Diversification of Bank Income in European Banks

Research period 2014 - 2024

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

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Diversification of Bank Income in European Banks - Research period 2014 – 2024

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The study examines the impact of non-interest income and changes in general interest rates on banks' profitability and risks. The study focuses on European banks. In recent years, banks have been forced to increase their non-interest income due to changes in the market environment, so the aim is to identify whether this affects profitability or bank risks. The research methods used Fixed Effects (FE) regression, in which profitability is measured by return on assets (ROA) and return on equity (ROE). For risks, risk-adjusted return on assets (RARROA) and risk-adjusted return on equity (RARROE) are used. For reliability checks, banks are divided into large and small banks and by region into Nordic countries and the rest of Europe.

The research data covers 30 banks from a total of 15 different countries. The results cover the period 2014–2024, with quarterly values available for each year. Except for Euribor interest rates, the data have been compiled from the Refinitiv Eikon database. Euribor interest rate statistics have been collected from the European Central Bank database.

The results of the study show that banks' profitability improves when the share of non-interest income in total income increases. Based on regression models, the share of non-interest income is positively correlated with ROA and ROE ratios, and the models are statistically significant. In risk-adjusted models, the impact of non-interest income is not significant, so an increase in non-interest income does not necessarily increase the stability of income or improve risk-adjusted profitability. An increase in the Euribor interest rate supports the stability of income and has a positive impact on risk-adjusted income. The rise in interest rates does not directly improve profitability. Based on the results, it can be concluded that diversification into non-interest income has a positive effect on profitability, but the impact on the stability of returns and risks is not significant.

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Tutkimuksessa tarkastellaan ei-korollisten tuottojen, sekä yleisen korkotason muutosten vaikutusta pankkien kannattavuuteen ja riskeihin. Tutkimuksen kohteena on eurooppalaiset pankit. Pankit ovat viime vuosina joutuneet markkinaympäristön muutosten vuoksi kasvattamaan ei-korollisia tulojaan, joten tavoitteena on tunnistaa vaikuttaako tämä kannattavuuteen tai pankin riskeihin. Tutkimusmenetelminä käytetään kiinteiden vaikutusten regressiomallia, jossa kannattavuutta kuvaa kokonaispääoman tuotto (ROA) ja oman pääoman tuotto (ROE). Riskien osalta käytetään riskikorjattua kokonaispääomantuottoa (RARROA) ja riskikorjattua oman pääoman tuottoa (RARROE). Luotettavuustarkastuksissa pankit on jaoteltu suuriin ja pieniin sekä alueittain pohjoismaiset sekä muu Eurooppa.

Tutkimusaineistossa on 30 pankkia yhteensä 15 eri maasta. Tulokset ovat aikajaksolta 2014–2024 ja jokaiselta vuodelta on saatavilla luvut neljännesvuosittain. Aineisto on Euribor korkoa lukuun ottamatta koottu Refinitiv Eikon tietokannasta. Euribor koron tilastot on kerätty Euroopan Keskuspankin tietokannasta.

Tutkimuksen tulokset osoittavat, että pankkien kannattavuus paranee, kun ei-korkotuottojen osuus kokonaistuotoista kasvaa. Regressiomallien perusteella ei-korkotuottojen osuus on positiivisesti yhteydessä ROA- ja ROE tunnuslukuihin, sekä mallit ovat tilastollisesti merkitseviä. Riskikorjattujen mallien osalta ei-korkotuottojen vaikutus ei ole merkitsevä, joten ei-korkotuottojen kasvu ei välttämättä lisää tuottojen vakautta tai paranna riskikorjattua kannattavuutta. Euribor koron nousu tukee tuottojen vakautta, sekä sillä on positiivinen vaikutus riskikorjattuihin tuottoihin. Koron nousu ei kuitenkaan suoraan paranna kannattavuutta. Tulosten perusteella voidaan todeta, että ei-korollisiin tuottoihin hajauttaminen vaikuttaa myönteisesti kannattavuuteen mutta vaikutus tuottojen vakauteen ja riskeihin ei ole merkittävä.

Abbreviations

EBA	European Banking Authority
ECB	European Central Bank
EU	European Union
FE	Fixed Effects model
GDP	Gross Domestic Product
NII	Non-Interest Income
NIM	Net Interest Margin
MENA	Middle East & North Africa
OLS	Ordinary Least Squares
PSD2	Payment Services Directive 2
ROA	Return on Assets
ROE	Return on Equity
RARROA	Risk-adjusted Return on Assets
RARROE	Risk-adjusted Return on Equity

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Artificial Intelligence disclaimer

Artificial intelligence was used to assist in this thesis. Artificial intelligence was used to search for articles, for example: "Which articles examine the impact of interest rates on bank profits?" Artificial intelligence also helped generate the Python code I used to format and combine the data for the study. In addition, artificial intelligence helped correct MATLAB calculation errors. In the finalisation phase, artificial intelligence helped, among other things, find abbreviations, obvious typos, incorrect references, and comma and punctuation errors. The AI also provided suggestions for a more academic writing style.

1 Introduction

Banking is facing another revolution. The market is increasingly characterized by the emergence of non-traditional players who are seeking to compete with traditional banks through different cost and service structures. In addition, interest rates have fluctuated widely, and it is no longer safe for banks to rely solely on interest income. In addition to traditional fiat currencies, cryptocurrencies are also becoming increasingly popular, although they are not yet used in the payment system, except in a few places.

Interest income has always been a significant source of income for banks. In the 2000s, the common reference interest rate of the euro countries, Euribor, published daily, was at its highest in 2000 and 2008 at more than five percent. After 2008, the Euribor fell steadily until it became negative in 2016. The Euribor rate remained negative until 2022, after which it rose rapidly to more than four percent. When interest rates were negative, banks had to collect income in other ways. After 2022, Euribor and other interest rates started to rise, and banks' net interest income increased. However, banks have changed their income sources, and interest income no longer plays as significant a role as before.

Banks have already begun offering additional services beyond deposit and financing to generate income. Banks are sticking to traditional lending and account services, but they are also offering savings and investment services, such as funds, stocks, and other more complex investment products. In cooperation with payment card companies, banks also offer debit cards and credit cards. Banks have also started to offer insurance and increasingly high-quality digital services, such as financial monitoring and budgeting.

In addition to accounts, finance, and cards, banks also offer businesses high-quality digital services such as preparatory accounting, financial management tools, savings and investment services, insurance for companies and staff, invoicing services, and cash flow monitoring and budget planning.

Digitalization has enabled new players to enter the sector, and the role of traditional banks is not necessarily as strong as it used to be. Revolut, for example, is a fully digital "neo-bank" from the UK that provides services to individuals and businesses. Its range of services includes money transfers, debit cards, stock and cryptocurrency exchanges, and interest-bearing savings accounts. The basic service package is free, but paid packages are also available that offer benefits and a wider range of services. The Neobanks' earning model is based on ease of use and affordability. Traditional banks will also have to assess the impact of neobanks on their own future earnings model.

1.1 Research background

The impact of changes in the share of non-interest income (NII) on profitability has been studied across various time periods. The motivation for this study came from changes in the market environment driven by interest rates, competition, and global instability. I was interested in Mikko Kärnä’s (2015) master’s thesis on Bank Income Diversification and its Impact on Profitability and Risk. He also investigated whether there are categories of non-interest income that are more profitable and less risky than others. Kärnä’s research is from 2015, and the research data is from 2004–2015.

In their systematic literature review, Zouaoui and Zoghlam (2023) examine 83 peer-reviewed publications on the effects of diversifying bank revenues. Based on the results, the contradictions between different studies are due to, for example, different research environments, such as the United States, Europe, and Asia. The differences are also due to the research periods, as well as to any significant crises or changes in the general market situation during those periods. The studies also use many different evaluation methods and regression models, which can produce different results in the same market.

This study focuses on European banks, as there are no recent studies available from Europe that also address the impact of the interest rate market. In addition to the Basel regulatory frameworks, banks in Europe, and especially in the European Union, are subject to the European Union's own regulations. Furthermore, countries have more detailed regulations for banks in their own legislation. There are therefore differences in local regulations, as well as in the situations across countries regarding the roles of banks, digitalization, and competition. The period in question is the ten years ending in 2024; at the time of writing, the previous year, so this is the most recent ten-year period available.

The chosen time period covers the global COVID-19 pandemic, which also affected the economy. In a study by Kozak and Wierzbowska (2022), they examined the profitability of

European banks during the COVID-19 crisis. The study found that non-interest income had a significant impact on banks' profitability during the crisis. They also state that a high share of non-interest income helped banks maintain profitability even at pre COVID-19 levels. The study is one of the most recent on banks in Europe regarding income diversification. Still, it examines the effects of the pandemic rather than the impact of interest rate changes.

Neobanks that specialise in fully digital business models have become more common in recent years. Citterio et al. (2024) discuss the performance and risks of neobanks in their recent article. They have identified 65 neobanks in Europe. Based on their research, neobanks have performed slightly worse than traditional retail banks during the selected period. Neobanks have already generated relatively better interest income, while traditional banks and the digital service model also enable the collection of non-interest income through a wide range of services. These banks increase competition in the sector and force traditional banks also to increase their non-interest income. The operating environment has therefore also changed for competitors. However, this study does not examine the impact of neobanks in more detail.

While many studies examine the diversification of bank income globally, few examine European data beyond 2020, in the context of rising interest rates. The results also shed light on how banks have responded to increasing competition, the impact of the pandemic, and the war in Ukraine on their income policies. This study contributes to the literature by using the most recent time period and by addressing the impact of changes in the interest rate market on profitability.

1.2 Research questions and objectives

The impact on banks' interest rate returns and risk in Europe is measured using data from 30 banks from 2014 to 2024. The entire data has been collected quarterly to improve the accuracy of the results. The selected period has included many significant changes that have impacted the situation of banks, such as the previously mentioned negative Euribor rates and the COVID-19 pandemic. In the last years of the review period, consumer uncertainty caused by the war in Ukraine and the sharp rise in interest rates also changed the operating environment, reducing the attractiveness of loans and, in turn, interest rates.

The share of non-interest income has been growing since the 2000s in the United States and later also in Europe (Lepetit et al., 2008). The main reason is certainly the improvement of operational profitability. As competition in the sector increases and the interest rate cycle changes, the amount of interest-bearing income is no longer as stable. Based on the facts mentioned above, the first research question is as follows:

1. Does the bank improve profitability by increasing the share of non-interest income in total income?

Business cycles have played a role in the stability of interest-bearing income. If monthly or annual service fees and trading fees are increased, income streams should continue to grow steadily. The greatest variation may be related to the attractiveness and competitiveness of the services. Still, many factors affect banks' risk. The first thing that comes to mind is the capital requirements, which are also heavily regulated. Many banking crises have started with a run on deposits, when banks have been unable to allow all customers to withdraw their funds. However, the stability of returns also plays a major role in banks' risk. Still, banking is a business, and the goal is to make a profit. The second research question is set as follows:

2. Does the growth in non-interest income have a negative impact on earnings volatility, i.e., risk-adjusted profitability?

Since non-interest income is generally increasing at banks, it naturally affects total income. Usually, the biggest impact on interest income has been business cycles and the general attractiveness of loans. When the share of interest income decreases, will business cycles have the same effect? Therefore, the third research question is as follows:

3. Do rising interest rates increase the amount of income and stability, even though the share of non-interest income increases and the share of interest income decreases?

These research questions, together with previous research, will be used to formulate hypotheses. The hypotheses will underpin the research and the interpretation of its results. The hypotheses are defined at the end of the literature review in section 2.5. Based on previous research and theory, it is expected that an increase in the share of non-interest income is associated with higher bank profitability, as diversifying revenue streams reduces dependence on traditional interest income. However, the impact on risk-adjusted profitability may be more complex: although diversification can stabilize part of the income, non-interest income, particularly trading or commission income, may be more volatile than interest income, which may increase the volatility of returns. Rising interest rates, on the other hand, are expected to strengthen traditional interest income, increasing both profitability and stability, especially for banks that rely on lending. Overall, the results are expected to reflect a balance between profitability and income stability, which depends on the ratio of interest and non-interest income.

1.3 Thesis structure

The first section presents the research topic and the background of the work. In addition, the study’s research questions are presented. Next, the second section contains a literature review that introduces the industry, non-interest income, and regulation, based on previous articles. The second section also discusses bank risks and previous research material on the topic of this thesis. This supports the third section, which presents a description of the data and the methodology chosen for the study. In addition, the third section discusses the variables and formulas. The fourth section presents the study's results. The fifth section is a summary and conclusions.

2 Literature review

Based on the articles, the literature review provides more detail on the banking industry and the importance of non-interest income (NII) and interest income. In addition, it discusses typical banking industry regulations and their impact on bank operations. As non-interest income increases, risks also change, so the review examines articles related to risks. Theories related to the research and the topic are also discussed, along with previous research on the topic, after which hypotheses suitable for the research questions are presented.

2.1 Banking industry

Traditional banking has been based on granting long-term loans and financing them by issuing short-term deposits. The basic business is therefore to receive and hold customer deposits, which the bank lends out through advances on current accounts, installment loans, investments in marketable debt securities, and other forms of lending (Edwards, 1995). Banks must hold a certain proportion of deposits to guarantee their availability. In addition to deposits, banks also obtain money by borrowing from other banks or from the central bank, which issues new money and regulates the economy with its own policy rate.

Interest income remains the largest source of income and the core of banks' operations. However, increased competition has affected banks' roles in financial markets. Also, innovations have forced banks to rethink their operating models even before 2000. Increased competition in the sector has reduced banks' cost advantage in raising funds. To remain profitable, returns have to be sought elsewhere (Edwards, 1995; Smith et al., 2003).

Stiroh (2004) noted that the US banking industry is moving away from traditional sources of income, such as lending, and is also beginning to generate profit from fee income, service charges, trade fees, and other fees. Sithor's article examines the impact of non-interest income on the average and variation in bank profits and revenues. Since 1984, the share of non-interest income had increased from 25 percent to 43 percent in 2001. The article also notes that non-interest income, being less sensitive to interest rate fluctuations, can help reduce the correlated variability of bank earnings. There has been a shift towards diversification of bank earnings in the United States over the period covered by the article. (Stiroh, 2004)

A similar article from Europe, written by Köhler (2014), discusses the impact of non-interest income on bank risk from a German perspective. In their data, in Germany, non-interest income accounts for 37 percent of total returns for investment-oriented banks, while savings and cooperative banks average 20 percent of total returns. (Köhler, 2014) This difference may stem from structural factors: the US market in Stiroh's period was highly liberalized and competitive, while German savings and cooperative banks traditionally followed more conservative, locally oriented business models.

The proliferation of financial technology (FinTech) over the past decade has significantly changed traditional banking. Digital developments in online banking, investment platforms, and mobile applications have reduced branch visits and created new opportunities to sell services. At the same time, it has also opened the door to new competitors. A study of the Iranian banking sector found that the adoption of FinTech increased banks' profitability. Banks that invested in digital solutions increased their non-interest income while reducing operational risks. FinTech has thus been a driver of growth in non-interest income, but the study found that traditional interest income declined during the same period. (Karami & Esmaeilpour Moghadam, 2025)

Bodellini et al. (2024) explain in their book that banking is shaped by three different factors. The first is the rise of FinTech companies that are challenging banks' business models, the second is the changes brought about by the COVID-19 pandemic, and the third is the sustainability goals. Fintech companies refer to financial technology companies, i.e., actors that use technology and digital solutions to improve financial services. For example, crowdfunding providers offer financing without a bank.

So-called "neobanks" also offer a better digital customer experience and have the same services like accounts, cards, and some also offer loans. The COVID-19 pandemic increased the role of governments that helped through grant funding. In addition, during the pandemic, digital transactions increased, and the level of services rapidly reached new heights. There were also temporary relaxations in banking regulation. The book also mentions that banks play a key role in supporting sustainable development through green lending, ESG principles, and banks' own corporate social responsibility. (Bodellini et al., 2024.)

Puschmann (2017) also argues in his articles that digitalisation will have a strong impact on the financial services sector, as financial products are almost entirely based on information. Process automation is also creating new products on the market. So the opportunities created by new products alone will challenge banks to rethink how they earn to maintain their place in the financial market. Fintech players are also starting to compete with traditional banks, posing a challenge for banks that previously had a clearer scope of activities. (Puschmann, 2017)

The use of FinTech has also rapidly become more widespread in Europe. The European Union's common regulatory framework, the new Payment Services Directive PSD2, and its open banking requirements have provided operators with many opportunities for digital development. This has led to a high rate of FinTech adoption in Europe. (Mark-Denis et al., 2025) Based on these findings, it can be concluded that increasing non-interest income is possible for all banks that have adopted FinTech.

2.2 Regulations

Banks are one of the most regulated industries. Regulation is also influenced by the huge risks associated with the banking business. Risks can include changes in the banks' own financial situation, which can affect the stability of society. Historical financial crises are examples of how the risks associated with banking activities have materialized and caused problems worldwide. In overseeing the payment system, banks also play a major role in the fight against money laundering and terrorist financing (Dill, 2020).

There has been a lot of research on the impact of regulation on banks. Some of these studies conclude that strict regulation can improve efficiency and stability by curbing excessive risk-taking. It is also true that regulation can place a burden on banks, increase costs, and limit lending. This in turn reduces banks' profitability. From a risk perspective, strict capital and liquidity requirements reduce risks and the possibility of crises, but regulation can also have indirect effects. Local supervisory mechanisms and actors also influence the strength of regulation. How well the regulation is enforced and implemented. (Bouteska et al., 2023)

In terms of regulation, banking is mostly governed by the Basel Accords. The Basel Accords are banking regulatory frameworks, meaning that their application depends on the regulatory authority in each region. (BCBS, 2017) The first Basel I Accord was introduced in 1988. It aimed to harmonise capital requirements for internationally active banks, i.e., requiring them to hold a minimum capital of 8 percent of their risk-weighted assets (Mayordomo & Rodriguez-Moreno, 2017).

The main shortcoming was that Basel I failed to consider the different risks associated with different assets. Risk weights were the same for all and were determined by credit type. This allowed for circumvention of the requirements. Basel II was introduced in 2004 and filled the gaps in the Basel I agreement. Basel II was based on three pillars: capital requirements, supervisory process, and market discipline. Banks used either their own rating models, the Internal Ratings-Based (IRB) approach, or a common standard. However, the new risk definitions slowed down SME lending as banks only financed lower-risk cases. (Gopalakrishnan et al., 2021)

The Basel III regulatory framework was introduced to strengthen both micro- and macroprudential rules to improve the resilience of the banking system. Its key objectives are to ensure that banks have sufficient capital and liquidity buffers to survive even a big crisis. Protecting banks can prevent the entire financial system from instability. About capital adequacy, the minimum capital requirement was raised to 4.5 percent of risk-weighted assets, and a 2.5 percent capital buffer brings the total requirement to 7 percent. In addition, a capital buffer has been created to follow against excessive lending during an economic growth period. (BCBS, 2017)

In terms of risk management, Basel III requires comprehensive risk assessment, regular stress testing, and strong governance. All insights from the financial crisis have led to a focus on counterparty risk and market risk monitoring. In terms of liquidity, banks are required to have funds to survive a stress period of at least 30 days. Additional capital requirements were established for Global Systemically Important Banks and Domestic Systemically Important Banks to ensure that the largest banks can withstand market uncertainty. (BCBS, 2017)

Overall, Basel III strengthens banks' ability to manage losses and maintain lending. As Basel III tightens capital requirements, it also increases banks' interest in generating income from other sources. It may also affect profitability by changing interest rates, as banks become more cautious in their risk-taking.

Roulet (2018) studied the impact of the Basel III Accord on European bank lending. She found that capital ratios and liquidity indicators negatively affected bank lending. In the aftermath of the crisis, the aim was to plug the gaps in the Basel II Accord to prevent a similar crisis from happening again. The new prudential rules introduced by the regulation provided an incentive to replace ordinary retail bank loans with less risky government loans. However, Roulet's study found that European banks face challenges in reducing their commercial loans, even as they should be reducing their assets. (Roulet, 2018)

The Basel IV regulation reform package was introduced in the European Union on 1.1.2025. Basel IV will bring updated capital requirements, some of which were already decided at the time of the Basel III agreement. Basel IV also restricts the use of internal risk models for large companies with a turnover of at least €500 million. Basel IV also links a bank's internal risk calculation to a standardised risk methodology. This means that the maximum return on the use of internal models is limited to 27.5 percent of risk-weighted assets, to be precise. The use of internal models is therefore no longer possible in the same way. This, of course, further reduces banks' ability to take risks. (Nordea, 2025; KPMG, 2024)

Although banking is subject to strict regulation, it also has adverse effects on banks' operations. Regulation affects the profitability and stability of banks of different sizes in different ways. However, capital requirements, for example, generally enhance stability, and extensive banking supervision is most effective. Over-constraint, on the other hand, negatively affects profitability and stability. Regulation's effectiveness can also be affected by corruption. (Asteriou et al., 2021)

2.3 Interest income vs. non-interest income

Interest income arises when a bank borrows its funds and invests them in assets with longer maturities. In this situation, the bank acts as a "maturity converter". Interest income is generated from residuals, such as pricing margins or market power. (Chaudron et al., 2023) Net Interest Income is the difference between the bank's income and expenses from interest rate-linked transactions, i.e., interest income on loans - interest expenses on deposits. Net Interest Margin is usually used for comparison as it represents the share of interest income in the bank's total productive assets. (Agiomirgianakis et al., 2024) The general interest rate level affects this income, but the study found that banks maintained a strong net interest margin during low interest rates. The bank does not reduce deposit rates or margins to negative levels but collects them as usual even if interest rates fall to negative levels (Chaudron et al., 2023).

Stiroh (2004) defines non-interest income as consisting of four main components: fiduciary income, service charges, trading revenue, and fees and other income. Fiduciary income refers to the management of investments on behalf of others. Service charges mean fees for online banking, cash withdrawals, foreign payments, or, for example, for accounting records for companies. Trading revenue is income from off-balance-sheet contracts or changes in the book value of assets and liabilities, and fees and other income includes other non-interest income. (Stiroh, 2004)

More recent articles have also identified non-interest income as income from insurance provided by banks, as well as legal services and digital products. In Köhler's (2014) article net non-interest income to total operating income, of which net fee and commission income, of which net trading income, of which net other operating income, net fee and commission income to total operating income, net trading income to total operating income and net other operating income to total operating income were used as non-interest income. (Köhler, 2014)

DeYoung and Torna (2013) found that in the United States, non-interest activities such as brokerage and insurance reduced the probability of bank failures during the financial crisis. However, Lepetit et al. (2008) reached the opposite conclusion for European banks, where fee-based income was associated with higher risk. The difference may be due to differences in regulation and business models. European banks often conduct trading-related activities under stricter capital constraints. In contrast, US banks were able to expand their operations into more stable service-based income in the post-GLB environment, which came into force in 1999.

Based on research by Brei et al. (2020), low interest rates affect banks' returns, leading them to rely more on fees and investments rather than interest income. Banks' securities portfolio returns should increase during periods of low interest rates, as the values of stocks and bonds rise. Also, when interest rates are low, customers may need more stock, and bond investors (Albertazzi & Gambacorta, 2009). Service and other fees will increase as demand for the loan increases.

Antao and Karnik (2022) studied the impact of non-interest income in Asia. They noted in their literature review that while income diversification has reduced bank risk in the US and Europe, the opposite was true in Asia. Other than interest income, inflation worsened bank risk in all countries. This is an interesting observation because banking is largely similar in nature. There are large differences in the markets and cultures of different continents, so the situation in Asia may therefore be different. This thesis focuses on the situation in Europe.

In bank-based countries such as Germany and Japan, banks focus more on basic lending and deposit activities. In this case, interest income is more important than non-interest income. The United States and the United Kingdom are more market-based countries, and their banks generate more non-interest income. (Saklain & Williams, 2024)

There are also differences in non-interest income and interest income for different types of banks. Retail banks, such as savings and cooperative banks, focus more on interest income. Most of these type of banks income comes from traditional lending. Non-interest income accounted for 20-29 percent of total revenue for these banks in Köhler's (2014) study. Non-interest income at retail banks consists of fees for payment services, insurance, and securities brokerage. For investment banks, the share of non-interest income is higher at around 37 percent. Income in investment banks comes mainly from capital market activities. Interest income is less important for investment banks, so their net interest margin is lower. (Köhler, 2014)

In the future, the popularity of non-interest income will grow as market orientation increases in bank-based countries. Technological developments, customer needs, and fierce competition are forcing changes in the sector. It is already apparent that the more developed the market, the less banks can rely on traditional interest income. (Saklain & Williams, 2024) Retail banks should increase non-interest income, but increasing the share of non-interest income in investment banks may even increase risks. Increasing non-interest income does not automatically guarantee stability. (Köhler, 2014)

O'Connell's (2023) article measured profitability by return on average assets (ROAA) and net interest margin (NIM). In this study, the variables used to determine profitability were capital and equity ratios. Loan loss provisions to gross loans, deposits to assets, and liquid assets to total assets. Productivity, expense management, loan portfolio growth, and size are also mentioned. (O'Connell, 2023) In an article by Asteriou et al. (2021), ROAA, ROAE, and NIM were used as dependent variables to measure profitability.

2.4 Income diversification and risks

Banking involves risks, as does any other business. However, people are often concerned about banking risks because the volatility of banking has led to many crises in the past. Measuring banks' risks is methodologically challenging. The more advanced the techniques available, the better the ability to assess risk. Banking risks generally refer to at least the following risks:

Capital risk is the amount of loss a bank can sustain. It can be measured, for example, by the ratio of equity to the balance sheet. The higher the capital relative to risk, the more stable the bank is (Klomp & de Haan, 2012).

Profitability volatility, i.e., how stable the bank's profitability is. If there is much volatility in profits, it can weaken trust in the bank. If profitability is highly volatile, it can mean that market shocks and risks have a bigger effect on the bank than on others. Indicators of profitability include Return on Equity (ROE) or Return on Assets (ROA). (Klomp & de Haan, 2012)

Credit risk, which mainly means that the bank does not get back the money it has lent and thus incurs a loss. However, lending is at the core of banking, as a large share of the bank's income still comes from interest income. Measures can be, for example, loans that have had to be marked as non-performing or certain risk measures of solvency. (Lepetit et al., 2008)

Market risk, i.e., the sensitivity of a business to economic fluctuations. Indicators of market risk may include government securities, cyclical fluctuations in interest rates, and equities. Market risk can affect a bank's investment returns, but also its own cost of funding. Also, a rise in interest rates has a negative impact on the demand for loans.

Insolvency risk, meaning the bank itself is insolvent and would, in the worst case, be forced to file for bankruptcy. (Lepetit et al., 2008).

Köhler's (2014) research shows that retail banks become more stable when they increase their share of non-interest income. For investment banks, risks increase. It is therefore important to consider that the results affect retail and investment banks differently. A study by Klomp and de Haan (2011) finds that 40 percent of the total variation in bank risk can be attributed to country variation. This suggests that country-specific regulation also plays an important role in influencing risk beyond the Basel Accords. However, regulation does not have a significant impact on low-risk banks, while it has a very significant impact on high-risk banks. (Klomp & de Haan, 2012)

Ben Lahouel et al. (2024) study the impact of liquidity risk on the risk and return profile of European banks. The data were collected in the post-financial crisis period, as during the crisis, several financial institutions collapsed when liquidity risk materialized. They used a financing gap measure calculated as the difference between bank loans and deposits relative to total assets. They found that income diversification can act as a "buffer" for banks against liquidity risk. However, if income flows are not stable, the outcome is more difficult to predict. (Ben Lahouel et al., 2024)

In a recent article, Mehdi et al. (2025) discussed the impact of banking risk on performance. The three main risks, namely credit, solvency, and liquidity, and their impact on return on equity (ROE), earnings per share (EPS), and price/earnings ratio (PER) are assessed. The variables used for credit risk are the loan-to-value ratio (LTV) and the non-performing loan ratio. The liquidity risk variables were loans divided by deposits, and the solvency risk variables were core capital divided by risk-weighted assets and equity divided by total capital. The results showed that the variation in return on equity was mainly influenced by credit risk and, secondly, by liquidity risk. The price-earnings ratio was most affected by liquidity risk and secondly by solvency risk. (Mehdi et al., 2025)

2.5 Income diversification of banks worldwide

In this section, I will review previous studies on income diversification conducted worldwide. After the above background information and these research articles, the hypotheses for this study will be determined in Section 2.6.

Stiroh (2004) has studied the relationship between non-interest income and net interest income in the US banking sector. The hypothesis is whether banks' shift from interest income to non-interest income can lead to more stable results and lower risks. Stiroh suggests that non-interest income could reduce income volatility because it is less sensitive to cyclical fluctuations. The data used in the study were Call Reports and FDIC data from 1978 to 2001. In addition to income, key variables were the Sharpe ratio, return on equity, assets, equity ratio, balance sheet, and asset growth. Stiroh used descriptive analysis, volatility analysis, OLS time series regression, and other correlation analyses. The main results were that non-interest income is more volatile than net interest income, but there was no evidence that non-interest income reduces the volatility of income, i.e., risk (Stiroh, 2004).

Smith et al. (2003) examine non-interest income and the stability of total income in EU countries. A total of 2655 institutions were included in the balanced sample. The research questions were whether the profitability and risk of non-interest income differ from interest income, and what the potential diversification benefits of non-interest income are for banking firms. The results of the study are similar to Stiroh's, showing that non-interest income is much more volatile than net interest income. However, they also found that as a bank's scope of operations expands, income volatility decreases (Smith et al., 2003).

Although both studies conclude that non-interest income increases volatility, their results also highlight differences. Stiroh (2004) analyzed a highly competitive US market where non-interest income was derived from trading and investment activities that fluctuate with market cycles. In contrast, Smith et al. (2003) focused on European banks, where non-interest income often consists of fee-based and service-related income. That may be more stable when banks operate in multiple regions. The difference suggests that the stabilising potential of non-interest income depends not only on its share of total turnover but also on the composition and geographical diversification of income. Thus, results from one financial environment cannot be directly generalized to another without taking into account the structural and regulatory contexts.

Laeven and Levine (2007) also examine the relationship between non-interest income and net interest income and their impact on bank valuation. The data are collected from 1998 to 2002 and include 836 banks. The hypotheses of the study are: The market value of banks engaged in both interest and non-interest-based activities is lower than the combined values of specialized banks. The study found that diversification of returns reduces bank value. The likely reason for this was considered to be agent costs. The article used non-interest income and similar variables as variables, but did little to address risk or profitability (Laeven & Levine, 2007).

Lepetit et al (2008) examine the relationship between non-interest income and net interest income from a risk perspective. The research question is: Is the shift of banks from interest income to non-interest income related to the banking crisis and insolvency? The hypotheses are that diversification does not directly reduce risk and that fees in particular may increase risk. The study used 734 European banks from 14 countries; i.e., this article has a similar spatial coverage to the data used in this thesis. In addition to returns, variables used include standard deviations of ROA and ROE, loan loss provisions divided by net loans, and various Z-score variants. The study found that the share of non-interest income is associated with a higher default risk. The study also finds that small banks react more strongly when they have increased fee income (Lepetit et al., 2008).

In a recent article, Marwan Alzoubi (2025) examined noninterest income and bank performance in Europe, the Middle East, and North Africa (MENA). Alzoubi's hypotheses were as follows. However, the effect may be positive in regions with less developed markets, such as the Middle East and North Africa. Alzoub's data covers the period 2009-2020 and is based on 1014 banks. The main variables used are ROAA, equity-to-asset ratio, credit risk, GDP and non-interest income. The results of the study show that the increase in non-interest income benefits banks in the Middle East and North Africa. In Europe, the benefits are limited. This is probably due to differences in market efficiency and competition. (Alzoubi, 2025)

Saklain and Williams (2024), in “Non-interest income and bank risk: the role of financial structure,” examine whether financial structure affects the amount of non-interest income and its impact on bank profitability and risk. The study uses a global sample of over 2000 banks and 126 countries and study have three hypotheses. The second hypothesis is that a higher share of non-interest income in banks' profits is associated with better profitability because their financial structure is generally more market oriented. The third hypothesis is that a higher share of non-interest income in banks' profits is associated with higher risk because their funding structure is generally more market oriented. Profitability is measured by the standard deviation of ROAA, and risk is measured by the ratio of non-performing loans to gross loans and the volatility of earnings. (Saklain & Williams, 2024)

While Alzoubi (2025) and Saklain & Williams (2024) both stated that non-interest income can enhance profitability. Still their conclusions differ regarding the conditions under which that occurs. Alzoubi found that the benefits are strongest in less-regulated and less-developed markets such as the MENA region. There banks face lower competition and can capture higher margins from fee-based activities. In contrast, Saklain & Williams (2024) observed similar positive effects even in developed markets, provided that the financial structure is market-oriented and regulation is light. When these results are compared with the earlier findings of Lepetit et al. (2008), who reported a higher risk for European banks with increased non-interest income it becomes clear that regulatory context and market maturity play a decisive role. In tightly regulated or bank-based financial systems, diversification may push banks toward riskier trading activities. In more liberalized environments, it can improve efficiency and revenue stability.

Laporšek et al. (2025) also examined the factors affecting the profitability of European banks over the five-year period from 2013 to 2018. During this period, Basel III regulations were in force, and the economy began to recover from the financial crisis. The study focused primarily on bank-specific factors such as bank size and capital adequacy, as well as market factors such as changes in GDP and the impact of inflation. The study included 3076 banks from 34 countries. The conclusions were that factors that increase returns can also lower risk-adjusted returns. Regulation also increased income stability but reduced returns. The decline in interest rates was a key driver of the recovery in profitability. During the period, the Euribor reference rate was very low and even turned negative. The period selected for this study covers the same time frame, but also includes a period when interest rates rose sharply, which changed the operating environment for this study.

A recent study by Bist (2025) examined income diversification and financial stability in Nepalese banks. The objective was similar to that of this study: How income diversification affects financial stability and profitability. The data covered Nepalese banks from 2014 to 2023. ROA and ROE were used as dependent variables. For Nepalese banks, commission income had a significant positive impact on ROA and ROE, meaning that increasing commission and foreign exchange income improved the stability and profitability of the bank. However, a larger bank size does not automatically guarantee better profitability. (Bist, 2025) The analysis only covered banks in one country, which is a developing economy. The study focused only on returns and did not consider risk-adjusted indicators or macroeconomic variables.

From a risk perspective, Gerek and Tuncez (2024) examine the impact of European banks' income diversification on profitability and risk-taking. They examined revenues broken down into those originating in the bank's home country, those originating elsewhere in Europe, and those originating outside Europe. The results of the study show that the more revenues are diversified, the weaker the risk-adjusted profitability becomes. At the same time, risk also increases. In their study, Gerek and Tuncez use RARROA, RARROE, and Z-score as risk-adjusted measures. (Gerek & Tuncez, 2024) This thesis also uses RARROA and RARROE to describe risk-adjusted profitability. Still, this study focuses more on how the growth of non-interest income affects risk-adjusted profitability.

The more recent studies by Laporšek et al. (2025), Bist (2025), and Gerek & Tüncez (2024) further illustrate how time period, economic phase, and methodological choices shape the conclusions. Laporšek et al. (2025) examined European banks under the Basel III framework. They found that stricter regulation increased income stability but reduced profitability, suggesting a trade-off between risk control and return potential. Bist (2025), using data from Nepal, identified clear profitability gains from commission and foreign-exchange income in a developing economy, supporting Alzoubi's argument that diversification is more beneficial where financial markets are less saturated. Gerek & Tüncez (2024), however, found that for European banks, broader income diversification across regions weakened risk-adjusted profitability. Taken together, these contrasting results imply that the impact of non-interest income is highly context-specific: it depends on the stage of financial development, regulatory intensity, and the type of non-interest activities pursued. Thus, what appears as risk-reducing diversification in emerging markets may translate into higher volatility in mature, competitive banking sectors.

Busch et al. (2022) analyse the impact of interest rate changes on banks' interest margins. Their data cover German banks for the period 2015-2019, when interest rates were very low. The study itself was conducted using a quantitative survey. Low interest rates have a negative impact on banks' interest income, as evidenced by several studies. (Busch et al., 2022) This argues that when interest rates fall, the share of interest margin decreases, and if a bank wants to smooth out the volatility of income, it must generate income in another way, i.e., by increasing the share of non-interest income. The article also mentions that when interest rates fall, banks not only increase the share of non-interest income but also reduce their costs (Busch et al., 2022).

As mentioned in the research background section, despite extensive global research, there is no recent research data available for the European market from the start of the war in Ukraine and the post-pandemic period.

2.6 Conceptual Framework and Hypotheses

The reviewed literature shows that the relationship between income diversification and bank performance is complex and depends on several factors. These are regulation, competition, and the interest rate environment. While diversification into non-interest income can increase profitability by broadening the sources of revenue, it may also expose banks to new forms of operational and market risk.

This study builds on three main theoretical perspectives. According to the **Bank Income Structure Theory**, changes in monetary policy, interest rates, and regulatory conditions affect the balance between interest and non-interest income (Lepetit et al., 2008; Stiroh, 2004). When interest margins decrease due to low interest rates or increased competition, banks seek to maintain profitability by expanding other sources of income, such as service fees, commissions or trading activities.

According to the basic principles of economic **Diversification Theory**, overall risk can be reduced when income is generated from a variety of sources rather than from a single activity. If one source of income declines, other sources can remain stable and then balance the total income (O'Sullivan & Sheffrin, 2003). For banks, this means that non-interest income-type services can help maintain income when interest margins fall. However, this depends on the composition of non-interest income. Trading-based income is typically more volatile, whereas commission and service fees tend to be steadier.

The Risk–Return Trade-off Theory (Modigliani & Pogue, 1974) proposes that higher expected returns are generally associated with higher risk. In the banking context, this implies that increasing non-interest income may enhance profitability but not necessarily stability. The outcome depends on the bank's income structure, efficiency, and market environment (Köhler, 2014; Saklain & Williams, 2024).

Based on these theoretical perspectives and the empirical findings discussed earlier, three hypotheses are formulated to address the research questions presented in Section 1.2.

The first research question addresses whether banks improve their profitability by increasing the share of non-interest income in total income. Previous research shows that an increase in non-interest income is generally associated with higher profitability, especially in market-based systems and regions with less regulation. These regions are for example the Middle East and North Africa (Saklain & Williams, 2024; Alzoubi, 2025). According to the income structure theory of banks, lower interest margins force banks to expand non-interest income to maintain profitability (Lepetit et al., 2008).

Hypothesis 1: An increase in the share of non-interest income in total income improves banks' profitability (ROA and ROE).

Another research question concerns whether the growth of non-interest income negatively affects earnings volatility and risk-adjusted profitability. According to risk-return theory, higher expected returns also imply higher risk (Modigliani & Pogue, 1974). However, diversification across multiple income streams can reduce volatility if the income streams are not perfectly correlated. The empirical evidence remains mixed: Stiroh (2004) and Smith et al. (2003) found that non-interest income is more volatile than interest income, while Ben Lahouel et al. (2024) found that moderate diversification can initially increase volatility, but a higher share of non-interest income eventually stabilizes it. More recent studies (Saklain & Williams, 2024; Gerek & Tuncez, 2024) suggest that risk-adjusted returns can improve when banks rely on diversified and recurring non-interest income.

Hypothesis 2: A growing share of non-interest income reduces earnings volatility and improves banks' risk-adjusted profitability (RARROA and RARROE).

The third research question examines whether rising interest rates increase banks' income and stability, as the share of non-interest income increases. According to business cycle theory, interest rate fluctuations directly affect the composition of banks' income. When interest rates rise, interest margins increase and profitability typically improves. On the other hand, during periods of low or negative interest rates, banks are forced to compensate by increasing non-interest income (Busch et al., 2022). Recent studies, such as Abbate and Thaler (2023), also find that low interest rates can lead to banks' risk appetite, while Saklain and Williams (2024) found that diversified income structures help maintain stability even if traditional interest income declines.

Hypothesis 3: Rising interest rates improve both income and income stability, even as the share of interest income decreases and the share of non-interest income increases.

Together, these hypotheses integrate theoretical and empirical insights into a framework that explains how the balance between interest and non-interest income affects banks' profitability and stability under different market conditions. The next chapter presents the data, variables, and methodology used to test these hypotheses empirically.

3 Data and methodology

3.1 Data

The data used in this study consists of financial statement data from a total of 30 different banks, from 15 different European countries. Banks have been selected from 1 to 3 in each country. As a limitation, each bank had to be from Europe and have total assets of more than 20 billion euros. In addition, I excluded banks that had only semi-annual reporting in place.

The data were collected entirely from the Refinitiv Eikon database and supplemented, where necessary, by the banks' own website financial reports. The need for completion was mainly in the most recent figures, if the latest financial statements had not yet been uploaded to Refinitiv. The countries included are Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Slovenia, Spain, and Sweden. The data is collected quarterly from Q1 2014 to Q4 2024. Almost all selected countries use the Euro, so the figures are in euros. The figures for Sweden and Denmark have been converted to euros using the exchange rate from Refinitiv Eikon. In addition to the bank data, the data includes 1-year Euribor data for the same period, Q1 2014 - Q4 2024. This data has been retrieved from the European Central Bank (ECB) website.

All participating banks are relatively large, with assets exceeding €20 billion. The banks are also similar in nature, as each bank offers services to both private customers and businesses. All banks also offer investment banking services. All participating countries are EU member states, so the comparison is fair in terms of EU directives. However, there are differences in banking practices even between European countries. For example, Farnè & Vouldis (2017) discuss the business models of banks in the euro area and report that in the Nordic countries and Germany, the emphasis is on banks with stable financing and a moderate risk profile. In southern European countries, on the other hand, there are more banks whose operating model is based on interest margins. Southern European banks have been more prone to risks and profitability problems. (Farnè & Vouldis, 2017)

3.2 Data trends in research period

Let us examine the trends in the data on the share of non-interest income (NII) and the interest rate, specifically the one-year Euribor. As noted earlier, banks had already increased their non-interest income before the 2000s (Smith et al., 2003). Currently, the average share of the data is 32.3 percent of all income. However, there is significant variation, with the highest quarterly values exceeding 70 percent. The lowest values are close to zero and even negative, but these may also be outliers. Therefore, all negative values have been excluded from this trend analysis.

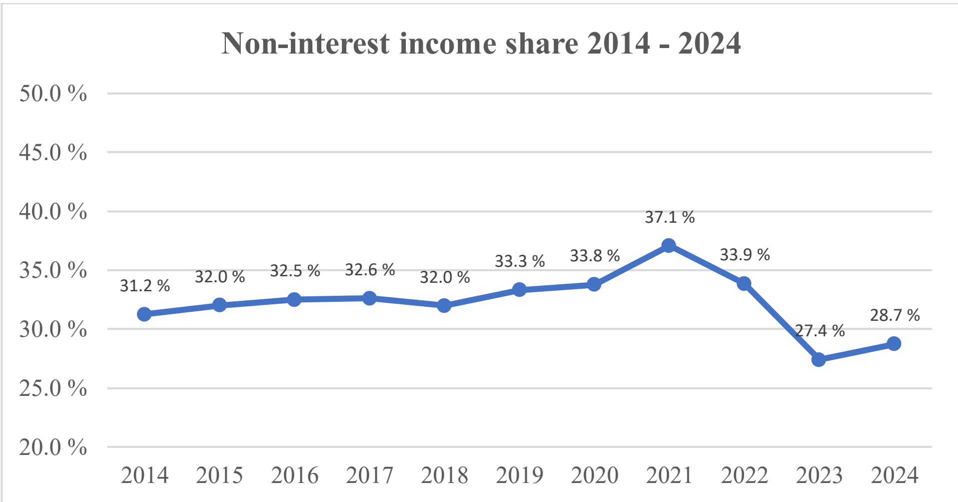

Figure 1. Development of non-interest income share in 2014 – 2024.

Figure 1 shows that non-interest income also grew during the research period until interest rates began to rise. The Euribor began to rise in the second quarter of 2022 (Figure 2), and it is logical that interest income also grew at that time, reducing the share of non-interest income.

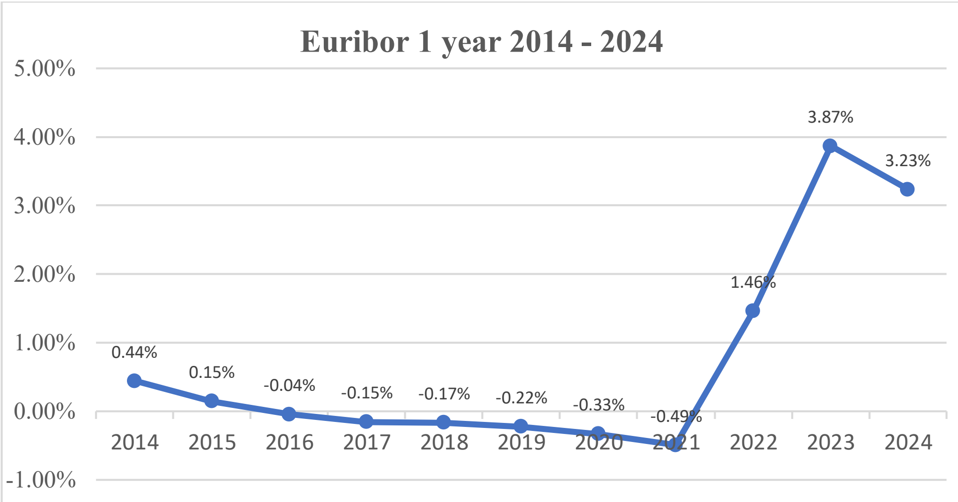

Figure 2. Euribor 1 year - development in 2014–2024

For Euribor, most of the study period shows a negative interest rate. However, as mentioned earlier, when the war in Ukraine began in the second quarter of 2022, Euribor began to rise, reaching a peak of over 4 percent. After peaking, it began to decline and at the end of the review period the Euribor rate settled at 2.44 percent.

3.3 Dependent and independent variables

The dependent variables used in the study are Return on Assets (ROA), Return on Equity (ROE), RARROA, which is the four-quarter moving average divided by the corresponding standard deviation, i.e., risk-adjusted ROA, and RARROE, which is the corresponding risk-adjusted ROE figure. ROA indicates how much profit a bank generates in relation to its total assets. The indicator thus normalizes the result to the size of the balance sheet, making banks of different sizes comparable in the study. ROA was selected as a dependent variable because it is a commonly used indicator in the academic literature. Stiroh (2004) and DeYoung & Torna (2013) use ROA and ROE as explanatory variables in their articles. The results obtained based on ROA are therefore highly comparable. The analysis has also been calculated with ROE as the dependent variable. Return on Equity refers to the return on invested equity, i.e., how well the bank generates value for its owners. There may be differences between ROA and ROE if banks have different operating models.

Since the study also takes the risk perspective into account, RARROA and RARROE are also used as dependent variables. RARROA and RARROE can also be used to examine how the share of non-interest income affects the stability of returns. In terms of profitability, ROA and ROE have been the most common variables, but RARROE, RARROA, and z-score have also been used in previous literature. (Zouaoui & Zoghlami, 2023) Risk-adjusted indicators are obtained as follows:

$$RAR_{ROA} = \frac{\overline{ROA}}{\sigma_{ROA}}$$

$$RAR_{ROE} = \frac{\overline{ROE}}{\sigma_{ROE}}$$

The explanatory variables used are the share of non-interest income in total income, total assets (i.e., the size of the bank), net debt to capital (i.e., the bank's debt ratio as net debt in relation to total capital), and the 12-month Euribor reference rate, which reflects the impact of the interest rate environment. The share of non-interest income in total income is a key variable in the study, while total assets describe how the size of different banks affects their results. Net debt to capital helps in analyzing the risk perspective. The 12-month Euribor is an interesting explanatory variable that shows how different interest rates affect results. (Zouaoui & Zoghlami, 2023)

Before performing regression analyses, the data were pre-processed so that any extreme values and individual exceptionally large observations would not distort the results. All variables were checked for missing values and negative or unusually large numbers. Observations with missing key indicators (e.g., ROA, ROE, or income components) were first removed from the data, after which the variables were winsorized at the 5 percent and 95 percent quartiles. Winsorization was performed in particular for variables that showed strong variation or extreme values clearly attributable to market conditions, such as non-interest income, total income, net income, and total assets. The method aimed to preserve the original distribution of the observations but prevent individual observations from having a disproportionate effect on the regression coefficients.

In addition, variations in bank size were smoothed using a logarithmic transformation. Ratio variables, such as net non-interest income/total income, were retained in their original relative form. Still, negative values were checked to ensure that they were actual reported figures and not data errors. As the data contained loss-making or negative income items, these were not removed but were included in the winsorization.

The final sample contains 1,070 observations. Almost all data on French banks had to be removed because their net interest income and net non-interest income were only available in Refinitiv on a semi-annual basis. Table 1 summarizes the descriptive statistics of the key variables used in the analysis, providing an overview of the range, median, and variability across the dataset.

Table 1. Descriptive statistics for key variables (2014–2024)

Variable	**Min**	**Median**	**Max**
ROA	0.00	0.01	0.02
ROE	-0.04	0.09	0.19
RARROA	-13.00	2.66	203.70
RARROE	-5.82	2.70	63.20
Non Interest Share (%)	8%	32%	50%
Total Assets (billion €)	2.30	162	2 861
Net Debt to Capital	-0.18	0.05	0.48
Euribor 12 months (%)	-0.50%	-0.11%	4.15%

In terms of profitability indicators, the median ROA is +1 percent, and the median ROE is +9 percent. The minimum ROA is 0, and the maximum is +2 percent. The minimum ROE is -4 percent, and the maximum is +18 percent. The variation in ROA is reasonable, but ROE values are much more volatile. This is due to the way ROE is calculated, as it is based on equity. In banking in particular, equity usually accounts for a very small proportion of total assets. So fluctuations in earnings have a much stronger impact on ROE than on ROA. The variation in risk-adjusted metrics, i.e., RARROA and RARROE, has been different. The median RARROA of 2.66 is close to the median RARROE of 2.70, but the volatility of RARROA has been higher than that of RARROE. This means that small differences in ROA can increase risk-adjusted returns more. In terms of medians, it can be said that banks' risk-adjusted returns are moderate, even though there is considerable variation and high values within the range.

Regarding explanatory variables, the share of non-interest income in total income indicates that approximately one-third of total income in the data comes from non-interest income. The median in the data is 0.32. The balance sheet total indicates the size of the banks included. The minimum is 2.30 billion and the maximum is 2,861 billion. Median was 162 billion. The large variation in balance sheets also supports the robustness test based on size. The risk would be that the largest banks would otherwise have a greater impact on the result than the small ones. Net debt to capital shows that banks typically included in the data have 5 percent net debt in relation to capital, with a median of 0.05. The 12-month Euribor variation clearly shows what kind of economic period was underway during the review period. Interest rates were still negative in 2015–2021, after which they began to rise, with the maximum in the data being 4.15 percent.

Table 2. Correlation Matrix of all variables

	ROA	**ROE**	**RAR-ROA**	**RAR-ROE**	**Net NII**	**Total Income**	**Net Debt to Capital**	**Total Assets**	**Euribor**
ROA	**1.00**	0.88	0.13	0.22	-0.11	-0.09	-0.22	-0.17	0.35
ROE	0.88	**1.00**	0.23	0.34	0.01	0.04	0.03	0.00	0.39
RARROA	0.13	0.24	**1.00**	0.59	0.06	0.07	0.18	0.08	0.11
RARROE	0.22	0.34	0.59	**1.00**	0.10	0.12	0.24	0.13	0.19
Net NII	-0.11	0.01	0.06	0.10	**1.00**	0.94	0.02	0.91	0.03
Total Income	-0.09	0.04	0.07	0.12	0.94	**1.00**	0.01	0.97	0.06
Net Debt to Capital	-0.22	0.03	0.18	0.24	0.02	0.01	**1.00**	0.10	-0.05
Total Assets	-0.17	0.00	0.08	0.13	0.91	0.97	0.10	**1.00**	0.01
Euribor	0.35	0.39	0.11	0.19	0.03	0.06	-0.05	0.01	**1.00**

Table 2 shows the correlations between all variables used in the study. ROA and ROE correlate strongly (0.88), as expected, since both measure profitability from different perspectives. The risk-adjusted profitability measures RARROA and RARROE correlate moderately with each other (0.59) and weakly with the original profitability measures, indicating that risk adjustment changes absolute values but not the overall picture.

Net non-interest income and total income are strongly correlated (0.94), and both also correlate strongly with total assets (0.91–0.97), suggesting that larger banks generate more revenue. However, the correlation between net non-interest income and ROA or ROE is weak (-0.11 and 0.01), so the significance of non-interest income for profitability is limited in this data set.

Net debt to capital correlates negatively with ROA (-0.22) and almost zero with ROE (0.03), suggesting that higher indebtedness does not automatically increase profitability. The balance sheet total has a weak negative correlation with ROA (-0.17) and an almost non-existent correlation with ROE (0.00), indicating that the size of the bank alone does not determine profitability.

The 1-year Euribor rate correlates moderately positively with ROA (0.35) and ROE (0.39), suggesting that the rise in interest rates has been linked to improved profitability. Risk-adjusted profitability indicators correlate less strongly with interest rates (0.11–0.19), indicating that the impact of interest rates is more limited when risk-adjusted.

No significant multicollinearity was observed among the explanatory variables, as all VIF values were less than 1.3. In the ROA and ROE models, the variance of the residuals was homogeneous, whereas in the RARROA and RARROE models, heteroscedasticity was observed ($p < 0.001$), so the robust standard errors method was used in these models. The Durbin–Watson statistics ranged from 1.58 to 1.80, indicating a slight positive autocorrelation. Overall, the assumptions of the linear regression model are largely met, so the regression results are reliable.

3.4 Regression models

The methodology of this study is based on the research methods of the articles collected in the literature review. For example, Gerek and Tuncez (2024), Stiroh (2004), DeYoung and Torna (2013), and Mikko Kärnän (2015) used the OLS regression model in their master's theses. Zouaoui and Zoghlami (2023) analyzed studies related to income diversification in their article. According to them, most studies have used OLS regression. The most promising alternatives to OLS regression are panel-data techniques with fixed effects and the generalized method of moments (GMM).

Since the residuals of the data show some autocorrelation according to the Durbin-Watson test, the Fixed Effects (FE) regression model is better for this study. I originally carried out the calculations for the study using the normal OLS regression model. Based on the results, the Fixed Effects (FE) model provided slightly more reliable results, although the results remained similar, indicating no major impact on the conclusions.

Hausman tests were used to compare the fit of Fixed Effects (FE) and Random Effects (RE) models for different dependent variables. The tests showed that for ROE and RARROE, the FE model is better, while for ROA and RARROA, the RE can also be acceptable. However, to ensure consistency and comparability of the results, it was decided to use the Fixed Effects (FE) model for all regression analyses.

The dependent variable Y in the Fixed Effects (FE) regressions is alternatively ROA, ROE, RARROA, or RARROE. The model includes four explanatory variables introduced in Section 3.2: the non-interest income share, the logarithm of total assets, the net debt-to-capital ratio, and the 12-month Euribor rate. In addition, the model contains bank-specific fixed effects α, which capture all time-invariant characteristics of each bank, and a residual term ε that includes all unexplained factors. The FE specification is linear and is not intended for forecasting but for estimating the within-bank relationship between the explanatory variables and the performance measures. The model is defined as:

$$Y_{it} = \beta_1 \frac{NII_{it}}{TotalIncome_{it}} + \beta_2 \ln(TotalAssets_{it}) + \beta_3 NetDebttoCapital_{it} + \beta_4 Euribor_t + \alpha_i + \varepsilon_{it}$$

The Fixed Effects (FE) model is the best fit because it considers unobserved, time-invariant characteristics of each bank that could otherwise bias the results. By controlling for these bank-specific effects, the FE model provides a more accurate estimate of the within-bank relationship between the explanatory variables and the performance measures. To ensure the robustness of the results, robustness tests are performed by comparing large and small banks by bank size. Another robustness test is performed by region, comparing Nordic banks with other European banks. These tests confirm that the observed relationships are not due to a specific bank group or regional differences.

The statistical significance of regression coefficients is assessed using a t-test, and the overall significance of the models is tested using an F-test. The levels of statistical significance used in this study are as follows. If the p-value is less than 0.05, the result is statistically significant. If it is less than 0.01, the result is highly significant. The significant results are recorded in tables, where the regression results are available in section 4.1.

Hypothesis tests were prepared for the hypotheses using the regression formula and the selected research data. The results are therefore used and discussed in more detail in the following section. The hypotheses can be tested using the selected formula because they can be tested using statistical connections between the selected dependent and independent variables. The same significance level is used in hypothesis testing: if the p-value is less than 0.05, the null hypothesis is rejected, and the effect is statistically significant.

Based on the test results, the impact of non-interest income on ROA and ROE was positive and statistically significant. This supports the first hypothesis, i.e., that non-interest income improves the bank's profitability. However, for the risk-adjusted return indicators RARROA and RARROE, the impact of non-interest income was not statistically significant, indicating that its effect on volatility and risk-adjusted return cannot be determined. The impact of the Euribor rate was statistically significant, supporting the hypothesis that higher interest rates are associated with higher returns. In the risk-adjusted RARROA and RARROE models, the impact of Euribor was also statistically significant, supporting the third hypothesis.

4 Results

4.1 Results of empirical research

This section presents the results of fixed effects (FE) regression models of bank profitability and risk-adjusted profitability measures. Tables 3 and 4 show how the explanatory variables, i.e. the share of non-interest income, bank size, net debt-to-equity ratio and Euribor, are related to bank profitability using different measures. The section first examines the ROA and ROE models, which can be used to assess the dependence of traditional profitability on explanatory factors, and then the RARROA and RARROE models, which describe risk-adjusted profitability and the stability of results. The chapter also discusses the statistical significance of the models, the degrees of explanation and the directions of the regression coefficients, which help to explain which factors have a significant impact on bank profitability and stability.

Table 3. Fixed Effects (FE) regression results for ROA and ROE

	ROA			ROE		
	Coefficient	**t-stat**	**P-value**	**Coefficient**	**t-stat**	**P-value**
Intercept	0.000	0.000	1.000	0.000	0.000	1.000
NII share	0.006***	6.584	0.000	0.070***	7.023	0.000
Assets	0.001	1.271	0.204	0.032***	3.452	0.001
Net debt to capital	0.001	1.117	0.264	0.029*	1.850	0.065
Euribor	0.122***	14.664	0.000	1.539***	15.955	0.000
R^2	0.210			0.261		
F	70.960			94.020		
P-value (model)	0.000			0.000		

* , **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

First, examine the ROA model. The p-value of the ROA model is less than 0.05, so the model is statistically significant. In addition, the R2 value is 0.210, indicating that the model explains 21 percent of the variation in ROA. The R2 value is quite low, which means that ROA is influenced by multiple factors not included in the model. In the ROA model, the share of non-interest income is positive and highly statistically significant (Coefficient = 0.006, $p < 0.001$). This means that a one-percentage-point increase in the non-interest income share increases ROA by approximately 0.6 percentage-points, indicating that greater reliance on non-interest income improves banks' profitability.

Regarding bank size, the results show that larger banks are associated with slightly higher ROA (coefficient = 0.001), but the effect is not statistically significant ($p = 0.204$). Net Debt to Capital also has a small positive effect on ROA (Coefficient = 0.001). Still, it is not statistically significant ($p = 0.264$), suggesting that leverage does not have a strong influence on ROA in this dataset. Regarding the market interest rate, i.e., Euribor 12 months, an increase in interest rates significantly affects profitability. The beta for Euribor is 0.122, and the p-value is < 0.001. This implies that a one-percentage-point increase in Euribor raises ROA by 12.2 percent, highlighting the strong effect of interest rates on profitability.

The ROE model is also statistically significant, with a p-value < 0.05 and an R-squared of 0.261, indicating that the model explains 26.1 percent of the variation in ROE. In the ROE model, the share of non-interest income is positive and highly significant (Coefficient = 0.070, $p < 0.001$). This translates into a 7.0 percent increase in ROE for a one-percentage-point increase in the non-interest income share.

Total Assets is statistically significant in the ROE model (Beta = 0.032, $p = 0.001$), showing that larger banks tend to achieve higher ROE. Net Debt to Capital is not statistically significant (Coefficient = 0.029, $p = 0.065$), suggesting that leverage does not meaningfully affect ROE. The Euribor 12-month rate remains highly significant (Coefficient = 1.539, $p < 0.001$), confirming that higher interest rates positively impact ROE. This is consistent with the idea that rising rates improve interest margins, and since equity is a small portion of the balance sheet, ROE is strongly affected.

Therefore, from the perspective of banks, increasing non-interest income increases profitability. However, increasing the size of a bank does not guarantee an improvement in profitability as measured by ROA. In ROE, the growth is greater when non-interest income increases than in ROA. ROE also increases with the size of the bank, unlike ROA. In summary, increasing non-interest income significantly affects ROE, which is especially popular with investors. Banks that increase non-interest income can offer more stable and high returns.

Table 4 reports the regression results for risk-adjusted profitability measures (RARROA and RARROE), indicating whether non-interest income and other factors contribute to income stability.

Table 4. Fixed Effects (FE) regression results for RARROA and RARROE

	RARROA			RARROE		
	Coefficient	**t-stat**	**P-value**	**Coefficient**	**t-stat**	**P-value**
Intercept	0.000	0.000	1.000	0.000	0.000	1.000
NII share	0.300	0.123	0.902	1.265	1.041	0.298
Assets	-4.547**	-2.032	0.042	-2.840**	-2.558	0.011
Net debt to capital	1.586	0.419	0.676	0.720	0.383	0.702
Euribor	108.610***	4.601	0.000	96.188***	8.211	0.000
R^2	0.021			0.060		
F	5.610			17.070		
P-value (model)	0.000			0.000		

* , **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The RARROA model is statistically significant, with a p-value < 0.05 and an R-squared of 0.021, indicating that the model explains 2.1 percent of the variation in RARROA. Compared to the standard ROA model, the R-squared value is considerably lower, indicating that much of the variation in risk-adjusted profitability is not captured by the included explanatory variables. In the RARROA model, the share of non-interest income is not statistically significant (Coefficient = 0.300, p = 0.902).

Regarding other variables, Total Assets has a negative and statistically significant effect on RARROA (Coefficient = -4.547, p = 0.042). This implies that larger banks tend to have slightly lower risk-adjusted ROA, suggesting that size may increase risk exposure relative to returns. Net Debt to Capital is not significant (Coefficient = 1.586, p = 0.676), indicating that leverage does not have a meaningful impact on RARROA in this dataset. Euribor 12 months has a strong positive and highly significant effect (Coefficient = 108.610, p < 0.001). Overall, interest rates are the strongest predictor of RARROA among the included variables.

The RARROE model is also statistically significant, with a p-value < 0.05 and an R-squared of 0.060, indicating that the model explains 6.0 percent of the variation in RARROE. The share of non-interest income is no statistically significant (Coefficient = 1.265, $p = 0.298$), indicating it does not meaningfully affect risk-adjusted ROE. Total Assets has a negative and statistically significant effect on RARROE (Coefficient = –2.840, $p = 0.011$). This means that larger banks tend to exhibit lower risk-adjusted ROE. Net Debt to Capital is not statistically significant (Coefficient = 0.720, $p = 0.702$), suggesting that leverage does not strongly influence risk-adjusted ROE. Euribor 12 months is highly significant (Coefficient = 96.188, $p < 0.001$), indicating a strong positive relationship with risk-adjusted ROE. Similar to RARROA, interest rates are the key driver of RARROE, confirming that higher market rates strongly increase risk-adjusted profitability.

The explanatory power of the models, i.e., the R^2 values, is fairly low, ranging from 0.210 in the ROA model to 0.261 in the ROE model. In the risk-adjusted models, the values are significantly lower, at less than 0.060. This means that even though the explanatory variables have a statistically significant impact in many models, a large part of the variation remains outside the model. This suggests that banks' profitability is affected by many macroeconomic and industry-specific factors that the model does not account for. Such factors include economic growth, inflation, and efficiency ratios.

Since the risk-adjusted models had very low explanatory power, this suggests that the volatility of banks' returns is influenced by many external factors not included in this analysis. Low explanatory power does not reduce statistical significance, but it does highlight the complexity of explaining bank profitability and earnings volatility.

4.2 Results and hypotheses of research questions

The previous section examined the results of the study. Based on these results, the aim is to answer the research questions and verify the hypotheses. The first research question relates to profitability and is:

1. Does the bank improve profitability by increasing the share of non-interest income in total income?

Based on the results of the selected regression model, the coefficient for the share of non-interest income is positive, and the model is statistically significant when the dependent variable is ROA or ROE. This means that the bank's profitability improves as the share of non-interest income increases. The result would therefore be similar to that found in recent studies by Saklain & Williams (2024) and Alzoubi (2025). However, the corresponding effect of the risk-adjusted models RARROA and RARROE is not statistically significant for the share of non-interest income. Based on this, it can be concluded that an increase in non-interest income does not necessarily improve risk-adjusted profitability. The hypothesis for the first question is: "As the share of non-interest income in total income increases, bank profitability improves." Based on the studies' results, the hypothesis is supported: profitability increases as non-interest income rises.

The second research question relates to stability and is as follows:

2. Does the growth in non-interest income have a negative impact on earnings volatility, i.e., risk-adjusted profitability?

This question can be answered by examining the results of risk-adjusted indicators, i.e., RARROA and RARROE. This is because risk-adjusted indicators are calculated using moving averages to measure income stability. Based on the regression results, the coefficient for the share of non-interest income is positive but not statistically significant. The coefficient for the RARROE model is +1.265, and the p-value is 0.298, while for the RARROA model, it is +0.300, and the p-value is 0.902. It cannot, therefore, be concluded that there is a connection between the growth of non-interest income and risk-adjusted profitability. The hypothesis related to the second research question is: "The growing share of non-interest income reduces earnings volatility and improves banks' risk-adjusted profitability." Based on the results obtained, the hypothesis is not supported because the model is not statistically significant.

The results are similar to those in the article by Gerek & Tuncez (2024). In both studies, the direction of the risk-adjusted indicators is similar. Their study showed that diversification does not automatically reduce risk or volatility. Nor does an increase in the share of non-interest income have the same effect.

The third research question concerns the impact of interest rates:

3. Do rising interest rates increase the amount of income and stability, even though the share of non-interest income increases and the share of interest income decreases?

The variable that has the greatest impact on the third research question is the fourth explanatory variable, Euribor 12 months, which describes changes in the Euribor interest rate during the research period. When examining the regression model results, all others were statistically significant. For the RARROA model, the coefficient is +108.610 for Euribor and +96.188 for RARROE. This means that rising interest rates have a positive effect on risk-adjusted profitability. For the ROA and ROE models, the coefficients for Euribor are 0.122 and 1.539, respectively, both highly significant ($p < 0.001$), indicating a strong positive effect on regular profitability as well.

Hypothesis for the third research question: "Rising interest rates improve income and income stability even as the share of interest income decreases and the share of non-interest income increases." Both regular and risk-adjusted metrics support the hypothesis. Rising interest rates, therefore, positively affect profitability and especially income stability.

4.3 Limitations

The first limitation is the study’s time period. It is 10 years, from 2014 to 2024, and the data are collected quarterly, i.e., four results per variable per year. This means that most banks have 40 results per variable. There were also gaps in the data, and empty values were deleted to ensure the data remained meaningful and of high quality for the study. The beginning of the review period is characterized by negative interest rates, which turn positive towards the end. In addition, the time period includes the COVID-19 pandemic, during which the results in the economy were significantly different from usual.

The second limitation is the banks included in the study. All banks in the study are relatively large, as this was a good condition for collecting data. However, there are many small banks in Europe whose operations may differ from those of large banks. The results describe the situation of large banks well, but the situation of small operators cannot be assessed based on the results. The study’s data cover European banks, so the results cannot be generalized to other continents or economies.

There are also limitations associated with the study and the chosen research method. The study used fixed effects (FE) regression, which controls for time-invariant unobserved heterogeneity across banks but still assumes a linear relationship between the explanatory and dependent variables. The method does not fully account for potential endogeneity biases or omitted variable effects. Although robustness tests were conducted to complement the results, other factors, such as the management practices and strategic choices of individual banks, may influence the findings. The models in this study are intended to describe the relationships between variables rather than to predict future developments.

The data used in the study were collected from the Refinitiv Eikon database and some missing values filled with banks' public financial statements. Although the data collected from the database are reliable, differences in reporting practices across banks and countries may lead to deviations in the figures. For example, the results for French banks had more missing values than others. For this reason, incomplete or inconsistent observations had to be removed from the analysis. This affects the sample size and the representativeness of certain banks in the data. Fewer banks were selected in some countries than in others, which means the results for those countries may have had less impact on the overall results.

Regarding the selected variables, the study focused on four key explanatory variables. These was non-interest income share, assets, net debt to capital, and the Euribor interest rate. These variables describe certain dependencies between profitability, risk, and the general market situation. However, other potentially significant factors, such as credit risk, bank cost efficiency, or economic differences between countries, were not included in the study. Based on the study's results, the low explanatory power of many models suggests that a significant portion of the variation in profitability remains unexplained. For example, including measures such as GDP, inflation, and efficiency ratios could increase explanatory power.

4.4 Robustness tests

To ensure the robustness of regression model results, robustness tests are also conducted. The purpose of robustness tests is to improve reliability, ensuring that results are not solely due to the selected model and banks but reflect a more general phenomenon that is the objective of the research. In this study, robustness tests are performed by comparing the size of banks and by regional comparison. In the size comparison, banks are divided by total assets, which is also one of the study’s explanatory variables. Banks are divided into smaller and larger ones based on the median. The dividing line is EUR 250 billion, i.e., smaller banks with assets of less than EUR 250 billion and larger banks with assets of more than EUR 250 billion. If the results are consistent across different size categories, it can be said that the study's results do not depend solely on bank size.

The second test is a regional comparison, i.e., sorting based on the bank's location. There are slight differences in the operating practices of banks in different regions, even though Basel and EU regulations are the same for all. The classification is made so that the Nordic countries, Finland, Sweden, and Denmark, are in one category, and other countries are in another. The classification is also interesting from a risk management perspective. The challenge for the review is that Sweden and Denmark use currencies other than those of the other countries in the study, although the figures have been converted to euros. An alternative would be to conduct the reviews on a currency basis, but this is not done in this study.

As a robustness test, the differences between the results of traditional profitability indicators, ROA and ROE, are also compared with those of risk-adjusted indicators, RARROA and RARROE. Since the study calculates all of these variables, it is also worthwhile to compare the results from a reliability perspective. At the same time, the results for risk-adjusted indicators indicate whether the results are also significant from the perspective of banks' risk management. The dependent variables for robustness tests are as follows:

$$Y^{Nordic} \ \& \ Y^{OtherEurope}$$

$$Y^{Small} \ \& \ Y^{Large}$$

Y stands for dependent variable. The tests has been performed for all four dependent variables. The findings are divided into small and large. Small banks have total assets of less than EUR 250 billion, and large banks have total assets of more than EUR 250 billion. The purpose of the size classification is to ensure that individual banks, i.e., the largest ones, are not the reason for the results obtained.

Table 5. Robustness test results - Large banks & Small banks

	Large banks				Small banks			
	ROA	**ROE**	**RARROA**	**RARROE**	**ROA**	**ROE**	**RARROA**	**RARROE**
Coefficient - NII share	0.004	0.066	-1.939	4.130	0.013	0.155	-2.701	-2.406
P-value - NII share	0.001***	0.001***	0.820	0.209	0.000***	0.000***	0.291	0.310
Coefficient - Assets	0.003	0.053	-11.825	-6.175	-0.001	0.019	-2.287	-2.237
P-value - Assets	0.002***	0.001***	0.086*	0.020**	0.531	0.208	0.161	0.139
Coef. - Net debt to capital	0.003	0.056	4.904	3.013	0.000	0.007	-0.136	0.122
P-value - Net debt to capital	0.022**	0.009**	0.599	0.402	0.960	0.825	0.969	0.970
Coefficient - Euribor	0.074	1.229	139.900	110.480	0.175	1.948	63.212	73.326
P-value - Euribor	0.000***	0.000***	0.004**	0.000***	0.000***	0.000***	0.000***	0.000***
R^2	0.244	0.266	0.024	0.077	0.242	0.281	0.032	0.048
F	37.14	41.76	2.89	9.59	47.76	58.40	4.99	7.50
P-value	0.000***	0.000***	0.022*	0.000***	0.000***	0.000***	0.001***	0.000***

* , **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In the ROA model, the results for both large and small banks are statistically significant based on p-values and F-values. The coefficient of determination, or R-squared value, is 0.244 for large banks and 0.242 for small banks, meaning that the model explains the variation slightly better than previously reported. For large banks, the model explains the variation significantly better than for small banks. According to the coefficients, the explanatory power increases when large banks are examined separately. However, the coefficients are fairly small, indicating that the model's structure is consistent. In the ROE model, the model is also significant based on the F and p-values. The ROE model is similar to the ROA model in that the coefficient of determination is higher for large banks than for small banks, but the coefficient of determination is lower than in the ROA model.

In risk-adjusted models, both RARROA and RARROE are statistically significant, as indicated by F-values, for large banks. Still, RARROA for large banks remains weakly significant at 0.024, while for small banks, the R^2 values remain low (3–5%). Unlike conventional models, the RARROE model provides higher explanatory power than the RARROA model.

Overall, the robustness test shows that diversification behaves differently for small and large banks. For small banks, the non-interest income multiplier is stronger in both the ROA and

ROE models, suggesting that diversification improves profitability more when banks operate with narrower interest-rate margins. This may be because smaller banks have future interest income. In contrast, large banks show more moderate diversification effects but benefit from stronger stability at higher interest rates, as reflected in significant Euribor multipliers. Risk-adjusted measures show that neither group gains stability from increasing non-interest income. Still, large banks' results are relatively more predictable, consistent with their larger customer bases, economies of scale, and more sophisticated risk management processes.

Table 6. Robustness test results – Nordic & Other Europe

	Nordic				Other Europe			
	ROA	**ROE**	**RARROA**	**RARROE**	**ROA**	**ROE**	**RARROA**	**RARROE**
Coefficient - NII share	0.012	0.142	-2.264	11.090	0.009	0.118	-1.538	-1.773
P-value - NII share	0.000***	0.000***	0.917	0.142	0.000***	0.000***	0.431	0.337
Coefficient - Assets	-0.006	-0.048	-23.247	-9.532	0.001	0.036	-2.967	-2.922
P-value - Assets	0.001***	0.107	0.329	0.248	0.322	0.002***	0.014**	0.010**
Coef. - Net debt to capital	0.006	0.106	12.352	-11.596	0.001	0.022	1.765	0.948
P-value – Net debt to cap.	0.029**	0.028**	0.749	0.385	0.659	0.316	0.431	0.655
Coefficient - Euribor	0.101	1.491	246.680	152.590	0.137	1.683	68.206	77.439
P-value - Euribor	0.000***	0.000***	0.026**	0.000***	0.000***	0.000***	0.000***	0.000***
R^2	0.477	0.382	0.030	0.078	0.210	0.260	0.045	0.048
F	47.97	32.48	1.60	4.46	56.47	74.83	10.09	10.09
P-value	0.000***	0.000***	0.176	0.002***	0.000***	0.000***	0.000***	0.000***

* , **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In terms of regional results, Finland, Sweden, and Denmark are classified as Nordic countries, while the other countries are classified as the rest of Europe. The ROA model is significant for both regions. In the Nordic countries, the R-squared value is 0.477, meaning that the model is highly explanatory. For the rest of Europe, the R-squared value is 0.210. In both regions, the beta of the non-interest income share is also positive, indicating a positive correlation between non-interest income growth and ROA. In addition, the interest rate level, i.e., Euribor 12 months, has a significant positive impact on both regions. The beta value for the Nordic countries is 0.101, and for the rest of Europe, 0.137, indicating that Euribor has a clearly greater impact on ROA in the Nordic countries than in the earlier description.

In the ROE model, the model explains approximately 38 percent of the variation in ROE in the Nordic countries, compared to 26 percent in the rest of Europe. The models for both regions are statistically significant. The results of the risk-adjusted RARROA and RARROE models are statistically significant in both regions. However, the models explain the results much better in the Nordic countries than in the rest of Europe.

A regional comparison reveals significant differences between Nordic and Nordic and other European banks. Nordic banks have much higher explanatory power in both profitability and risk-adjusted models, indicating that their performance is better aligned with the selected explanatory variables. The positive profitability effect of non-interest income is stronger in the Nordic countries. At the same time, the risk-adjusted models remain largely unchanged, suggesting that Nordic banks already benefit from at least strong efficiency. Outside the Nordic countries, diversification also improves profitability, but the effect is weaker and more volatile, reflecting differences in market competition, cost structures, and interest rate sensitivity.

In both regions, banks benefit from rising interest rates. However, the benefit is greater in the other Europe region than in the Nordic region. This may also be affected by the different currencies in the Nordic countries. Other Europe countries are mainly Euro countries. Overall, diversification appears to be more systematically beneficial for Nordic banks, while in the rest of Europe, it acts as a complementary source of profitability that can vary.

In general, the robustness test results show that even when restrictions are placed on the bank's size or region, the models remain statistically significant. In terms of coefficients, the directions of the models also remain largely the same, although there is some variation between models. There were differences in the degree of explanation, especially in the regional comparison. The robustness tests support the basic model in terms of significance, but there is variation in significance.

4.5 Discussion of the results

Based on this study's results, increasing non-interest income improves banks' profitability. However, the impact on risk-adjusted returns is not statistically significant. This indicates that diversification into non-interest income does not necessarily make income streams more stable. This is consistent with the risk-return theory. (Modigliani & Pogue, 1974) According to the theory, an increase in returns also means an increase in risk. Regarding the impact of interest rates, changes in Euribor rates had a significant impact on both profitability and risk-adjusted profitability. The increase in interest rates clearly strengthened both measures, confirming the importance of the interest margin as a key determinant of bank performance.

The results suggest that banks should consider increasing non-interest income from the perspective that it can increase profitability in a way that it is not the only source of profitability. When interest rates are low, interest income is low as interest margins fall. In this case, non-interest income can maintain profitability. During periods of higher interest rates, banks can also maintain or improve profitability through interest income. In this case, the situation depends a lot on the strategies of individual banks.

These findings are largely consistent with previous research by Stiroh (2004) and Köhler (2014), which showed that diversification into non-interest income can increase profitability. It can also introduce new types of volatility phenomena, especially for smaller or retail-focused banks. These results differ from those of DeYoung and Torna (2013), who found that fee-based activities can improve stability under certain circumstances by reducing default risk. The lack of significance of risk-adjusted profitability in this study suggests that the stabilizing effect of non-interest income is limited in the European environment, especially during periods of volatile interest rates.

According to diversification theory, risk can be reduced by diversifying activities across different income streams (O'Sullivan & Sheffrin, 2003). Non-interest income typically consists of service fees, brokerage fees, insurance, and investment-related income. Many of these business areas are highly specialized, requiring banks to invest in expertise and infrastructure.

Offering new services increases operating costs, which negatively impacts profitability. (DeYoung & Roland, 2001). In this sense, larger banks can exploit diversification more effectively, while interest income still plays a larger role in smaller banks. The model explaining risk-adjusted profitability presented in Table 4 shows that assets have a significant negative impact on both RARROA and RARROE. This means that larger banks achieve lower risk-adjusted returns.

The lack of risk-adjusted indicators can be explained, for example, by the ample evidence of volatility across various non-interest income sources. Chen et al. (2017) state in their article that non-interest income sources are not homogeneous and that riskier returns can increase volatility and risk. Smith et al. (2003) point out that the correlation between interest income and non-interest income varies across countries, which weakens the stabilizing effect of diversification. However, an increase in non-interest income can reduce volatility. As Köhler (2014) noted in his article the situation varies across banks. This study could not show that this is generally the case across Europe.

For example, using the Z-score to assess risk-adjusted returns could have improved the stability of the results, as the Z-score combines return and solvency measures more effectively. However, the Z-score may not capture stability changes well when viewed in conjunction with income diversification. Farag et al. (2025) note that in their study, as income diversification increased, the Z-score decreased.

The research results also have implications for supervisors and policymakers. From a regulatory and risk perspective, the results support the view that supervision should focus on the overall risk profile of banks and not just their income structure. The Basel III and Basel IV frameworks strengthen capital adequacy, liquidity and leverage requirements, but do not directly address the impact of income diversification. From an EU regulatory perspective, the aim is to balance financial stability with market innovation. The European Commission states that higher capital and liquidity requirements must be implemented in a way that allows banks to provide funding and support economic growth. (European Commission 2025) As non-interest income does not automatically improve risk-adjusted stability, supervisors should closely monitor the expansion of non-interest income generating activities and assess how they impact operational and market risks, both at the individual bank level and across banking groups.

The results suggest that banks need to continuously review the distribution of income in relation to market conditions and the interest rate cycle. In times of low interest rates, it is important to increase other income sources to maintain profitability, while as interest rates rise, the importance of traditional net interest income increases. However, as interest rates can change rapidly, expanding the range of services is not always realistic in the short term. Therefore, profitability can often be supported by developing existing services, enhancing cross-selling and utilizing digital platforms cost-effectively.

From a management perspective, the results highlight that increasing non-interest income is not risk-free and does not necessarily lead to more stable results. Banks should focus on business areas that generate predictable cash flows and are less exposed to operational risks, such as payment services and other service fees. Since these revenues cannot be increased indefinitely, the profitability of riskier product areas needs to be carefully assessed. Although banks have a strong position in lending, future profitability requires a balance between interest and fee income and the ability to adapt to rapidly changing market and interest rate situations.

Summary of key takeaways in this section:

- Non-interest income increases profitability. However, it does not improve risk-adjusted returns, i.e. diversification increases average returns but does not stabilize returns, especially in an unstable interest rate environment.
- Interest rates remain the strongest driver of both profitability and risk-adjusted returns, with non-interest income playing a larger role when interest rates are low.
- Some non-interest income can be highly volatile, such as trading income and other income fees. Increasing these types of income can also increase risks.
- Banks need to balance interest and fee income in line with market conditions, cost structures and operational risks, focusing on stable and scalable service areas while carefully assessing more volatile income sources.
- For supervisors, the findings highlight the need to monitor banks' overall risk profiles, not just their income structure. Supervisors should closely monitor the expansion of fee-based activities and assess how they impact operational and market risks.

5 Conclusion

The aim of this study was to investigate how changes in non-interest income and interest rates affect the profitability and stability of earnings of European banks. The results show that non-interest income has a statistically significant positive impact on banks' profitability, i.e. in this study ROA and ROE. However, the impact on risk-adjusted measures i.e. RARROA and RARROE was not significant. Diversification into other income sources may therefore improve returns, but it does not necessarily make earnings more stable.

The results show that changes in the Euribor rate had a significant and positive impact on both profitability and risk-adjusted returns. This means that the interest margin still plays a key role in banks' profitability. These findings extend previous research on European banks by providing new evidence for the period 2014–2024 during the Basel III and IV regulations. In summary, income diversification benefits profitability, but its stabilizing effect is limited when regulatory and market conditions are tight.

From a practical perspective, the results suggest that banks should consider the strategic balance between interest income and non-interest income. In times of low interest rates, shrinking interest margins weaken the profitability of traditional banking, which makes it worthwhile to improve other income sources, such as fees and investment services income. It can also be said that when interest rates are high, lending and deposit activities become very important for profitability again. Banks also need to observe how the growth of different income sources affects cost.

The results show that the size of the bank matters. Larger banks can theoretically exploit diversification more effectively, although the results of the regression analysis in this study show that larger banks achieve lower risk-adjusted returns. This means that economies of scale do not automatically lead to greater stability. For smaller banks, interest income remains the primary source of income, although digitalisation and fintech developments may gradually change this. In terms of regulation, the results show that stability cannot be achieved by increasing non-interest income alone. The Basel frameworks focusing on capital adequacy and liquidity remain relevant, but regulators could also consider how diversification of the business model affects overall income stability.

This study focuses on a ten-year period (2014–2024) and a sample of European banks. The results should therefore be interpreted in the context of this region and time frame. Non-interest income was treated as an aggregate variable, so the study does not distinguish between distinct income categories such as fees, trading income and insurance income. Furthermore, possible country-specific differences such as taxation or bank structure were not modelled separately. These limitations suggest that the results reflect general patterns rather than country-specific causal relationships.

Future research could extend the analysis in several ways. First, separating the different components of non-interest income would allow for a deeper understanding of which activities are most representative of profitability and stability. Second, cross-regional comparisons with markets outside Europe would provide insights into how regulatory regimes and financial maturity affect the outcomes of decentralization. Finally, as FinTech and digitalization continue to reshape banking models, future research should examine how technological developments change the balance between interest and non-interest income and its implications for long-term stability.

In conclusion, this study complements the research on the European banking sector conducted during the Basel IV period. It provides empirical evidence on what banks should consider when adapting their income structures in a changing interest rate environment. The results show that banks need to find an appropriate balance between interest income and non-interest income to ensure sustainable profitability. This balance is expected to remain a key source of competitive advantage as the European banking sector evolves into an increasingly digital operating environment.

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Appendix

Appendix 1. List of banks

Bank	Country	Total Assets (millions)	Large or small	Nordic or Other Europe
Erste Group Bank AG (ERST.VI)	Austria	353736	Large	Other Europe
Oberbank AG (OBER.VI)	Austria	28383	Small	Other Europe
Kbc Groep NV (KBC.BR)	Belgium	373048	Large	Other Europe
Zagrebacka Banka dd (ZBB.ZA)	Croatia	25947	Small	Other Europe
Hrvatska postanska banka dd (HPBZ.ZA)	Croatia	7882	Small	Other Europe
Danske Bank A/S (DANSKE.CO)	Denmark	584992	Large	Nordic
Jyske Bank A/S (JYSK.CO)	Denmark	105542	Small	Nordic
Nordea Bank Abp (NDAFI.HE)	Finland	725854	Large	Nordic
BNP Paribas SA (BNPP.PA)	France	3009340	Large	Other Europe
Credit Agricole SA (CAGR.PA)	France	2309782	Large	Other Europe
Societe Generale SA (SOGN.PA)	France	1609202	Large	Other Europe
Deutsche Bank AG (DBKGn.DE)	Germany	1955465	Large	Other Europe
Commerzbank AG (CBKG.DE)	Germany	605252	Large	Other Europe
Deutsche Pfandbriefbank AG (PBBG.DE)	Germany	68071	Small	Other Europe
National Bank of Greece SA (NBGr.AT)	Greece	119266	Small	Other Europe
Piraeus Financial Holdings SA (BOPr.AT)	Greece	89457	Small	Other Europe
Alpha Services and Holdings SA (ACBr.AT)	Greece	78011	Small	Other Europe
Bank of Ireland Group PLC (BIRG.I)	Ireland	161813	Small	Other Europe
AIB Group PLC (AIBG.I)	Ireland	141266	Small	Other Europe
Banco BPM SpA (BAMI.MI)	Italy	208662	Small	Other Europe
BPER Banca SpA (EMII.MI)	Italy	162954	Small	Other Europe
ING Groep NV (INGA.AS)	Netherlands	1178657	Large	Other Europe
ABN Amro Bank NV (ABNd.AS)	Netherlands	438102	Large	Other Europe
Banco Comercial Portugues SA (BCP.LS)	Portugal	100226	Small	Other Europe
Nova Ljubljanska banka dd Ljubljana (NLBR.LJ)	Slovenia	28035	Small	Other Europe
Banco Santander SA (SAN.MC)	Spain	1837081	Large	Other Europe
CaixaBank SA (CABK.MC)	Spain	704505	Large	Other Europe
Bankinter SA (BKT.MC)	Spain	121972	Small	Other Europe
Svenska Handelsbanken AB (SHBa.ST)	Sweden	348100	Large	Nordic
Swedbank AB (SWEDa.ST)	Sweden	298736	Large	Nordic