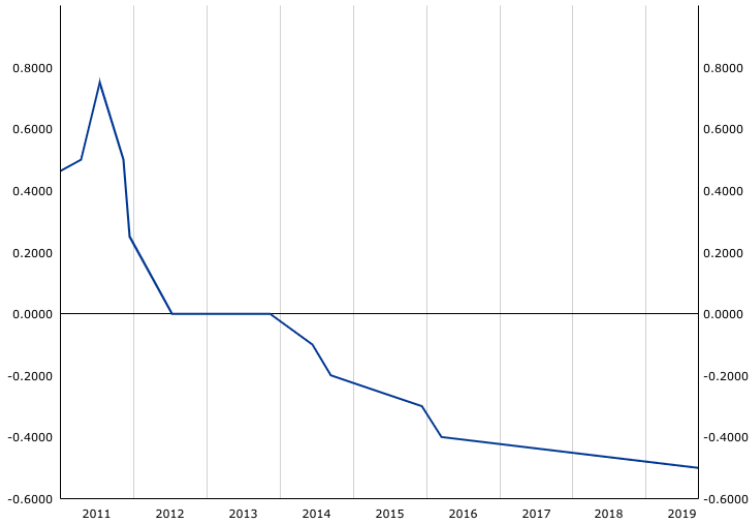

Figure 1. ECB Deposit facility (European Central Bank, 2022).

The implementation of negative policy rates was also discovered elsewhere in Europe. The national bank of Denmark was the first to lower its policy interest rate to negative in July 2012. Later, several central banks of European counties followed in its footsteps. The below table shows countries in Europe that implemented the NIRPS. In addition, the table summarizes the central bank, the policy rates, and the date when the NIRP was first introduced in the country.

Table 1. Overview of Central Banks with negative policy rates in Europe (The central banks in question).

Country	Central bank	Date	Rate
Eurozone	European Central Bank	June 2014	-0,10 %
Bulgaria	Central Bank of Hungary	January 2016	-0,30 %
Denmark	Danmarks Nationalbank	July 2012	-0,20 %
Hungary	Magyar Nemzeti Bank	March 2016	-0,05 %
Sweden	Sveriges Riksbank	February 2015	-0,10 %
Switzerland	Swiss National Bank	December 2014	-0,25 %

To simplify, the negative nominal interest rates are the opposite of what we are used to seeing in a “normal” economy. Would a person lend a dollar to someone if they would get less back tomorrow, i.e., would one be prepared to essentially have to pay for being the creditor? According to the conventional macroeconomic theory, the answer is no. This is because people generally prefer to hold onto their wealth rather than give it away for less than what it's worth. Another example of the negative nominal rates is that if an institution or an individual borrows money from a bank, they would have to pay back less that they had originally borrowed. From the perspective of banks, the adoption of the negative nominal rates means that when a commercial bank deposits their funds to the central bank, they do not receive interest on their deposit but instead they must pay for it (López-Penabad et al., 2022).

The negative interest rate policy is quite exceptional, considering that economists, on the basis of the so called zero lower bound (Jobst & Lin, 2016), considered it impossible for a long time. In theory, when there is a threat of inflation and the economy is booming, the central bank can raise the policy rate. However, during the weaker economic conditions, i.e., when there is a threat of deflation, the central bank cannot cut the policy rate below zero (Buiter, 2009). The central bank had the presumption that if the policy rate is going lower than zero, individuals and corporations might start to convert deposits into cash as a safeguard against devaluation risk. Hence, the nominal lower bound would be mixed with the real lower bound. Yet, if the nominal rate did not fall negative, the real rate could not, during low inflation, fall further either to support demand and ease the debt burden (Jobst & Lin, 2016). The fact that central banks have introduced a negative policy rate calls into question the significance of the zero limit in the monetary policy.

1.1 The purpose and motivation of the study

The purpose of this thesis is to study the effects of negative interest rate environment on bank profitability. More closely, this paper examines the relationship between (near-) negative nominal interest rates and commercial bank profitability (measured in NIM and ROAA) in Germany, Sweden, and Denmark. The aim herein is to assess whether nominal interest rates influence bank profitability and, if so, is the effect positive or negative. If an effect is found, this paper will also touch on its relative magnitude.

Low interest rates may help the economy to recover and, at the same time, have a positive impact on banks' performance in improving banks' balance sheets leading to capital gains and reduction of non-performing loans. However, low or negative interest rates are also associated with lower net interest margins (Claessens et al., 2018). The business model of a conventional bank is a spread business, which is based on the difference between lending and borrowing rates; which rates tend to follow the changes in the central banks' policy rate. When the market rates drop to low or negative, banks

may have to respond by lowering the interest rates on new and existing loans. Simultaneously, however, banks are reluctant to lower depositors' interest rates with the same hastiness due to the competition, since banks know that their customers could withdraw their deposits and take their money elsewhere (Claessens et al., 2018).

Considering this scenario and the difficulties a bank may face during periods of low or negative interest rates, the following hypothesis is formulated:

H_1: Low or negative nominal interest rates has a negative impact on banks' profitability.

H_2: There is a positive relationship between nominal interest rate and profitability.

Also, the slope of the yield curve can narrow banks' profits. More specifically, a flatter yield curve can impact bank profits negatively. When interest rates decline, the yield curve does not automatically flatten, but it can be subjected to a more indirect effect. While central banks have a strong influence on the short-term interest rate through the policy rate, the impact on the yield curve often takes place indirectly through market participants' expectations from future policy rate path and through extensive operations targeting the prices of government securities (Borio et al., 2017). Banks usually borrow at a short interest rate and lend at a long-term rate. Thus, when the difference between long-term rates and short-term rates declines i.e., when the yield curve flattens, the net interest margin of the bank will diminish.

Considering the scenario of a flatter yield curve, this study also examines the effect of the yield curve on banks' profitability, and the following hypothesis is formulated:

H_3: There is a positive relationship between yield curve slope and profitability.

Although the impact of external factors on banks' profitability has been studied, the literature on the low and negative nominal interest rates on profitability is surprisingly

narrow. Thus, this study attempts to further investigate the impact of negative and low interest rates and contribute to the existing literature.

Commercial bank profitability is an important indicator of the soundness of the financial sector and profitable banks are a crucial part of a stable economic system. Hence, it is important to understand the effects of monetary policy and other factors on profitability. Profitability, among other things, attracts external capital and banks can use profits for reconstruction if they incur large losses. In addition, profits function as a safeguard and banks can write off credit losses against them (Hack & Nicholls, 2021). Additionally, banks' willingness and ability to extend credit can have an effect on how monetary policy is transmitted. The benefits of easing monetary policy may diminish further if very low interest rates reduce banks' profits significantly. In extreme cases, easing policy could be self-destructive if banks are less willing to lend (Eggertsson, et al. 2019).

The design and implementation of monetary policy exhibits a significant imbalance: it should not be possible for nominal interest rates to be negative. Yet, we have witnessed that. Thus, the objective of this study is to explain and investigate the consequences of this relatively new and, frankly, bizarre phenomenon. Also, understanding the impact of negative nominal rates has several real-life benefits. It can help banks' management to examine their ability to provide credit and other financial services to individuals and businesses. Negative nominal interest rates are a relatively new policy tool that has been used in some countries to stimulate economic growth and inflation. Understanding the impact of negative nominal interest rates on bank profitability is important for assessing the effectiveness of this policy tool and informing future policy decisions.

1.2 Structure of the study

This study is structured as follows. The first section, *Introduction*, outlines the purpose and motivation of the study, as well as its structure. The second section, *The Banking Sector*, discusses the financial intermediaries and the income structure of banks, bank risk, and the theory of central banking. Additionally, the second section includes a

discussion of banking in the low-interest-rate area. The third part, *Bank Profitability*, examines the determinants of bank profitability including size, capital, credit risk, diversification, operational efficiency, and liquidity. Additionally, the external determinants of profitability, such as the business cycle and inflation, are discussed.

The fourth section, *Literature Review on Banks and NIRP*, provides an overview of relevant literature on the research concerning the effect of low and negative interest rates on bank profitability. The fifth section, *Data and Methodology*, describes the dependent, independent, and control variables, as well as the method used in the study. The sixth section, *Empirical Results*, presents the results of the study, including the impact of low and negative rates on the banks' net interest margin and return on assets after adjustments. Finally, the seventh section, *Conclusions*, presents the conclusions drawn from the study and offers recommendations for further research.

2 The Banking Sector

Banks are financial institutions that provide banking and other financial services to their customers. This chapter briefly discusses the banking sector and banks' role in the economy. As central banks also play an enormous role in the operation of commercial banks, as well as influence interest rates, this section also presents the idea and the main tasks of central banks.

2.1 Financial intermediaries

Banks offer a wide range of services to their customers but one of their main tasks is to allocate funds from savers to borrowers and thus act as financial intermediaries. Financial intermediaries and financial markets play a crucial role in the economy as they create a system for transferring funds to the most productive projects. In summary, the intermediary function of banks works through banks raising funds from the surplus sector and directing them to the deficit sector. Thus, by channeling funds, they allocate the funds to better use and promote economic efficiency (Casu, et al., 2015, pp. 5). The intermediary function is illustrated in figure 2.

Lenders and borrowers can also transfer their funds directly through financial markets and therefore do not necessarily need banks. However, there may be certain barriers in direct financing to which banks, as financial intermediaries, offer some solutions. First, lenders want to minimize the risk of their borrowers becoming unable to repay their obligations, as well as the risk that the value of the assets drops. In addition, lenders aim to the minimization of costs and value liquidity. Borrowers, however, require funds on a specific date, preferably for long periods of time and for the lowest possible cost. In summary, most borrowers request liabilities that are modest and long-term. In contrast, most lenders want to loan for shorter timeframes and for the most elevated possible return (Casu, et al., 2015, pp. 4-5).

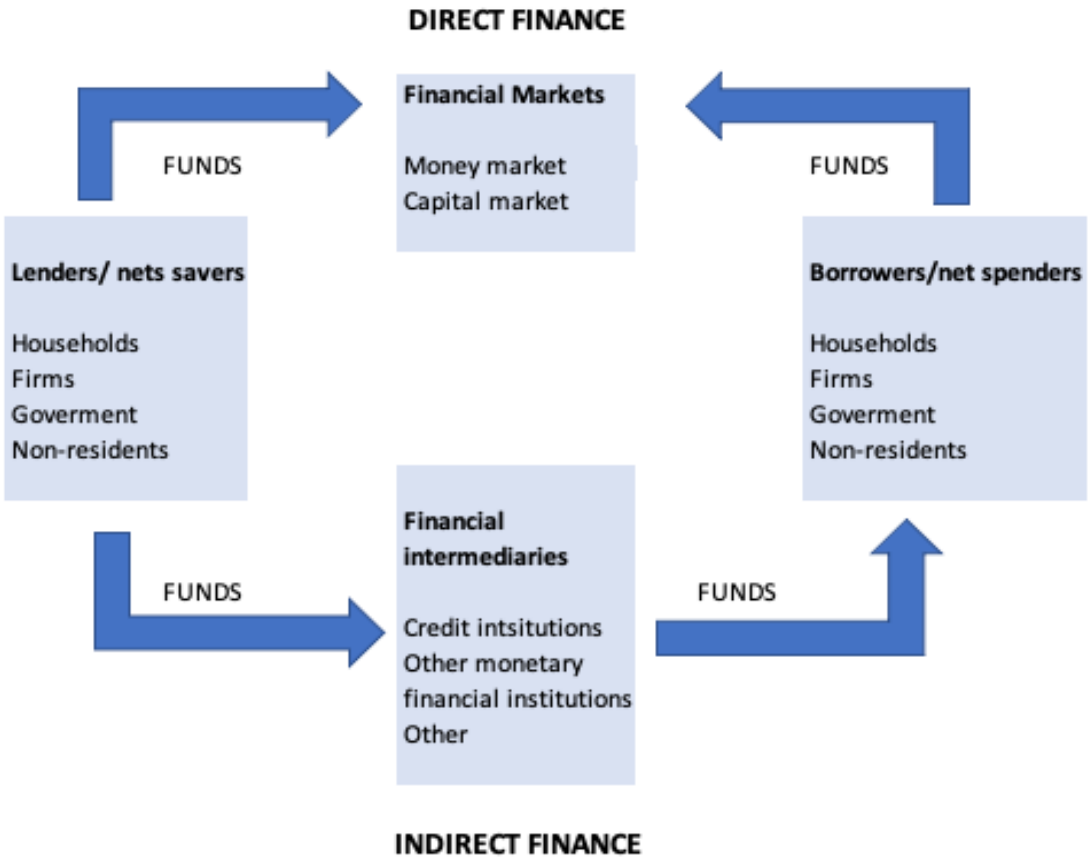

Figure 2. Financial Intermediaton (Suomen Pankki, 2022).

Financial intermediaries possess the capability to mitigate challenges arising between borrowers and lenders and accommodate their frequently contradictory necessities and goals. This is accomplished by offering providers of funds safety and liquidity by utilizing reserves saved for investments and loans. Particularly, financial intermediaries assist with limiting the expenses related with direct lending, i.e., transaction costs and information asymmetries (Casu, et al., 2015, pp. 6).

Werner (2014) proposes three different theories that describe how banks work and make profit. According to the financial intermediation theory of banking, banks operate as financial intermediaries collecting resources and re-allocating them. Hence, according to this theory, banks function the same way any other non-bank financial institution; there are not any special features (Werner, 2014).

The second theory is called the fractional reserve theory of banking. It states that, based on the fractional reserve, banks differ from other financial intermediaries because they can together create money. However, this view also claims that a singular bank cannot individually create money as they are just financial intermediaries who collect deposits and lend them out (Werner, 2014).

The third theory, the credit creation theory of banking, is in line with the fractional reserve theory, but it goes one step further, arguing that each individual bank can generate money independently. According to this theory, banks create loans themselves from scratch, instead of just mediating deposits or central banks' reserves (Werner, 2014).

2.2 Income structure of banks

The balance sheet of a bank shows its wealth on a given date, or, in other words, how the bank has collected its funds (liabilities) and how it has used them in financial markets (assets). The main source of banks' funds are deposits from both companies and general public (retail depositors). In addition, banks' funds come from other financial institutions, debt issues, equity issues and savings from past profits. Banks convert these funds to financial assets such as loans, liquid assets, short-term money market instruments, cash and other investments. A bank's profit is the difference between the interest received on assets and the interest paid on liabilities (Casu et al., 2015, pp. 196-197; Mishkin & Serletis, 2011, pp. 314-315). Figure 3 below illustrates a bank's balance sheet in a simplified way.

Assets	Liabilities
Cash	Deposits: retail
Liquid assets	Deposits:wholesale
Loans	
Other investments	
Fixed assets	
	Equity
	Other capital terms
Total assets	**Total liabilities and equity**

Figure 3. Commercial bank balance sheet. (Casu et al., 2021).

Banks are generally required to hold cash reserves to meet regulations. The purpose of the regulation is to ensure that banks have a certain amount of liquidity. Thus, banks hold reserves to manage the requirements of their short-term liquidity and also in case of unpredictable and large withdrawals by liability holders (Mishkin & Serletis, 2011, pp. 317). Cash reserves include the deposits in banks' vaults and in their relevant central bank; they are the most liquid form of assets (Casu et al., 2021). Usually, banks hold a relatively small amount of cash aiming to minimize it, since the reserves can be allocated to more profitable assets.

Loans are the most important type of banks' assets as banks primarily make their profits by issuing loans. Loans can be divided into four major categories: commercial loans, consumer loans, mortgage lending and real estate loans. These categories include, e.g., short-term loans to businesses (commercial loans), credit card loans (consumer loans) and long-term loans to commercial real assets, like office buildings (real estate loans) (Casu et al., 2021).

Investments correspond to all of a bank's long-term securities, including securities that it has sold for a finite period but has committed to repurchase in the future. Investments include such securities as bonds, floating rate notes (FRNs), preference shares and other debit instruments, but exclude securities that have been purchased for a fixed period with the intent of reselling the instruments after the fixed period has expired (Casu et al. 2021).

From the liability side, the largest part of funds typically comes from deposits made by other firms and individuals. Banks generate funds by offering liabilities, such as deposits, which serve as the banks' source of funds. These funds are used to invest in assets that generate income. Banks have three primary sources of funding: deposits, borrowings, and equity. Deposits can either be demand deposits, which can be withdrawn at any time, or notice deposits, which require prior notice but are often treated as demand deposits. Fixed-term deposits are the main source of bank funds with higher interest rates compared to chequable deposits, but customers cannot write checks on them (Mishkin & Serletis, 2011, pp. 316). The most common type of fixed-term deposits are savings accounts.

Borrowings refer to the various loans a bank obtains from other banks, financial entities, and central banks. These loans may be in the form of overnight loans, repurchase agreements, or standard loans. Bank capital, which is equivalent to the bank's net worth, includes retained earnings and equity raised by the bank. It acts as a buffer against the risk of loan defaults (Casu et al., 2021 ; Miskhin & Serletis, 2011, pp.316). Banks typically hold a lower equity-to-asset ratio compared to manufacturing firms due to high leverage. Non-repayment of a small portion of loans can result in a significant decrease in equity and insolvency. Losses from loan defaults are absorbed by the capital cushion, and a higher level of capital provides greater protection. Insolvency occurs when losses surpass capital and even selling all assets would not cover deposits. In addition, capital is required for investments like technology, branches, payments systems, and acquisitions for financial services (Casu et al. 2021).

Capital and risks are interlinked, where higher risk necessitates more capital. Currently, banks face diverse financial risks as their operations expand in markets susceptible to fluctuations in interest rates, exchange rates, and credit conditions affecting both on- and off-balance-sheet positions. Hence, banks require more capital compared to the past. Holding other factors constant, capital adequacy should align with risk exposure. (Casu et al., 2021, pp. 204-205).

A bank's profitability is shown on its income statement or profit and loss account, which measures the bank's performance over a year between two balance sheet dates. The balance sheet reports stock values (e.g. loan amounts), while the income statement reports cash-flow values (e.g. interest received on loans) for the year. The income statement displays the bank's revenue sources and costs (Casu et al., 2021). Figure 4 below illustrates a typical income statement of a commercial bank. The letters on the left-hand side illustrate how the components of income statement are calculated.

a	Interest income
b	Interest expense
c(=a-b)	Net interest income
d	Provision for loan losses (PLL)
e(=c-d)	Net interest income after PLL
f	Non-interest income
g	Non-interest expense
h(=f-g)	Net non-interest income
i(=e-h)	Pre-tax net operating profit
l	Securities gains (losses)
m(=i+/-l)	Profit before taxes
n	Taxes
o	Extraordinary items (net)
p(=m-n-o)	Net profit
q	Cash dividends
r(=p-q)	retained profit

Figure 4. Commercial bank income statement. (Casu et al., 2021).

Costs on the liability side of a bank's balance sheet come from required payments like interest on deposits, dividends, debt interest, loan loss provisions, and taxes. Revenues from the assets side come from loan and investment interest, fees and commissions (both interest and non-interest). Banks also face operating costs like staffing. The overall profit is the difference between income and costs (Casu, et al., 2021).

Banks generate their income from interest income or non-interest income. Interest income is the revenue earned from assets like loans, securities, and lent-out deposits to borrowers like households and institutions. Interest expense is the cost of paying interest on liabilities such as deposit accounts, CDs, short-term debt, and long-term borrowing. Thus, the net interest income (NII) is the difference between interest income and interest expenses (Figure 4). Non-interest income consists of fee income, commissions, and trading, for example. In addition, to the interest expenses, banks' expenses arise also from non-interest expenses, which consist of typical business costs such as employee salaries, rent and equipment purchases (Casu et al., 2021).

2.3 Bank risk

Like any commercial company, a bank is also subject to other types of risks that can affect its profits or profitability. The potential risks involved encompass the likelihood of depositors making impulsive withdrawals of their funds, the possibility of borrowers failing to fulfill their repayment obligations, the fluctuations in interest rates, and the potential for underperformance in the bank's securities trading operations (Cechetti & Schoenholtz, 2015, pp. 308). In order to better understand banking, this section briefly introduces the typical risks that banks face: credit risk, interest rate risk, liquidity risk and trading risk.

Credit risk is the most prevalent type of risk in banking, being central to financial intermediation. It represents the possibility of a borrower defaulting on their loan

obligations to the bank, which leads to a decline in their creditworthiness. Credit risk affects not only a bank's clients, but also the bank itself due to holding securities such as bonds, guarantees or derivatives that see a drop in credit rating, for instance, when a credit agency lowers a security's credit rating (Casu et al., 2021; Cechetti & Schoenholtz, 2015, pp.312).

In order to attain profitability, financial institutions must effectively address the issues of adverse selection and moral hazard, which increase the likelihood of loan defaults. To mitigate these risks, financial institutions implement various strategies, including credit risk management principles such as screening and monitoring of borrowers, building long-term customer relationships, implementing loan commitments, utilizing collateral, establishing compensating balance requirements, and rationing credit (Mishkin & Eakins, 2018).

Banks, being in the business of transforming deposit liabilities into loan assets, experience a mismatch between the two sides of their balance sheet. A crucial distinction between these two sides lies in the fact that bank liabilities are typically of a short-term nature, whereas their assets tend to have a long-term maturity. This incongruence between the maturities of the liabilities and assets results in a situation of interest rate risk (Cechetti & Schoenholtz, 2015, pp.312-313). More closely, the interest rate risk refers to the potential danger posed by unexpected variations in interest rates. In theory, if a bank possesses a greater proportion of interest rate sensitive liabilities than assets, a rise in interest rate is likely to lead to a decline in the bank’s net interest margins.

One of the traditional ways to manage interest rate risk is gap analysis, which determines the responsiveness of a bank’s income to alterations in interest rates. The process involves subtracting the quantity of rate-sensitive liabilities from the quantity of rate-sensitive assets, thereby providing a straightforward and efficient manner of measurement. However, the gap analysis is somewhat limited in its scope as it focusses

solely on the impact of interest rate fluctuations on income. It is imperative for bank owners and managers to consider not only the effect on income, but also the effect on the market value of the bank's net worth. An alternative approach to assessing interest rate risk is duration gap analysis, which evaluates the sensitivity of the bank's market value of net worth to fluctuations in interest rate (Mishkin & Eakins, 2018).

Another typical risk financial institutions face is liquidity risk, which arises from a sudden demand for liquid funds. An asset may be considered liquid if it can be converted into cash promptly and without any capital depreciation or financial penalties. Banks' deposits, for example, are widely considered as highly liquid assets while investments in real estate are considered to be highly illiquid. The level of liquidity required by a lender is influenced by various factors, including the liquidity characteristics of other securities held. Furthermore, a financial institution must maintain sufficient liquidity to address any unexpected increase in operating expenses and to meet loan demand. Generally speaking, lenders prefer to hold a high degree of liquidity in their loan portfolios, when all other factors are equal (Casu et al., 2021).

Banks are exposed to liquidity risk on both the liability and asset sides of their balance sheet. On the liability side, the risk arises from potential deposit withdrawals. On the asset side, the risk arises, for instance, from banks' obligations to extend lines of credit to households and businesses, which are essentially promises to provide loans upon request. When these loan commitments are exercised, the bank must have access to sufficient liquidity to fulfill its obligations (Cechetti & Schoenholtz, 2015, pp.312-313).

Moreover, when managing liquidity risk, it is important to distinguish two types of liquidity risks. Daily liquidity risk refers to the potential for daily withdrawals by depositors. This type of risk is typically predictable as only a small fraction of deposits are usually withdrawn on a given day. Most banks are unlikely to experience a cash shortage as they can easily borrow funds from other banks trough interbank markets. However, a liquidity crisis can occur when depositors demand higher than normal

withdrawals. In this scenario, the bank is forced to secure funding at an elevated interest rate, which is higher than the rate at which other banks are borrowing similar funds. This type of liquidity crisis is typically unpredictable and can be caused by a loss of confidence in the bank or a sudden and unexpected need for cash. If left unchecked, a liquidity crisis can impede a bank's ability to fulfill its obligations, leading to a run on the bank and potentially causing insolvency, particularly in the absence of central bank intervention or deposit insurance (Casu et al., 2021).

"Market risk" (or trading risk) refers to the potential for losses in on-balance and off-balance sheets positions resulting from fluctuations in market prices. The risk is particularly relevant in short-term trading of assets, liabilities and derivatives, and encompasses changes in exchange rates, interest rates and other asset prices (Casu et al., 2021). Nowadays, financial institutions engage in complex asset and liability management and employ traders to actively purchase and sell securities, derivative products, and loans using a portion of a bank's capital, with the goal of generating additional profits for the owners. However, trading financial instruments entails a significant level of risk. It arises from the possibility that the price at which an instrument is bought differs from the price it is sold, which may result in a decline in value rather than an increase (Cechetti & Schoenholtz, 2015, pp.315-316).

The management of trading risk is a paramount concern for contemporary banking institutions. It has been observed that a number of the largest banks globally have incurred substantial financial losses, amounting to billions of dollars, due to the unregulated risk-taking behavior of their trading personnel. This arises from the prevalent practice where traders typically participate in the gains derived from successful investments, while the losses are shouldered by the bank. This creates a moral hazard, wherein traders have a motivation to undertake risks that exceed the preferences of bank management (Cechetti & Schoenholtz, 2015, pp.316). In general, large banking institutions employ value-at-risk (VaR) analysis to evaluate the risk of loss on their trading asset portfolios. Conversely, smaller banking institutions tend to gauge

market risk through sensitivity analysis. VaR is a statistical methodology that utilizes historical market trends and volatilities to calculate the probable or estimated maximum loss on a bank's portfolio or line of business over a specified period, with a predetermined degree of certainty. The objective of this approach is to obtain a single value that summarizes the maximum loss faced by the bank within a statistical confidence interval (Casu et al., 2021).

2.4 Theory of central banking

In general, a central bank is a financial institution tasked with managing a nation's or a group of nations' monetary system with the objective of "price stability", and later promoting economic growth while preventing inflation. The organization and structure of central banks may differ slightly depending on the country or the individual task the bank performs. However, their main task today is to implement the monetary policy of the country or area in question. In addition, the main functions of central banks consist of controlling the issuing of notes and coins, controlling the amount of credit-money created by banks, and acting as a lender of last resorts; meaning that they supervise the financial industry to prevent crises and protect depositors (Casu, et al., 2015).

The Eurosystem in Europe consists of the national central banks of the euro area and the ECB. The currency euro was created in 1999 and currently 19 of the 27 EU member states have it as their official currency. ECB (2022) states that its primary objective is to maintain price stability, i.e., secure the value of the euro. A key part of the objective is to direct inflation towards the target that is set to 2 %. To meet this objective, ECB uses a set of monetary policy tools that impacts both the cost and the amount of loans. ECB's most essential monetary policy tool is the ECB policy rate set. There are three different rates that are set by the Governing Council of the ECB: The interest rate of the main refinancing operations, the rate of the deposit facility and the rate of the marginal lending facility (ECB, 2022). The rate of the deposit facility and the rate of the marginal lending facility set an upper and lower limit on the overnight interest rate at which banks can loan assets to each other.

Before the financial crisis in 2008, the monetary policy of the ECB consisted mainly of setting the key interest rates. Due to the crisis, however, ECB has later extended its strategy instruments to impact the financial circumstances faced by individuals and organizations in troublesome times while the failing of financial system harmed the transmission component of monetary policy. The short-term interest rates were drawing nearer to their effective lower bound during the difficult times following the crisis. The effective lower bound is the line beyond which further reductions in interest rates will no longer lead to an increase in economic activity. As a result, ECB introduced new monetary policy instruments to secure price stability (ECB, 2022). These instruments include, e.g., setting a negative interest rate, offering banks central bank loans as much as they require, purchasing public and private financial assets and offering long-term loans to banks at favorable rates (ECB, 2022).

Of the countries covered by this study, Germany is a member of the Eurosystem but Sweden and Denmark have their own currencies. Thus, the national central banks in Sweden and Denmark are responsible for conducting monetary policy in their own countries. Danmarks Nationalbank (2021), the central bank of Denmark, states that they exercise fixed exchange-rate policy which means that the monetary policy in Denmark aims to keep the Danish krone stable against euro. Danmarks Nationalbank sets the monetary policy interest rates in the conduct of monetary policy.

The monetary policy interest rates are connected to the deposit and lending facilities that Danmarks Nationalbank make available to the banks. At the point when the interest rates are changed by the Danmarks Nationalbank comparative with those of the ECB, it ordinarily influences the exchange rate of the Danish krone against euro. Thus, the monetary policy interest rates additionally influence lending and deposit rate offered to consumers and businesses through the currency market (Danmarks Nationalbank, 2021). Similarly, Sweden has not joined the monetary union and does not have a common currency, the euro, or a common central bank, the European Central Bank. The National

Bank of Sweden, The Riksbank, conducts monetary policy by controlling the repo rate, which is similar to the Danish monetary policy interest rate (Sveriges Riksbank, 2017). Thus, the repo rate is the policy tool that The Riksbank uses to streer inflation. The Riksbank also uses deposit rate and lending rate as policy rates to steer inflation, but the repo rate is the most commonly used in Sweden.

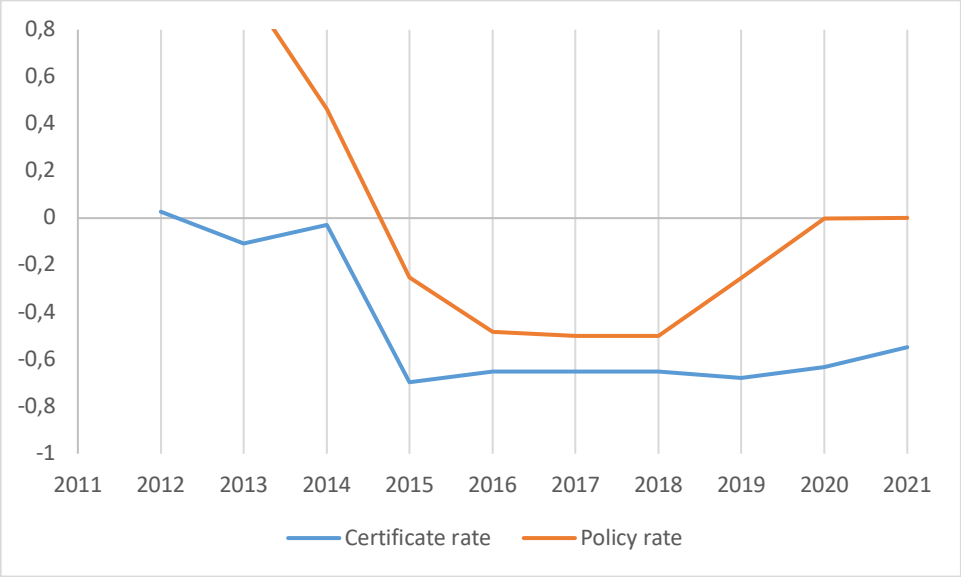

Figure 5. Denmark and Sweden policy rates. (National banks in question).

2.5 Banking in the low interest rate area

Interest, in the context of banking, refers to the compensation that a lender receives for lending money and the cost that a borrower incurs for borrowing it. When an individual borrows money from a financial institution, the interest rate represents the expense associated with the loan. Conversely, when an individual saves money in a financial institution, the interest rate represents the return on their investment. Interest rates are expressed as a percentage of the borrowed or lent amount and are a measure of the cost or return associated with the transaction.

The rates that are stated by lenders or financial institutions like banks, are called nominal interest rates. They represent the rate of interest that a borrower must pay to a lender in exchange for borrowing money, without adjusting for inflation. Real interest rates, on the other hand, are adjusted for inflation, meaning that they take into account the change in the purchasing power of money over time. Thus, real interest rates can be calculated by subtracting the rate of inflation from the nominal interest rate.

Real interest rates have been negative in history before. Most of the time in history, the rates that borrowers pay on loans have been above zero, i.e., the nominal rates have been positive. However, if inflation is higher than the interest rate on a loan, the return of the lender is less than zero. Such situation causes the real interest rate (nominal rate minus inflation) to be negative (Haksan & Kopp, 2020). In years 2012-2016 this happened for the first time to the nominal rates as well. To recover from the international financial crisis central banks introduced a negative policy rate. The negative rates pose challenges against economic theories.

A zero lower bound has been used in economic theory. It refers to a situation where central banks lower interest rates to zero or close to it. This zero lower bound has been considered a trap, since it limits the activities of central banks in the future. In the past, it was thought that interest rates cannot be lowered below zero. When the interest rates have been reduced to zero, or close to zero, other means of resuscitation should be used than resuscitation with the help of control interest rates. However, monetary policy can be influenced through similar mechanisms both above and below zero. Negative interest rates give consumers and businesses the idea to spend more, rather than just keeping monetary assets in accounts where their value is reduced by inflation.

One of the most important functions of banks is changing loan periods. Banks themselves lend money (for example from the central bank) at a short interest rate. At the same time, banks lend money to their customers and make investments for a longer period of time at a longer-term interest rate. The traditional idea in the banking world is

that banks benefit from a steep yield curve, which translates into a large difference between short-term and long-term interest rates. The yield curve refers to the relationship between interest rates of different maturities over time. When the yield curve steepens, banks' net interest margins grow. This margin refers to the difference between the money the banks themselves lend and the money the banks lend out. Conversely, when the yield curve flattens out, banks' net interest margins also decrease. Other factors being constant, any change in interest rates should be reflected in the bank's bottom line. If the banks have changed their operations in response to interest rate changes, the interest rate changes should have little effect on the banks' result. Such functions include, for example, interest hedging or increasing the role of other functions (Genay & Podjasek, 2014).

3 Bank Profitability

This chapter deals with the banking sector and the profitability of a bank, thus providing a theoretical basis for the research. The determinants of bank profitability are identified as well as their effects on profitability in the light of earlier studies.

3.1 Determinants of Bank Profitability

Financial research typically uses two different metrics to measure a bank's profitability. Overall profitability is usually measured by Return on Equity (ROE) or Return on Assets (ROA). The ratio of profits to assets (ROA) is used to measure the bank´s ability to make profit from its assets. However, one of the problems with ROA is that, because of off-balance sheet activities, the variable may be biased (Athanasoglou et al., 2008).

$$ROA = \frac{net\ income}{total\ assets} \quad (1)$$

ROE on the other hand measures shareholder returns on invested equity. ROE is also often used to measure financial leverage as the bank's equity multiplier. Banks that have higher equity and thus lower leverage will usually announce higher ROA and lower ROE. Of these two variables, ROA has become a key measurement of banks' profitability as financial leverage is usually defined by regulation and ROE analysis does not consider the risk associated with high leverage (Athanasoglou et al., 2008).

$$ROE = \frac{net\ income}{total\ equity} \quad (2)$$

Another key measurement of banks' performance is their net interest margin (NIM). Traditionally, banks make profit by lending money at a higher interest rate than what they pay to their depositors. NIM describes the difference between interest earned on assets minus interest costs. Thus, it measures the net interest income relative to the total assets (Casu et al., 2015).

$$NIM = \frac{(interest\ income - interest\ expense)}{total\ assets} \quad (3)$$

Many studies also consider the determinants of bank profitability. Numerous variables such as the size of the bank, bank capital, level of risk, lending and business diversification usually have an impact on profitability. Next, this paper addresses these bank-specific factors and how they impact on bank profitability.

3.1.1 Size

Bank size is often measured as the value of a bank's total assets. One of the most important questions in literature and bank policy is which size is the most optimal in terms of profitability. The relationship between bank size and profitability is inconsistent as there is controversial empirical evidence of how the size affects profitability. In general, growing size has proven to have some positive impacts on profitability. However, extremely large banks may face negative effects due to bureaucratic and other reasons (Athanasoglou et al., 2008).

Some studies provide evidence on the positive link between the bank size and profitability (see e.g., Demirgüç and Huzinga, 1999; Borio et al., 2015). One possible reason for the positive link between larger banks and profitability may be the concept of economies and scales. According to the modern intermediation theory, larger banks or financial intermediaries can benefit from their size by being able to enter into agreements with large number of lenders and borrowers (Boyd & Runkle, 1993). Large numbers can translate into more diversification, which in turn can lead to less risk and lower contracting costs. Thus, the modern intermediation theory states that large banks are more cost efficient than small banks, and also less likely to fail (Boyd & Runkle, 1993).

Contrariwise, Kok et al. (2015) find a strong negative relationship between bank size and a bank's returns when they examine the impact of bank-specific factors on profitability. Their study seems to establish that smaller banks were actually more profitable during

the sample period. One explanation for this could be that the features of larger banks tend to be associated with a more complex and expensive structure. Athanasoglou et al. (2008) did not find a significant relationship between size and profitability and thus state that bank size does not bear significance. They hypothesize that the insignificant effect could be due to the fact that it is typical for smaller banks to grow faster even at the expense of their profitability. Furthermore, newly established banks are unlikely to be very profitable as they tend to concentrate more on increasing their market share than increasing profitability.

3.1.2 Capital

Another factor influencing bank profitability is bank capitalization. A bank's capital can be defined as its total assets minus total liabilities, i.e., the value of the net assets of the bank. In practice, however, a bank's capital is the sum of its accumulated capital reserves and paid-up-share capital (Casu et al., 2015). The capital plays a sizable role in the financial system and is therefore regulated. In principle, all losses of a bank must be covered by its capital, regardless of where the loss arises. They key is to keep deposits safe and thus maintain confidence in banks and the banking sector as whole (Casu et al., 2015).

The Basel Committee on Banking Supervision introduced the Basel I Accord in 1988 which determines the capital requirements of banks. Majority of the central banks in the world have later adopted it, and in 1992 EU implemented most of its features into EU and it is thus implemented in the member states' law (Casu et al., 2015). The Basel Accord requires banks to have a minimum level of capital as a percentage of risk-weighted assets (RWA). Referring to this, Iannotta et al., (2007) state that higher capital levels may indicate banks with riskier assets. Due to higher returns, higher capital ratios may result in higher profits, thus suggesting a positive relationship between capital and profitability.

A positive relationship between capital and profitability is generally observed in the financial literature. Athanasoglou et al. (2008) find that higher capitalization is associated with higher profitability, and it is an important and significant factor explaining bank profitability. They define capital as the ratio of equity to assets (EA) and find a strong positive relationship between the EA and ROA in Greek commercial banks. Athanasoglou et al. (2008) state that with a solid capital position, a bank is better positioned to pursue business opportunities and is better reserved if they face problem from unanticipated losses, hence they can maintain their profitability.

3.1.3 Credit risk

Like any other companies, banks face many different risks in their business. There are several risks that banks need to take into consideration such as operational risk, solvency risk and market risk. However, credit risk is considered the most significant, since, more than any other type of risk, it requires accurate measurements and efficient management (Campmas, 2020). Credit risk can be defined as the possibility of the borrower or counterparty of the bank defaulting in accordance with the agreed terms. In general, credit risk refers to the risk that a loan will not be repaid in full or in part (Casu et al., 2015). Risk often refers only to negative deviations from the expected result as positive deviations can be considered as opportunities (Campmas, 2020).

In bank research, credit risk is usually measured as the ratio of the loan-loss provisions to loans. Generally, these studies suggest that increased exposure to credit risk has a negative impact on bank profitability. Athanasoglou et al. (2008) provide strong evidence on there being a significant and negative relationship between credit risk and profitability (ROA). Thus, the higher the banks' exposure to credit risk, the lower their profitability. Therefore, by improving monitoring and screening of credit risk, a bank could improve its profitability (Athanasoglou et al., 2008). Credit risk has also been found to be asymmetric and pro-cyclical, i.e., it fluctuates around a trend during economic cycle (Marcucci & Quagliariello, 2009). For example, Dietrich and Wanzenried (2011) find no significant relationship between loan-loss provisions per gross loans and bank overall

profitability. However, during the financial crisis the effect became increasingly significant and thus impacted negatively to profitability.

3.1.4 Diversification

For banks diversification is often measured as the ratio of non-interest income over total income. It refers to the income a bank generates by commissions, fees, and trading activities (Campmas, 2020). Thus, it describes how banks distribute their sources of income from other income streams than their main operations. According to the modern intermediation theory discussed above, diversification can reduce risks and decrease the probability of failure (Boyd & Runkle, 1993). However, empirical evidence shows slightly contrary results on the effect of diversification on profitability.

Elsas et al. (2010) examined the impact of revenue diversification on bank value from nine countries over the years 1996-2008. The results of their research provide strong evidence suggesting that diversification enhances bank profitability. The higher profitability is achieved via higher margins from non-interest businesses and lower income ratios. On the contrary, ECB (2015) suggests converse results as the findings of their research show negative relationship between the share of non-interest income and total revenue. Thus, the results propose that, in general, a higher share of non-interest income seems to lead to weaker bank profitability. Demirgüç and Huzinga, (1999) provide similar results as they find that non-interest earning assets are negatively associated with net interest margin.

3.1.5 Operational Efficiency

The total expenses of a bank consist of operating cost (for example, staff salaries, administrative cost and property costs) and other expenses (such as taxes and depreciation). Operational efficiency is often measured as cost-to-income ratio, and it is calculated as the operating cost over assets. The ratio focuses only on operational expenses as they can be influenced by the banks' management through their own

operations. Hence, the ratio is expected to have a negative correlation to profitability, as better cost management will increase efficiency and thus profits (Athanasoglou et al., 2008).

The empirical evidence concerning the relationship between efficiency and profitability provides evidence for the abovementioned assumption that better efficiency leads to better profitability. Dietrich and Wanzenried (2011) examined the profitability of 372 commercial banks in Switzerland from 1999 – 2009 and found a strong negative relationship between the cost-to-income ratio (measure of operational efficiency) and return on average assets (ROAA). Thus, the result indicates that the more efficient the bank is, the more profitable it is. Athanasoglou et al. (2008) found similar results in Greek banks between 1985 and 2001.

3.2 External determinants of profitability

In addition to bank-specific factors, also the impact of external factors on profitability has been studied. Banks play a key role in the economy as financial intermediaries and are naturally strongly influenced by the environment in which they operate. This section addresses the external macroeconomic determinants affecting bank profitability found in relevant literature.

3.2.1 Business cycle

As banks are a part of the macroeconomic environment, business cycle has been found to have a major impact on their profitability. The business cycle is usually measured as the growth of real GDP, and financial literature suggests that it has a positive impact on bank profitability (see e.g., Athanasoglou et al, 2008; Demirgüç and Huzinga, 1999; Dietrich and Wanzenried, 2011). Thus, the empirical evidence concludes that bank profitability is procyclical. There reason for the procyclicality may be that the economic environment is thought to be riskier during downturn and therefore lending could

decrease (Athanasoglou et al, 2008). Vice versa, during the upswing, demand for lending increases leading to better profitability.

Bolt et al., (2012) find that the procyclicality is more grounded in downturn than under ordinary circumstances. Moreover, in periods of prosperity, the degree of credit risk is assessed to be lower, and the quality of the loaning portfolio is viewed to be higher, which brings down loan loss provisions and straightforwardly enhances profits. Also, Athanasoglou et al. (2008) find asymmetricity as their results indicate that the impact of procyclicality is significant only in the upper period of the business cycle.

3.2.2 Inflation

Inflation is another important determinant of the profitability but its impact is, however, ambiguous. Perry (1992) studies the impact of changing prices on net interest income and capital value and expresses that the degree to which inflation influences bank profitability relies upon whether inflation assumptions are completely expected. If banks' management completely anticipate the expected inflation rate, it suggests that banks can fittingly change interest rates to expand their incomes quicker than their expenses and therefore obtain higher financial benefits.

In general, empirical evidence suggests positive relationship between inflation and profitability. Demirgüç and Huzinga (1999) find that inflation has a positive effect on banks' net interest margins giving the understanding that high inflation converts into higher profits from bank float. However, they state that also bank costs generally rise along with the inflation. After all, on the net the results indicate a positive relationship, albeit it not being very significant. Athanasoglou et al. (2008) find a positive relationship between expected inflation (measured by current inflation) and profitability. They assume that the relationship is positive perhaps because of the capacity of banks' management to sufficiently, however not completely, figure future inflation, which thusly infers that loan fees have been properly acclimated to accomplish higher profits.

4 Literature Review on Banks and NIRP

In general, studying the effect of interest rates on banks' profitability is not a new area in financial literature. In addition to being a subject of academic research, the topic is also important on a more practical level as banks' shareholders, investors and other stakeholders are interested in how interest rates affect banks' income and profitability.

One of the earliest studies explaining how different variables affect banks' profitability is Demirgüç and Huzinga (1999). They used bank level data for 1988-1995 in over 80 countries and examined how banks' profitability and interest margin are affected by a number of macroeconomic and banks-specific variables. The research provides evidence on higher interest rates being associated with higher profits and interest margins. The relationship is pronounced particularly in developing countries, since there the interest rates on deposits are likely to be more controlled and lower that market rates.

Borio et al. (2017) study 109 large international banks in 14 different economies from 1995 to 2012 and find that changes in interest rates and in the slope of the yield curve have an impact on various parts of bank profitability. More specifically, Borio et al. (2017) investigate the effect of monetary policy on banking profitability and thus examine the impact of interest rate and yield curve slope on banks' net interest income, non-interest income and loan loss provisions. They use extensive data with a sample of bank-specific data covering more than 70 % of worldwide banks assets. The 18-year interval captures various economic cycles as well as the 2008 financial crisis. As the interest rate the study uses three-month interbank rate and the slope of the yield curve is determined as the difference between ten-year government bond yield and the interbank rate.

Borio et al. (2017) find a positive relationship between the short-term interest rate and net interest income. Also, the yield curve slope is positively connected with the net interest income. Furthermore, the results show that when the interest rates are close to zero, the effect is larger as the relationship between interest rates and the net interest income is concave. For example, an increase in short-term interest rates from 0 % to 1 %

results in 0.5 percentage point in net interest income over one year. However, a one percent rise in the interest rate from 6 % to 7 % increases net interest income by only 0.2 percentage points. This suggests that the rise in net interest income could be more precisely predicted by the relative rise of the interest rate, rather than the absolute rise in interest percentages, since a rise from 0 to 1 % is effectively relative to a 100 % rise in the rate, whereas a rise from 6 to 7 % is only a relative rise of around 16.6 %. The slope of the yield curve also has a similar effect in that the impact is greater when the yield curve slope is closer to zero (Borio et al., 2017).

The results, in turn, indicate a negative relationship between the short-term rate and yield curve slope with respect to the non-interest income, indicating banks searching alternative options to ensure the profitability. Borio et al. (2017) show evidence suggesting that when interest rates rise, it causes a decrease in non-interest income; in this case the decrease is greater when the interest rate is closer to zero level. Moreover, they find evidence showing that the effect on loan loss provisions is positive, but higher interest rates overall boost bank profitability as the rates and the ROA have a positive relationship. Thus, it can be concluded that the positive impact on net interest income is grater that the negative effects of non-interest income and provisions. In summary, the results show that low interest rates result in lower profitability. In addition, when interest rates start to rise from near-zero levels, the effect is larger at first but when the rates are already high, for example 6-7 %, the rise no longer has a such a significant effect on profitability.

One of the latest studies on the impact of negative interest rates on banks´ profitability is López-Pemabad et al. (2022) who examine the effect of negative interest rate policy on bank profitability in Europe. More closely, López-Penabad et al. (2022) examine the effect of negative interest rate policy (NIRP) on banks' net interest margin and ROA. In addition, they study the effect on banks´ risk-taking as well. The study covers European banks in 29 different countries from 2011 to 2019, of which countries' central banks six different banks had adopted the NIRP. As the interest rate they use three-month

interbank money market interest rate and the slope yield curve is measured by the difference between the 10-year Treasury yield and three-month interbank money market interest rate.

López-Pemabad et al. (2022) find evidence suggesting that the NIRP has a negative effect on the profitability of banks. More specifically, the results indicate that the implementation of NIRP lower both the net interest margin and the ROA. Banks increased their commissions and fees to compensate the weight of loan loss provisions, but overall profitability declined in 2011-2019 (López-Pemabad et al., 2022). In addition, the results conclude that when the short-term interest rates are already negative, their decline has no effect on ROA but still lowers the NIM. Consequently, banks increased net fees and commissions to become more competitive in order to counteract the decline in the net interest margin. On the contrary, when interest rates were above zero, the decline in short-term interest rate improved ROA with lower loan provision losses but had no effect on NIM.

The research of Molyneux et al. (2019) provides a similar result as López-Pemabad et al. (2022). Molyneux et al. (2019) investigate the effect of NIRP on banks margins and profitability in OECD countries. The data consist of bank level data from 7 352 banks over the period 2012 – 2016. The idea of the paper is to study whether the banks' NIM and ROA reduced after the country in question implemented the NIRP. To capture the effect on profitability and NIM after the conduct of negative rates, Molyneux et al. (2019) use a difference-indifference method (DiD). The methodology also gives the opportunity to examine the efficiency of the pass-through mechanism of NIRP in the context of different bank-specific and macroeconomic environments.

Molyneux et al. (2019) find strong evidence that the implementation of NIRP affects bank's margins and profits negatively. More closely, the implementation of NIRP decreases NIM 16,31 % and ROA 3,06 %, on average, compared to countries that did not introduce the policy. The results also indicate that the contraction of NIM weakens banks'

profitability even in the situation of low interest rates boosting profits indirectly through the reduction of non-performing loans and the valuation gains associated with fixed income securities.

The findings of Molyneux et al. (2019) also point out that NIRP impact on profitability also depends on the bank- and country-specific factors. NIRP seems to have a larger impact on small banks compared to large ones. This is because large banks can more effectively minimize the impact of the policy. For instance, they can hedge, diversify their lending portfolios, or switch their business model to be a more non-interest oriented one (Molyneux et al, 2019). In addition, Molyneux et al. (2019) find that in countries where the banking sector is more competitive and in countries where floating interest rates are dominant, the effect of NIRP is more powerful.

Claessens et al. (2018) study globally how long-lasting low interest rates affect banks' profitability. Their data consists of 3 385 banks from 47 countries from 2005 to 2013. More closely, they examine the impact of interest rates in banks' NIM and ROA in countries with a low interest rate compared to countries with higher interest rates. As interest rates, they use county´s implied 3-month sovereign bond yield as well as the difference between the average 10-year implied bond yield and the 3-month implied sovereign bond. A country with an average three 3-month sovereign yield of equal or less than 1.25 % is classified as a low-interest area.

The paper provides evidence that the impact of low interest rates on bank NIMs is much greater than that of high rates. In addition, the magnitude of the effect varies depending on the maturity of the bank as the impact is greater to banks with short maturity balance sheet (lower maturity than the median maturity for banks in its country) (Claessens et al., 2018). The results indicate that there is also a negative relationship between the level of the interest rate and profitability (ROA). However, the impact is not as strong as it is to NIM as a low interest rate can lead to some valuation gains and banks may mitigate

the effect from low interest rates by cutting costs and generating more income from non-interest sources (Claessens et al., 2018).

Based on the findings, Claessens et al. (2018) state that the positive relationship between profitability and interest rate proves that in an environment of low interest rates, banks have a challenging task of maintaining their income, especially if the interest rates stay low for a long period of time. Even if banks have some tools to compensate the low interest rates´ negative effects on profitability, such activities can take a considerably long time. In addition, given cyclical conditions and deleveraging pressures, the immediate benefits of these efforts may stay relatively small (Claessens et al., 2018).

The negative impact of low interest rate on banks' profitability raises some concerns about banks' capitalization and value in longer-term. Claessens et al. (2018) conclude that low profitability leaves banks vulnerable to market changes and shock until the lost income from lower NIMs van be compensated by other efforts. Thus, also their ability to support the real economic activity is compromised. Another problem with the reverse effect of low interest rates on profitability is related to monetary policy. Low interest rate can negatively affect banks' lending channel, as it weakens banks' market capitalization and lending capacity. Hence, lowering interest rates as a monetary policy tool may not be such an efficient action for boosting economic activity (Claessens et al., 2018).

Bikker & Vervliet (2018) study the effect of an unusually low interest rate on probability of banks' profitability in the United States banking sector and find partial evidence for their hypothesis that low rates indeed weaken the profitability. They analyze the data on United States commercial and savings banks from 2001 to 2015, allowing them to study the evolution of low interest rate environment, and consider the years before and after the financial crisis. As a measure of profitability Bikker & Vervliet (2018) use net interest margin, return on assets, return on equity and profit from banks' balance sheets. To examine the impact of low interest rates on the above, they use the 3-month money

market rate, 10-year government bond yield and the yield curve slope (the difference between the previous two) as a measurement for interest rate environment.

The paper by Bikker & Vervliet (2018) provides evidence on there being a positive relationship between the short-term interest rate and NIM. More specifically, they find that a one percentage increase in the 3-month money market rate leads to a 1.51 basis point increase in NIM. There is also a positive relationship between the long-term interest rate and NIM, albeit a much lesser one. Thus, the results are in line with the related literature suggesting that low interest rates are associated with a decline in profitability. Also, the results on impact on ROA provide evidence that a low interest rate undermines the performance of the bank as the increase in short-term rate is associated with an increase in ROA. Bikker & Vervliet (2018) also find that for both NIM and ROA, the quadratic term's coefficient of the short-term rate has a negative sign, which implies that the effect is stronger when the levels of interest rate are initially already low.

The results of the paper by Bikker & Vervliet (2018) are in accordance with several other studies on the topic which indicate that the profitability is affected by the low interest rates. However, Bikker & Vervliet (2018) find that the overall profits are not harmed by the lower interest rates as the banks on their sample were able to maintain their overall profit levels. More specifically, the findings address a negative relationship between the short-term interest rate and profits, i.e., as the interest rates increase, the profits decrease. The relationship is also negative with long-term interest rate. Bikker & Vervliet (2018) speculate that it is possible for banks to compensate for the decline in NIM in a way that does not adversely affect the overall profits.

On the other hand, some researchers find opposite results regarding the effect on interest rate on profitability. Scheiber et al. (2016) investigate the bank profitability in Denmark, Switzerland, and Sweden during 2010-2015, when the interest rates had been negative or very low. The results conclude that during the sample period the net interest income remained stable in all countries although the interest rates were negative and

thus the (near-) negative interest rates have not caused a significant collapse in profitability. Scheiber et al. (2016) find that during the period of low interest rates, net interest margins decreased slightly, but between 2010 and 2015 the net interest income remained fairly stable.

Scheiber et al. (2016) explain the stable income by the fact that all the banks in the sample managed to reduce their interest expenditure quicker and to a greater extent than their interest income. Thus, it is not noticeable that the composition of the banks' operating income has shifted from interest income to other income components. Also, some of the banks increased their commissions income and net fee. The authors point out that although they find no significant evidence of the effects of low interest rates on profitability, when interest rates are negative for a long time, banks' room for maneuvering and various actions may be reduced, thus causing a decrease in profitability. For example, banks may compensate for lower interest income by increasing the volume of lending, but on the other hand, regulations related to banks may prevent it (Scheiber, et al., 2016).

Madaschi and Pablos Nuevo (2017) find similar results as they study the profitability of banks in Sweden and Denmark. Their study indicates that banks' profitability in Sweden and Denmark continued to improve during the negative and low interest rates, implying that the monetary policy tools functioned effectively in those two countries. According to the authors, during the period in question, both negative interest rates and other political tools, such as foreign exchange interventions and quantitative easing, have enabled Sweden and Denmark to succeed in their monetary policy goals. Stabilizing the exchange rate in Denmark and lifting inflation and its expectations in Sweden.

English (2002) discovers that, in multiple countries, bank net interest margins are unaffected by changes in short- and long-term rates or the yield curve slope. The study focuses on the relationship between banks' net interest margins as well as assets and

liabilities and market interest rates using annual data from 10 industrial countries around the world.

English (2002) states that according to the conventional view of the financial literature, there seems to be a close relationship between returns on bank liabilities and short-term interest rates and that these returns also adapt somewhat quickly to changes in short term rates. Conversely, returns on bank assets are thought to be more closely tied to longer term rates and they do not adapt to changes as quickly. Hence, a steeper yield curve should increase bank net interest margins, because a steeper curve indicates higher rates on assets relative to liabilities when assets and liabilities are repriced. Furthermore, as liabilities adjust more quickly to changes in interest rates, an increase in long-term and short-term interest rates is expected to result in a reduction in net interest income.

Contrary to the conventional view, English (2002) finds that out of a total of ten countries under investigation, in five countries there is no evidence on bank net interest margins being impacted by the changes in short-term and long-term interest rates or the slope of the yield curve. Also, surprisingly in Sweden, Germany, Norway and Switzerland, the slope of the yield curve has a negative relationship between net interest margins.

The results indicate that the commercial banks in these countries manage to control interest rate fluctuations and the effect of the yield curve volatilities on net interest margins (English, 2002). Hence, the changes in interest rates do not seem to have a very strong effect on the banking sector even though they are believed to have a negative effect on profitability. As an outcome, a steeper yield curve leads to higher bank net interest margins for a long-lasting period because in the case of a steeper yield curve, the return on assets is higher in relation to the return on liabilities.

5 Data and Methodology

This section introduces the data and the data collection, as well as the methodology and model for an analysis of the impact of negative and low rated interest rates on bank profitability. A unique dataset is collected from several sources. Table 2 shows the full list of variables used in this study. Overall, the dataset contains data from 20 commercial banks in Denmark, 9 banks in Sweden and 21 banks in Germany. Hence, in total the data covers 50 banks, and it is from the years 2011–2021 (550 observations).

Table 2. Summary of variables.

Dependent variable	Description
Net interest margin (NIM)	The difference between interest earned on assets minus interest costs.
Return on average assets (ROAA)	The ratio of profits to average assets

Independent variable

Interest rate	Short-term interest rate: three-month money market interest rate
Slope of the yield curve	The difference between the long-term interest rate and the short-term interest rates.

Control variables

GDP Growth	The yearly growth of gross domestic product
Operational efficiency	Cost-to-income ratio of bank i in year t
Size	The natural logarithm of the amount of the total assets of bank i in year t .
Liquidity	Net loans/total assets of bank i in year t
Capital	Equity/total assets of bank i in year t

Table 3 presents the descriptive statistics of the dependent and independent variables used in the panel data regression. After that the chapter covers each variable separately and specifies the employed model used in the study.

Table 3. Descriptive statistics.

	Mean	Median	St.Dev.	Min	Max
NIM	2,10	1,72	1,73	-9,76	8,92
ROAA	0,66	0,53	0,94	-4,67	6,70
Interest rate	0,05	-0,19	0,58	-0,69	1,66
Slope of the yield curve	0,70	0,74	0,46	-0,12	1,48
Size	16,08	15,47	2,45	11,85	21,75
Capital	10,45	8,97	7,70	0,86	76,60
Operational efficiency	63,50	63,22	19,68	12,05	222,30
Liquidity	56,55	58,54	17,94	0,00	89,32
GDP growth	1,57	2,00	1,95	-4,60	4,90

Observations: 550

5.1 Dependent variables

Bank-related variables (NIM and ROA) are collected from the Orbis database by Brue van Dijk, which covers the same information as the European company database Amadeus. The banks in the data sample are selected using the following criteria. The company type is a commercial bank. The study uses consolidated balance sheet statements from commercial banks in Denmark, Sweden and Germany. The data is annual. Banks for which data is not available for a sufficiently large time horizon, and banks that are small in total assets have been excluded from the sample. Banks from the European countries in particular have been selected for this study because negative nominal rates have been in place in these three countries for a relatively longer period of time compared to many other European countries. For example, like stated in the introduction, The Danish National Bank introduced a negative rate in 2012. Furthermore – in addition to having a

significant banking sector – Germany, Denmark and Sweden are among the largest economies in Europe, which makes them representative of the region as a whole.

5.2 Independent variables

As this study focuses on the impact of low and negative nominal interest rates on bank profitability, the following variables are considered as a proxy of interest rate: short- term interest rate and the slope of the yield curve.

Short-term (and long-term) interest rates are collected from the OECD data (2022) and they are based on the three-month money market rates. It describes the interest charged on short term loans made between financial institutions. The tree-month money market rate is used instead of the policy rate because it reflects the adoption of unconventional monetary policies more accurately (López-Penabad et al, 2022). The figure below shows the short-term interest rates over time from Denmark, Sweden and Germany (euro area).

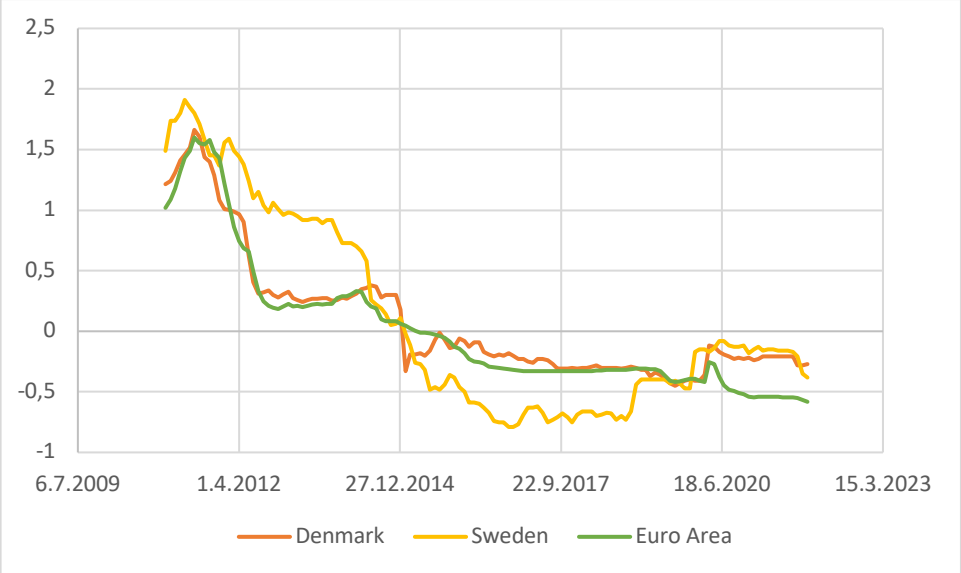

Figure 6. Short-term interest rates (OECD, 2022).

The slope of the yield curve is calculated as the difference between the long-term interest rate and the short-term interest rates. The long-term interest rate refers to the 10-year government bond and the data is collected from the OECD database (2022).

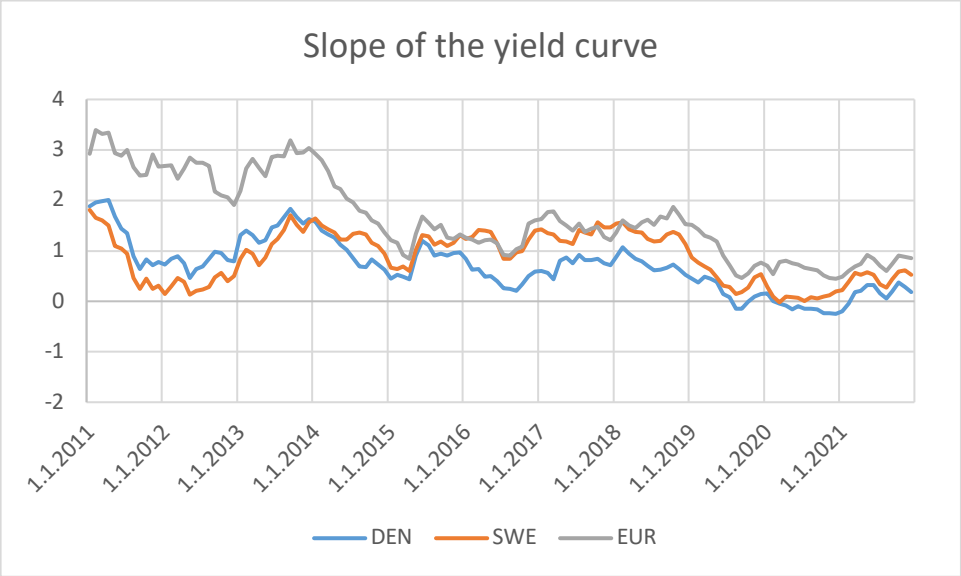

Figure 7. Slope of the yield curve (Calculated from OECD, 2022 data).

5.3 Control variables

Factors that, according to the literature, influence banks' profitability are used as control variables. The data includes numerous explanatory variables that can be used to justify the variation of different profitability accounting variables when the interest rate changes. There are both macroeconomic and bank-specific control variables.

In general banks' business activity and operations are linked to the development of the overall economy. The most significant consumption and investment decisions of households and companies can be aggregated to the banking sector as an increase in loan demand. Overall economic development therefore also determines the development of banks' profitability. The overall economic development is often measured in the change in gross domestic product (GDP), and thus it is used as a control

variable in the regression. GDP growth is collected from countries' National Statistics, Annual national accounts.

The bank-specific variables that presumably have an impact on profitability have been presented earlier in chapter three of this study. The proxies for bank size, capital and operational efficiency are collected from the Orbis database by Brue van Dijk.

5.4 Method

The main purpose of this study is to test the impact of low and negative nominal interest rates on bank profitability. To estimate the causal effect of nominal interest rates on bank profitability, this study uses panel regression where bank profitability is regressed against the short-term interest rate and the slope of the yield curve. Control variables are also included to control other bank-related and macroeconomic factors believed to affect profitability.

As a method this study uses linear regression analysis, which can be used to model the change in profitability before and after a negative interest rate. Linear regression analysis is used to find out the effect of one or more explanatory variables on the explained variable. The advantage of regression analysis is that it can be used to simultaneously determine the effect of several explanatory variables on the explained variable and their average ratios.

Each variable in the panel data contains both a time and a unit observation. The panel data can therefore be said to be a combined time series and cross-sectional data. The material of this study is explicitly used as panel data and the results of the study are formed using a regression model. The regression model of one explanatory variable in the panel data has the following form:

$$y_{it} = \alpha + X_{it}\beta + u_{it} \; ; \; i = 1, \ldots, N \; ; \; t = 1, \ldots, T \qquad (4)$$

where ‘y it’ is the explanatory variable in cross-sectional unit ‘i’ at time ‘t’, ‘X it’ is the explanatory variable and ‘u it’ is the error term.

In this model, the fixed effect (αi) represents the unique characteristics of the ith individual or group which are not captured by the independent variables. This allows the model to account for unobserved differences between individuals or groups, which can help improve the accuracy of the estimates. The regression coefficients (β1, β2, ..., βn) represent the estimated effect of each independent variable on the dependent variable, while the error term (ε) represents the unexplained variation in the dependent variable. Overall, the fixed effect regression model is used to estimate the relationship between the dependent variable and the independent variables while controlling for the effects of other variables.

A simple regression model can be further divided into fixed and random effect models. The Hausman test is a method used to determine whether a random or fixed effects model should be used in the data analysis. When choosing a model, attention should be paid to whether the time-independent individual effects are correlated with the other explanatory variables of the model. If it is noticed that they are correlated, then it can be concluded that the random effects model does not apply. Thus, the H0 is that random effects are independent of explanatory variables and H1 states that H0 is not true. The results of the Hausmann test suggest that H0 can be rejected at 1 % level for both NIM and ROAA. Hence, the fixed effect model can be an appropriate model to use in the study. The fixed-effects model is also often the preferred option, as it allows unbiased estimates to be obtained even if the no-correlation condition is valid.

When studying the effect of negative nominal interest rates on profitability, the regression model is as follows:

$$Profitability_{\ it} = \mu_t + \beta_1 Rate_t + \beta_2 Slope_t + \beta_3 Size_{it} + \beta_4 Capital_{it} + \beta_5 Efficiency_{it} + \beta_6 GDPLiquidity_t + \beta_7 GDP_t + \varepsilon_{it} \quad (5)$$

where

$Profitability_{\ it}$ = the profitability of bank i in year t (estimated by either NIM or ROAA)

μ_t = The intercept

$\beta_1 Rate_t$ = The interest rate broxy in year t (the three-month money market rate)

$\beta_2 Slope_t$ = The slope of the yield curve in year t

$\beta_3 Size_{it}$ = Logarithm of total assets of bank i in year t

$\beta_4 Capital_{it}$ = Equity per total assets of bank i in year t

$\beta_5 Efficiency_{it}$ = Cost-to-income ratio of bank i in year t

$\beta_6 Liquidity_t$ = Net loan per total asset of bank i in year t

$\beta_7 GDP_t$ = GDP growth in year t

ε_{it} = The error term

The regression is based on models used in earlier studies that examine the impact of different variables on bank profitability (e.g., Claessens et al., 2018 & López-Penabad et al., 2022). In this model, the control variables (GDP growth, size, capital, efficiency and liquidity) are included as additional independent variables along with the main independent variable of interest (the interest rate proxy). This allows the model to estimate the relationship between the profitability and the interest rate proxy while controlling the effects of the other variables on the net interest margin.

6 Empirical Results

This chapter analyzes the results derived from the regression model. First, the results of the effects on NIM are presented and analyzed. Second, the results of a similar regression are presented, but with ROAA as a dependent variable.

6.1 The impact of low and negative rates on banks' NIM

In this section, the estimation results from fixed panel data results are presented. It allows for the analysis of the impact of the interest rates on bank profitability of banks in Denmark, Germany and Sweden. Table 4 shows the results for the NIM.

Table 4. The impact of interest rates on NIM.

Dependent variable NIM

Variable	Coefficient
Constant	**6,015471****
Interest rate	**0,242754 *****
Slope of the yield curve	**0,260784 ****
Size	**-0,329819 ****
Capital	**-0,016605 ****
Efficiency	-0,003197
Liquidity	**0,028551 *****
GDP Growth	-0,032075
Number of obesrvations	550
Number of banks	50
Sample	2011 - 2021
R-squared	0,759491
F-statistic	27,80041
Prob (F-statistic)	0,000000

Significance levels * = p<10%, **=p<5%, ***=p<1%

The regression includes a total of 50 banks from Denmark, Germany, and Sweden from 2011 to 2021 and thus, there is a total of 550 observations. The data fits the model fairly well since the R-squared is 0,759. Hence, the independent variables explain approximately 76 % of the dependent variable (NIM). Also, the F-statistics show a high significance.

The results indicate that there is a significant positive relationship between the interest rate and the net interest margin during the sample period. The coefficient of the interest rate (0,242754) shows a strong and positive correlation at 1 % confidence level. A one percentage point increase in the three-month money market rate is associated with a 0,24-percentage point increase in the NIM, ceteris paribus. Thus, the lower the interest rate is, the lower the NIM is, and it can be concluded that low interest rates lead to decline in the net interest margin.

The results provide evidence for hypothesis one and two and are in line with much of the earlier literature (e.g., Bikker & Vervliet, 2017; Borio, et al., 2017, & Claessens et al, 2018). The reason for NIM dropping as the interest rates drop may be in the banks' business model. The results are in line with the presumption stated at the hypothesis section, i.e., banks struggle to make profits from their traditional lending and funding practices. More closely, as the interest rates decline and trough policy rates move to market rates, banks may be reluctant to lower interest rates for depositors, especially for depositors of retail customers, because then there would be a risk of losing customers. However, when the market rates fall, at the same time banks must respond by lowering rates on new and existing loans. As a result, low interest rates lead to a decline in NIM, which is the main indicator of bank profitability.

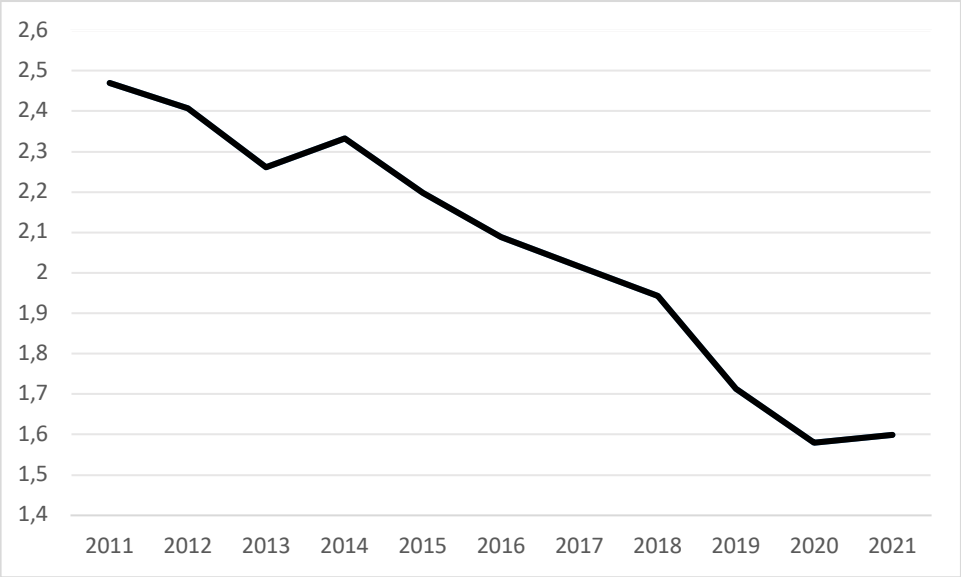

Figure 8. Changes in net interest margin between 2011 - 2021 on average.

The results also show a positive and statistically significant (p-value < 5 %) impact of the slope of the yield curve on NIM. A one percent increase in the slope boosts the NIM approximately by 0,26 percent. The impact is to be expected since a large number of studies propose that a steeper yield should have a positive effect on profitability (e.g., Borio et al, 2017).

Size has a significant negative effect on net interest margin. As the coefficient of the bank size is -0,33 at 5 %, the result indicates that larger banks are associated with lower margins. The negative effect may be due to larger banks rather suffer than benefit from economic of scale. A large bank usually faces more costs related to the larger size, such as agency costs and bureaucratic costs (Kok et al., 2015; Athanasogolu et al, 2018).

However, the effect of bank size is inconsistent in the literature and previous studies have also shown a positive or insignificant impact. For example, López-Penabad et al. (2022) find that large banks can benefit from low interest rates by obtaining cheap funding from the market. The results show that the amount of a bank's total assets have a clear connection with the bank's operational strategy when the interest rates fall. Large banks

take a larger share of funding from the capital markets and thus do not similarly suffer from the low or negative interest rates.

Surprisingly, capital has a negative significant effect on NIM with a coefficient of -0,017. Earlier studies generally show a positive impact between capital and profitability. For example, Athanasoglou et al. (2008) find a positive effect and state that better capitalization can act as protection against difficult times and thus, in a state of low interest rates, banks with good capitalization are able to maintain their profitability. However, the negative relationship shown by the results could be explained by the banks' lower risk taking. Lower risks lead to lower returns and thus indicate lower profitability. In line with the portfolio theory, riskier banks tend to make higher profits and thus larger capital affects negatively to banks' profitability as well.

According to the result of table 4, the relationship between operational efficiency and NIM is negative and insignificant. The finding is somewhat consistent with previous research as several studies show that operational efficiency is a prominent driver for a bank's profitability.

The coefficient on liquidity is positive and highly significant. A one percentage point increase in liquidity ratio is associated with approximately 2,9 basis points increase in NIM. The positive relationship may be due to the banks' better ability to guard or prepare for harder times. Bourke (1988) and Duraj & Moci (2015) find liquidity to be positivively and significantly related to profitability and argue that when a bank is more liquid, it has a better ability to prepare for potential shocks. The macroeconomic factor of GDP growth appears to be negatively but insignificantly related to NIM. Thus, contrary to literature, the results do not provide evidence for the pro-cyclical impact of the NIM.

6.2 The impact on ROAA

This section presents the regression results of the regression where ROAA is used as a measure of the bank profitability. Table 5 below provides the same statistics as the previous table but with ROAA as the dependent variable.

Table 5. The impact of interest rates on ROAA.

Dependent variable
ROAA

Variable	Coefficient
Constant	**6,562807 *****
Interest rate	**-0,254800 *****
Slope of the yield curve	**-0,168504 ****
Size	**-0,2600942 ****
Capital	**0,014425 *****
Efficiency	**-0,018402 *****
Liquidity	**-0.011904 *****
GDP Growth	**0,072467 *****

Number of observations	550
Number of banks	50
Sample	2011 - 2021
R-squared	0,571096
F-statistic	11,72217
Prob (F-statistic)	0,000000

Significance levels * = p<10%, **=p<5%, ***=p<1%

The same banks and variables are included also in this regression. The R-squared is lower (0,57) than in the other regression and thus the proportion of the variation in the dependent variable, which is explained by the independent variables, is smaller in this regression. However, it is a decent fit and R-squared alone does not imply the model is a good fit for the data.

Interestingly, the ROAA is not hurt as a result of decrease in interest rates and a negative interest rate environment. On the contrary, the results show that the coefficient of interest rate is highly significant but negative. A one percentage point increase in the interest rate is associated with a 0,25-percentage point decrease in ROAA. In other words, a decrease in the three-money market rate boosts the return on average assets, and thus causes the opposite effect in comparison to the impact on NIM. Also, the effect of the slope of the yield curve is significantly negative as well.

It is important to note that NIM and ROA are different financial metrics, which measure different aspects of a bank's performance. NIM measures the profitability of the bank's earning assets, while ROA measures the bank's overall profitability. So, it is possible for a bank to have a lower NIM but a higher ROA in a low-interest rate environment. When interest rates fall, banks typically earn less interest income on their loans and investments, which can lead to a decline in NIM. However, a lower rate environment may also increase loan demand and asset growth, which can boost the ROA. Additionally, banks may also turn to non-interest income streams, such as fees and charges, to offset the negative impact on NIM. It is also possible that a bank may take actions to reduce its cost of funds, such as by increasing deposits, lowering deposit rates, and issuing long-term debt at lower rates, which may help to mitigate the decline in NIM.

López-Penabad et al. (2022) find that when the interest rates are low but positive, the decrease in the interest rate causes an improvement in ROA, given the lower loan loss provision. Thus, lower provisioning cost could explain the negative relationship between interest rates and ROAA. As the economic conditions improve and credit risk decreases, banks may set aside fewer funds for bad loans, which can boost the ROAA. Lower rates may also encourage borrowing, which results in an increase in loan demand. This can raise the banks’ assets and improve the ROA.

Lower rates typically lead to an increase in the demand of mortgages, which in turn boost the assets. In addition, banks in Germany, Sweden and Denmark are reliant on wholesale

funding, which means that their funding costs are closely tied to interest rates. As interest rates decline, banks may be able to reduce their funding costs, which will boost their net interest income and improve ROA.

It's also worth noting that, as stated earlier in this study, the ECB had been implementing a negative interest rate policy since 2014. This policy aims to stimulate the economy by encouraging banks to lend more money while discouraging them from holding excess reserves at the ECB. Banks in Germany, Sweden and Denmark are also part of the European monetary system, so they have to comply with the ECB's monetary policy.

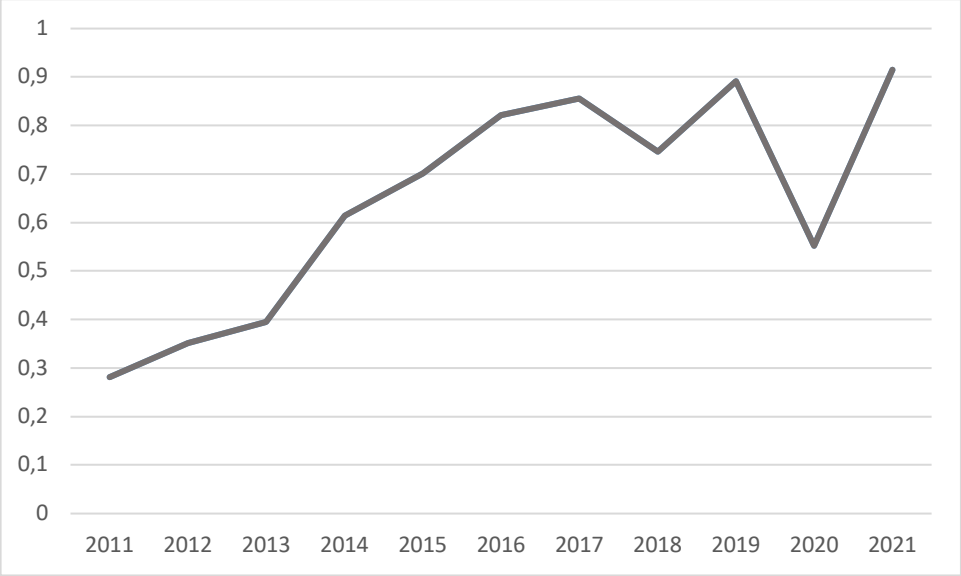

Figure 9. Changes in ROAA between 2011 - 2021 on average.

The impact of size is found to be negative as the coefficient of bank size is -0,26. Hence, larger banks are associated with lower ROA indicating lower levels of profitability. Furthermore, better capitalized banks are associated with better ROAA as the coefficient of capital is given 0,014. As stated earlier, when the market rates fall, banks may earn less income from the interest they charge on loans causing their net interest margin to drop. However, at the same time, the value of banks' assets (such as loans) may also fall, leading to a decrease in total assets. If the decrease in the value of assets is greater than the decrease in the value of equity, the bank's capital (equity/total assets) will increase,

which can positively impact the bank's return on assets. In other words, while the bank may be earning less income from interest, the increase in capital can help to offset this decrease and result in a positive return on assets.

The operational efficiency (cost-to-income ratio) has a negative relationship with ROAA. A one percentage point increase in cost-to-income ratio is associated with approximately 1,84 basis point decrease in ROAA. The result is expected and in line with, e.g., Athanasoglou et al. (2008) and Dietrich & Wanzenried (2011). Cost-to-income ratio is calculated by dividing a bank's operating expenses (such as, salaries, administrative cost and property costs) by its operating income. A lower ratio indicates greater efficiency. Thus, a higher cost-to-income ratio has a negative impact on bank profitability or, in other words, more efficient banks are more profitable.

When interest rates fall and banks earn less income from loans, they may offset the decrease in income by reducing costs. A higher cost-to-income ratio means that the bank is spending more on operating expenses (such as wages, rent, and other costs) relative to its operating income (such as interest income and fee income). This can lead to a lower net income, which would decrease the bank's ROAA. Additionally, a higher cost-to-income ratio can also indicate that the bank is not as efficient in generating revenue, which can also lead to a lower ROAA. For example, if a bank is spending more on operating expenses but not generating as much revenue from interest or fees, it will have a lower net income and a lower ROAA.

The effect of liquidity is negative as well. When a bank has a higher proportion of net loans to total assets, it means that it is lending out more money and earning more interest income. As interest rates fall, this can help to offset the decrease in interest income from other sources, such as deposits. On the other hand, having a higher liquidity can also have a negative impact on a bank's ROAA, which is calculated by dividing net income by average assets. If a bank has a high proportion of net loans to total assets, it means that it is not holding as much cash or other liquid assets. This can make the bank

more susceptible to financial stress in case of a sudden decrease of credit demand or increase of defaults. Additionally, banks with higher proportion of net loans to total assets have less flexibility to invest in other high-yielding assets like bonds or equities.

Economic growth has a positive effect on the ROAA and thus the result corresponds with the related literature of, e.g., Demirgüç-Kunt & Huizinga (1999) and Athanasoglou et al. (2008). The effect of the business cycle seems to be pro-cyclical, i.e., when economic conditions improve and lending increases, banks' business operations improve and thus profitability is boosted.

7 Conclusions

This thesis examines the impact of a negative interest rate environment on commercial bank profitability, with a specific focus on banks from Germany, Sweden and Denmark. The study aims to determine if a correlation exists between (near-) negative nominal interest rates and commercial bank profitability, as measured by net interest margin (NIM) and return on assets (ROA).

The profitability of commercial banks is a significant indicator of the overall health of the financial sector, and a profitable banking system is essential for a stable economy. As such, it is important to understand the impact of monetary policy and other factors on bank profitability. A profitable bank can attract external capital, which is crucial for recovery in the event of significant losses, and profits serve as buffers, allowing banks to offset credit losses. Thus, understanding the factors influencing bank profitability is of great importance.

In recent years, European banks have faced a unique set of circumstances. The global financial crisis of 2008 led to a decline in nominal interest rates worldwide, and as a result of weak economic conditions and the efforts of central banks to achieve their inflation goals, unconventional monetary policies were implemented throughout Europe. To stimulate economic growth and maintain price stability, the European Central Bank and central banks in countries such as Sweden and Denmark have employed a negative interest rate policy (NIRP) as part of their unconventional monetary policy strategies. This has resulted in nominal interest rates being reduced to near-zero levels and in some cases, even to negative levels.

It is generally supposed that, in long term, falling interest rates have a negative impact on profitability. The implementation of low or negative interest rates as a component of monetary policy can have a dual impact on the performance of commercial banks. On one hand, it can stimulate economic recovery, improve the health of the banking sector, and result in capital gains and reduced non-performing loans. On the other hand, it can

also lead to a decrease in net interest margins, as the banks' traditional business model of generating revenue through the spread between lending and borrowing rates may be impacted. Banks may be forced to lower their interest rates on new and existing loans while being hesitant to lower deposit rates as quickly due to the potential loss of customers to competitors.

The impact of changes in interest rates on the performance of banks has been the focus of extensive practical and limited academic inquiry. This is due to the high level of interest from bank shareholders and other investors regarding the effect of interest rate changes on the income and profitability of banks. The impact is expected to vary among banks depending on their interest rate exposures, which are influenced by their level of maturity transformation and use of risk management tools, including derivatives. There has been limited attention given to the specific examination of the differential impact of low interest rates on banks' net interest margins and profitability. Most related academic and empirical studies have posited that banks' net interest margins decline during periods of low interest rates. However, there are also findings that are inconsistent with this general trend.

The empirical part investigates the effect of (near-) negative nominal interest rates on bank profitability. Using a sample of 50 banks from the European countries of Denmark, Sweden and Germany over the period 2011-2021, it can be concluded that negative nominal interest rates lower banks' net interest margin, that is, the banks' main source of profitability. The result indicates that a one percentage point increase in short-term interest rate is associated with a 0,24 percentage point increase NIM. This is consistent with the hypothesis that, as a result of the low interest rate environment, banks encounter difficulties in generating profits through their conventional lending and funding activities. Specifically, as interest rates decrease and the policy rate falls in line with market rates, banks may be hesitant to decrease interest rates for depositors, particularly those of retail customers, as there is a risk of losing customers. On the other

hand, as market rates drop, banks must react by reducing rates on both new and existing loans. Consequently, low interest rates result in a decrease in net interest margins.

Despite the lowering effect which lower rates have on the net interest margins, the empirical study provides contradictory results on the impact on bank's ROAA. A one percentage point increase in the nominal interest rate is associated with a 0,25-percentage point decrease in ROAA. In other words, decrease in the three-money market rate boosts the return on average assets. While low interest rates can result in reduced interest income on loans and investments, leading to a decline in NIM, they may also stimulate loan demand and asset growth, thereby contributing to an increase in ROAA.

For future research, examining the impact of negative interest rates on the overall financial system, including interbank lending, financial stability, and the real economy, could provide a comprehensive understanding of the consequences of negative nominal interest rates on bank profitability.

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