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The effect of capital ratio on profitability in the Netherlands

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ABSTRACT

This paper studies the effect of the capital ratio on the profitability of banks in the Netherlands. By using a sample of 30 Dutch banks during the 2015-2021 period a panel dataset is constructed. Profitability is measured through the dependent variables ROA, ROE, and NII. To examine this relationship panel regressions with clustered standard errors for each bank are used including fixed or random effects, depending on the outcome of the Hausman tests. Firstly, the results show that there is no significant effect of the capital structure on the profitability. Thereafter, the CET1CapitalRatio and the Total Capital Ratio negatively affect the Net Interest Income of Dutch banks. While the Basel capital regulatory requirements suggest holding a higher capital ratio in order to avoid risks, these findings indicate that a higher capital ratio decreases banking profitability.

Keywords: Capital, profitability, banks

JEL codes: G21, G28, G29

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CHAPTER 1 Introduction

After the collapse of the banking system during the global financial crisis in 2008, the quality and quantity of capital held by banks has been questioned (King & Tarbet, 2011). This capital refers to the financial resources a bank holds to absorb unexpected losses. During periods of economic contractionary and uncertainty, banks must hold more capital in order to avoid credit risk, liquidity risk and market risk. This regulation is being enforced by the Basel Committee, which incorporated the Basel framework. Within this framework, Tier 1-capital serves as the core pillar for the minimum required capital ratio. A significant link has been found between bank failures and holding a small amount of Tier 1-capital, during the financial crisis in the US (Abou-El-Sood, 2016). Therefore, the profitability, or the sum of revenues minus the costs banks encounter, could be affected by the capital ratio. The Basel Committee on Banking Supervision (BCBS) has strengthened the amount of capital commercial banks must hold over the years (Roulet, 2018). Transitioning from Basel 2 to Basel 3, the Tier 1-capital requirements have increased from 4% to 8.5%. Thereby, the total capital requirements have increased from 8% to 10.5%, under Basel 3 (Allen et al., 2012). As a result, European commercial banks have made qualitative adjustments to the capital and liquidity in the assets they hold, taking riskiness into account (Roulet, 2018). Differences in capital ratio could explain variation in profitability.

There has been an abundance of research performed in the field of finance and banking regarding this relationship. Papers that have already researched the effect of capital ratio on profitability, have found mixed results leading to different conclusions. For example, Hellmann et al. (2000) explains that capital requirements are costly for banks. The main reason is that banks are forced to hold extensive capital which does not generate any additional income, due to the Basel regulations. This view indicates a negative relationship between capital ratios and profitability. On the other hand, a study performed in the US found that capital improves the financial operating results of large commercial banks, especially during economic crises (Berger & Bouwman, 2013). Another more recent empirical study has demonstrated that a higher level of capital ratio increases bank efficiency and profitability for banks in OECD countries (Bitar et al., 2018). Specifically, the authors explain this finding by implying that non-risk based capital ratios prove to be more profitable for banks. By using OLS regression models and a dataset from 1999 to 2013, including 1992 banks from 39 OECD countries, the authors show that banks are significantly more cost-efficient and have lower losses from loans when owning more capital. This reflects the importance of possessing higher quality capital. The outcomes of their research remain valid across multiple checks for robustness, including macroeconomic control variables, and different measures for profitability and risk.

Despite these previous results, no study has yet looked at this effect solely for the Netherlands. Therefore,

in this study, I will similarly replicate the research performed by Bitar et al. (2018) in the Netherlands, instead of looking at all OECD countries. It is interesting to emphasize the relation between capital ratios and profitability in the Netherlands for two main reasons. Firstly, it is important to highlight the unique structure of the Dutch banking sector. This market in the Netherlands has one of the highest market concentration in Europe. The market is being dominated by a few large banks (ING, Rabobank, ABN Amro), whom are in possession of an 80% share of the Dutch banking sector (Bos, 2004). Secondly, the Netherlands experienced abnormal development in their housing market. Before the financial crisis, Dutch banks increased mortgage lending, which resulted in higher housing prices. This can be explained due to the fact that mortgages had relatively low risk weights under the Basel framework, leading to lower capital requirements during favorable economic conditions (Saurina & Trucharte, 2007). After the crisis the housing prices started falling, leaving households with immense levels of debt (Everett et al., 2021). Little scientific research has been performed on how Dutch banks were influenced by these developments. Hence, it is interesting to examine how the profitability of commercial banks in the Netherlands has been affected by the amount of capital they hold. Therefore, the main research question I aim to solve in this paper will be: how does the level of capital affect the profitability of banks with regards to the Basel framework?

In order to answer the research question, I must specify the measurement of bank profitability in this paper. ROA is a standard measure for operating efficiency, while ROE proves to be a good performance target, because it captures the capital held within banks and gives an indication of potential investment growth (Petersen & Schoeman, 2008). In this case, the equity that banks possess must be sufficient to meet the capital requirements set by the Basel 3 framework. Additionally to compute profitability, I take into account the net interest margin profitability (NIMP), as used in the study performed by Bitar et al. (2018). For banks this is one of the most important factors to measure their returns, since their income heavily relies on the difference in interest from lending and borrowing (Tarus, Chekol & Mutwol, 2012). The required secondary data for these factors will be retrieved mainly from De Nederlandsche Bank (DNB) and the European Central Bank (ECB), reported in the IFRS accounting standard. From these databases key figures such as Tier 1-capital and the total capital ratio in percentages can be retrieved from all active Dutch banks. The ECB offers information on the net interest margins. The sample contains microdata over the years 2015-2022 and the sample size covers approximately 30 banks. Quantitative research methods will be used, mainly in the form of linear regression models. 3 regressions will be performed where profitability is given by ROE, ROA and NIMP, which will serve as the unit of analysis. In the main regression model the dependent variable will be profitability and the independent variable will be capital ratio, similar to the methodology in the paper by Bitar et al. (2018). Relevant control variables such as liquidity ratio and customer deposit ratio might be added to account for liquidity risk, since they might affect the capital ratio. The results of this regression will show us whether the capital ratio has a significant effect on a bank's profitability.

I expect to observe a positive relationship between capital ratios and profitability of banks, similarly to the findings conducted in the paper by Bitar et al. (2018). However, other factors, such as the liquidity ratio, might affect this relationship and prove statistically significant, which give room for improvement on this topic. Whether this will result in a better model fit, remains to be tested. The outcomes of this study will provide additional information which can contribute to the current knowledge of the Dutch banking sector and might prove useful for bank managers.

The remainder of this paper is structured as follows. Chapter 2 discusses relevant literature and previous research regarding profitability, capital ratio, and the relationship between these topics. Chapter 3 provides a description of the data used and the associated variables. Chapter 4 focusses on the methodology used to examine the effect. In chapter 5, I will discuss the obtained empirical results. Finally, chapter 6 will give a conclusion of this paper.

CHAPTER 2 Theoretical Framework

2.1 Profitability

Profitability is a well-known indicator for corporate firms to evaluate their financial performance and financial health. Profitability is defined as the generated revenue minus the total expenses in the same period (Alarussi & Alhaderi, 2018). The profitability of a bank is basically part of the financial development within the corporate sector. The main goal of commercial banks is to maximize their profitability in order to assure financial stability of the bank. To assess the profitability of a bank, specific financial measures are used such as return on assets (ROA), return on equity (ROE), and net interest income (NII) (Trujillo-Ponce, 2013).

Van Fenstermaker (1968) was one of the first to conduct a research on banking profitability. His study focused on analysing the factors that affected the profitability of American commercial banks during the 19th century. More specifically, this paper uses data from American commercial banks in six states between 1807-1830, investigating a set of variables that had a significant effect on their profitability. The data was mainly collected through state archives since banks rarely shared their financial reports publicly. In these reports, the dividend payments served as a measurement for earnings since net earnings were often not reported. Based on the gathered information, including the average annual dividends, this paper established a foundation for assessing profitability for banks. Van Fenstermaker (1968) notably highlighted the finding that annual dividend rates are a good indicator for the net earnings of a bank, and therefore provide a good representation of profitability.

One of the first studies on financial ratios, including profitability ratios, was written by Beaver (1966). The main objective of this paper was to establish a link between various financial ratios and firm failures. Beaver (1966) collected financial data from firms on the stock market and conducted a discriminant analysis to test which firms were close to bankruptcy. Based on the results, profitability measures, such as ROA and ROE tended to have significant predictive power to asses financial instability. Therefore, firms with lower financial ratios resulted in having less financial health and a higher chance of failure (Beaver, 1966).

In a subsequent study, Bourke (1989) expanded the existing literature regarding bank profitability. The main goal of this study was to further analyse the factors which determine bank profitability, while specifically focusing on market concentration and deregulation. The study collected financial statements from 90 international banks across 12 countries, during the period of 1972-1981. By performing linear regressions, Bourke (1989) finds that liquidity, capital ratios, and interest rates positively affect profitability. Additionally, the study also reveals that market concentration is positively related with

return on assets (ROA), mainly because the staff expenses are decreasing. Finally, the study basically concludes that bank profitability is larger for banks with a higher market concentration.

A crucial seminal study within the banking industry was performed by Berger & Mester (1997). The goal of their research was to measure the efficiency of commercial banks in terms of profitability. They aimed to explain why some financial institutions were more productive than others. By collecting an extremely large dataset of around 6000 commercial banks in the US during 1990-1995, they analysed key variables to explain the differences in costs and profits. These variables contain individual characteristics as well as macroeconomic factors such as interest rates. In conclusion, this paper mentions the fact that banks with higher asset quality achieve higher levels of profitability (Berger & Mester, 1997). They also discovered a significant effect of regulatory measures on a bank's revenue.

2.2 Capital Ratio

For the purpose of understanding this study, it is necessary to clarify what capital ratio represents. The capital ratio of a bank is defined as the total amount of capital held, expressed as a percentage of its risk-weighted assets (Demirguc-Kunt et al., 2013). The total capital consists of CET1, AT1, and Tier 2 capital. Common Equity Tier 1 (CET1) is also referred to as the 'core capital', and is mainly formed by common shares, retained earnings, and other equity reserves (King & Tarbert, 2011). Additional Tier 1 (AT1) capital includes preferred stocks and third party instruments, while Tier 2 capital (T2) functions as dated subordinated debt instruments (Sairally et al., 2013). Capital ratio is part of the Basel framework and is implemented to assure that banks meet the minimum capital requirements. Every bank is obligated to hold a minimum amount of money to maintain their licences and perform financial activities. The Basel Committee on Banking Supervision (BCBS) sets the policy for the minimum capital requirements, and banks must strictly obey these rules in order to avoid different kinds of risks and financial distress (Abou-El-Sood, 2016).

There have been a fair amount of studies performed on the effect of capital ratio. However, Modigliani & Miller (1958) were one of the first in the field of economics to write an academic paper on capital structure. Their paper demonstrated that the capital structure of a firm does not affect its market value. They created a theoretical model to support their proposition, which emphasized the importance of optimizing the debt-to-equity ratio in order to maintain a lower cost of capital (Modigliani & Miller, 1958). Although this paper is generally more applicable to the financial field, it also laid the foundation for capital ratios within the banking sector. Therefore, it is interesting to examine whether the capital structure of banks affects their profitability.

Karaken & Wallace (1978) expanded the existing literature regarding bank regulation. In their paper they researched the effect of deposit insurance on the risk behaviour of banks in the US. There was little information on the mechanism of deposit insurance and the banking sector was extremely volatile, which motivated them to perform this research. They created a partial equilibrium model for banks that incorporated regulatory constraints and functions. Thus, they applied the regulations set up by the Federal Reserve at the time, such as the minimum cash requirement. The model concluded that insurance on deposits and strict regulatory rules have stabilizing effects on banks. Thereafter, they suggested that regulators should expand their restrictions on banks. By enforcing minimum capital levels, banks would take less risk, leading to less failures (Karaken & Wallace, 1978)

Furlong & Keeley (1989) were among the fundamentalists of studying capital ratios. Given the high exposure of banks in the US to various risks during the 1980's, they examined whether higher capital ratios of banks led to fewer banking failures. To test this, they made use of a state-preference model and the option pricing model, which includes the Black-Scholes formula (Merton, 1977). In conclusion, their key finding indicated that a higher capital ratio does not lead to an increase in asset riskiness, when maximizing profit (Furlong & Keeley, 1989).

It is of utmost importance to highlight and summarize the evolution of the capital requirements, which basically form the guidelines for capital ratios. In 1988, the Basel Committee on Banking Supervision (BCBS) introduced Basel 1, which were the first international guidelines for banking solvency. Basel 1 was quite straightforward, requiring banks to hold capital of at least 8% of the risk-weighted assets (RWA) (Bodellini, 2019). In this case, the RWA are calculated through the Standardized Approach, where every asset has its own fixed risk-factor weight (Carpenter et al., 2001). This approach helps to clarify and visualize that banks are forced to maintain a certain level of capital based on the riskiness in their underlying assets.

In 2004, the BCBS expanded the framework by implementing Basel 2 (Cornford, 2006). Basel 2 included three pillars. The first pillar, which is the primary focus of this paper, outlined the minimum capital requirements. The second and third pillar focused on supervision and market discipline. In addition, Basel 2 implemented a more complex method to calculate the RWA through the Internal Rating Based (IRB) approach. This IRB approach allowed banks more flexibility in managing their assets and capital (Cornford, 2006).

After the global financial crisis, Basel 3 was implemented in 2011 to address credit and liquidity issues (Bodellini, 2019). The quality and quantity of the capital held by banks had to be improved. Hence, the CET1 was raised from 2% to 4.5% (Sairally et al., 2013). Currently, every bank supervised by the Basel

framework is following the latest version of the Basel 3 capital requirements, which is referred to as "Basel 4" (Feridun & Özün, 2020).

2.3 Theoretical link between bank profitability and capital ratio

The link between capital structure, which forms the basis of the capital ratio for banks, and profitability can be clarified through a theoretical perspective. To explain this relationship, I will apply the capital structure theory, which was primarily introduced by Modigliani & Miller (1958). In their study, they attempt to establish a link between capital structure and the total value of a firm. Their research mainly concludes that the capital structure is irrelevant for the valuation of companies. Hence, the debt-to-equity ratio does not play role in determining profitability. However, this assumption only holds when assuming an economy without imperfections, such as taxes and asymmetric information. Therefore, this theory seemed quite impossible in practice. Later on, Modigliani & Miller (1963) expanded their model, with the second MM proposition, by including the effect of corporate tax on the cost of capital and valuation. This addition clarified why some firms were more likely to choose debt-financing. By owning more debt, the tax shield would increase, thereby lowering the cost of capital. Many theories have evolved from the MM propositions, especially in the field of corporate finance (Myers & Majluf, 1984). However, I will solely focus on theories related to the banking sector.

Orgler & Taggart (1981) primarily argue that banks have a different capital structure compared to other corporate institutions. They argue that banking operations automatically deviate from the MM propositions due to their unique characteristics. Commercial banks increase their assets by creating deposits while giving loans to customers, which increases their liabilities. Interestingly, costs associated with generating deposits, are tax-deductible, which is a significant benefit for banks (Orgler & Taggart, 1981). Hence, many banks decide to take on a relatively large amount of debt compared to normal firms. This lowers the amount of equity a bank owns relative to its assets, which decreases the amount of capital.

Miller (1995) tests whether the MM propositions are applicable to the banking industry. Miller basically contradicts the first MM proposition by explaining that when the amount of capital increases, the cost of capital does not necessarily decrease. Hence, a surplus of capital does not directly reduce the value of a bank and therefore does not reduce the profitability. Subsequently, he emphasizes the importance of supervision and capital requirements. According to Miller, capital requirements are of utmost importance for financial health but are not totally effective in capturing all the risks that commercial banks face. The assets of a bank have a unique risk evaluation, which is why the capital structure of banks might variate

from the MM propositions. Regulatory constrains also cause complexity when applying this theory to the banking industry.

Berger & Bouwman (2013) apply the capital structure theory on the relationship between the capital ratio and profitability. Their findings indicate that banks with large capital usually achieve higher levels of profitability and encounter less risk. This contradicts the second MM proposition, which argues that more capital leads to a lower return on equity. However, after a certain threshold, an excess of capital does not have a causal relationship with profitability and might even cause losses. So the value of the bank does change depending on the capital structure in a world where imperfections do exist.

2.4 Empirical link between bank profitability and capital ratio

There have been quite a few studies performed that offer empirical evidence on the relationship between capital ratio and profitability across different countries. Some have previously found a positive relationship, while other studies prove a negative relationship. Hence, there is mixed evidence on the effect of the capital ratio on profitability. Therefore, I will discuss both views of the previous literature regarding this relationship.

In this section, I will discuss previous research that has shown a positive effect of the capital ratio on the profitability of banks. For example, Bitar et al. (2018) sampled all active banks in OECD countries and used panel data to find possible links. The research of the authors reveals that a higher capital ratio significantly improves profit and efficiency by reducing the destabilizing effect of risks. This is mainly due to supervision demanding higher capital buffers, which, in turn, leads to better investment choices by the banking managers. Furthermore, they find that high-quality capital, especially CET1 capital, reduces risk and achieves higher levels of profitability. However, small banks or high liquidity banks with a high capital ratio could sometimes encounter losses (Bitar et al., 2018).

Secondly, Ben Naceur & Goaied (2008) also found a positive relationship between the capital ratio and profitability. They examined the link between individual characteristics and measures of profitability of commercial banks in Tunisia during 1980-2000. Similarly to this study, profit is also measured through ROA and NII. Based on the results, the within-country variation of profitability can be largely explained by bank attributes, such as capital structure. Thereafter, the authors establish a strong correlation between capital ratio and net interest income. Hence, increasing the amount of loans will result in more profitability, while the capital ratio slightly increases.

Demirguc-Kunt & Huizinga (1999) show a similar view on how capital ratio positively affects profitability. They collect bank data from 80 countries during the period 1988-1995, and transform this dataset into linear regressions. Following their results, high quality-capital appears to cause an increase in the net interest margin, which positively affects the profitability of banks. Thereby, the ability to absorb losses becomes stronger for banks with a good capital ratio, and the probability of financial distress

declines. High-quality capital mainly offers insurance against credit risk and liquidity risk (Demirguc-Kunt & Huizinga, 1999).

On the other hand, some identical studies have found a negative effect of capital ratio on profitability for commercial banks. Hoffmann (2011) conducted a study on banks in the US during the period of 1995-2007. The dataset contained information from 11,777 US banks, primarily collected from income statements accessible through the Compustat database. The information on macroeconomic variables were obtained from the GMM system. The study used pooled OLS regressions on the panel data, with the efficiency of the return on equity as the dependent variable and capital ratio as the independent variable. Control variables, such as size and market concentration, were added to the regression. The main findings of this study indicate that banks operate with a high level of risk aversion and do not utilize profitable investment opportunities. The regression tends to illustrate a negative effect of capital ratio on the efficiency of the return on equity. As the capital ratio increases, there is less risk on equity, and therefore the returns on equity are lower. Banks also tend to hold extensive capital, which leads to a higher increase in costs rather than revenue. This results in a negative link between capital ratio and profitability.

Similarly, Osborne et al. (2012) have also discovered a negative effect of capital ratio on profitability for commercial banks. Their sample includes the US banking sector between 1970 and 2010. They form a regression where ROE is the independent variable, and capital ratio is the dependent variable. Throughout majority of this time period, the relationship seems to maintain negative. However, during times of financial distress, the negative effect of higher capital ratios on profitability actually decreases and sometimes even becomes positive. They explain that acquiring additional capital is less costly for banks during recessions. Particularly in the short run, an excess of capital tends to decrease profitability even further. Hence, reducing the capital ratio could improve profitability.

2.5 Bank profitability and capital ratios: the case for the Netherlands

When reviewing the link between capital ratios and bank profitability, there are not many studies that specifically perform research on this direct relationship in the Netherlands. However, some studies measure the whole European banking industry.

De Bondt & Prast (2000) conducted a research on which determinants affected the capital ratio and risk taking of commercial banks in 6 different countries. The total amount of banks accounted for 448 banks, during the sampling period 1990-1997. Through a cross-country analysis, they wanted to find whether banks have similar characteristics or show different reactions to the capital requirements. Following their results, they firstly find that banks in the Netherlands had a higher total capital adequacy ratio, compared to other European countries. This eventually led to a higher cost of capital, which explains the higher return on equity for the Dutch commercial banks. De Bondt & Prast (2000) found that Dutch banks actually had a higher ROE, largely due to the higher riskiness in their loan portfolio. Even with lower

interest rates than the US, banks in the Netherlands managed to increase their interest income, unlike the other European banks. Combined with the findings of Anbar & Alper (2011), banks can largely benefit and increase their profitability when taking advantage of high interest rates, by achieving higher levels of return on equity. So basically, De Bondt & Prast (2000) concluded that high operational risk, in combination with a high ROE, is the perfect formula to increase banking profitability, which proved to be the case for the Netherlands. They explain that risk-taking is beneficial because the Basel risk weighted assets (RWA) do not fully reflect the amount of riskiness in the assets. Hence, high capital ratios do not indicate that banks are risk-averse. Therefore, capital ratios do not have a direct effect on banking profitability in this study.

Chiaramonte & Casu (2017) collect evidence from the whole European banking sector. They test whether the upgraded capital restrictions from Basel 3 actually enhance financial stability for banks. To analyse the effect of capital ratios on banking performance, they analysed 28 EU member banks during the period 2004-2013 and transformed the data with a pooled logit model. They found that France, Germany and Netherlands showed the lowest probability of banking failure, due to their high financial health. This was explained due to the fact that the Netherlands had a high average Tier 1 capital ratio, compared to other EU countries. Chiaramonte & Casu (2017) further proved that only large stable banks could only afford to increase their capital ratio, without facing the consequences of credit and liquidity risks. Banks with a low level of liquidity and an excess of capital are often troubled with banking failure and losses.

Following the literature previously mentioned in this paper, I have found mixed results regarding the effect of capital ratio on profitability. Depending on the environment, capital structure, and riskiness involved in banking operations, this relationship might differ for commercial banks in the Netherlands. However, I expect to observe a generally positive relationship between the capital ratio and profitability, similarly to the outcomes of Bitar et al. (2018). The main research question I ought to answer in this study is: ‘How does the level of capital affect the profitability of commercial banks with regards to the Basel framework?’. This question will be answered by deriving a set of hypotheses.

Firstly, I aim to test whether the capital structure theory holds. As previously mentioned, Modigliani & Miller (1958) argued that the capital structure does not affect the firm value. Orgler & Taggart (1981) then mentioned that banks take on way more debt in comparison to normal firms because loans, their most important source of income, mainly depend on the liabilities of a bank. On the other hand, Berger & Bouwman (2013) found that more capital actually does increase the ROA and ROE of most banks.

Therefore, it is interesting to examine whether higher debt-to-equity levels affect the profitability of Dutch banks, leading to the following hypothesis:

Hypothesis 1: *For the Netherlands, a higher debt-to-equity ratio leads to a lower ROA and ROE.*

Subsequently, the effect of 'core capital' must be evaluated. As previously mentioned, prior research has emphasized the importance of CET1 capital in affecting profitability (Bitar et al., 2018). Bitar et al. (2018) proved that CET1 has a large positive effect on the profitability of banks on average for OECD countries. Therefore, specifically examining this segment of the capital ratio, could significantly explain the effect on profitability. To determine whether this is also the case for Dutch banks, the following hypothesis will be tested:

Hypothesis 2: *For the Netherlands, CET1 capital positively affects ROA, ROE and NII.*

Lastly, and most importantly regarding this research, is to identify whether there is an effect of the total capital ratio on profitability. Previous research has provided empirical evidence of both a positive and a negative effect. Bitar et al. (2018) found a generally positive effect of the total capital ratio on bank profitability, while Hoffman (2011) discovered a negative relationship between the total capital ratio and ROE for banks in the US. In order to find out how the total capital ratio affects banking profitability in the Netherlands, the following hypothesis must be evaluated:

Hypothesis 3: *For the Netherlands, the total capital ratio has a positive effect on ROA, ROE and NII.*

CHAPTER 3 Data

In this section of the paper, I will discuss the data obtained, and how this data will be utilized. Firstly, I will mention and describe the sample, as well as the variables that will be included in this research.

3.1 Sample

The data that is used in this research originates from the online database of De Nederlandsche Bank (DNB). This dataset contains the financial details of all individual active banks operating in the Netherlands. All financial figures, which are listed on the bank's balance sheets, are collected semi-annually and are included in the dataset. The dataset provides financial indicators and metrics related to balance sheet items, income, solvency (primarily capital), and concentration. The figures are presented in millions of Euros or as percentages. This data is assembled and derived from the banks' capital requirements directive (CRD) reports. In total, the dataset compromises information from 30 Dutch commercial banks. The total dataset consists out of 11,146 observations before transformation. It covers the period from July 2014 to June 2022. However, for the analysis, I will utilize the data from 2015-2021, since there are some missing figures in the excluded timestamps. After carefully selecting the needed variables and figures, the finalised dataset contains 420 observations.

3.2 Variables

In this section of the paper, I will describe the variables which will be used to assess the banking profitability. As previously mentioned, the large dataset contains numerous variables. In order to perform my research, some variables have to be transformed into the correct metrics. The return on assets (ROA) and return on equity (ROE) ratios are the most used financial profitability metrics. For the banking sector in specific, net interest income (NII) is mainly a key indicator for assessing profitability. Hence, using these variables to determine banking profitability is a logical choice in this study. To compute these profitability measures, I will create the variables ROA, ROE, and NII.

Return on assets is a widely employed ratio in the financial world for monitoring and analysing a company's profitability. ROA quantifies the capability to generate revenue based on the assets held by a company within a certain period. Specifically, ROA is defined as the net income divided by the total assets of a firm (Saptura, 2022). A high ROA ratio indicates that a company is capable of generating more profit due to their efficient utilization of its assets (Heikal et al., 2014). Hence, banks with a high ROA usually obtain more profit, which can attract more interest from potential investors.

Firstly, to compute *the return on assets (ROA)*, the income after tax is divided by the total assets and multiplied by 100 to express it as a percentage. The average ROA is computed for each of the 30 banks

considering the total period of analysis. The data on the income after tax and the total assets is retrieved from the DNB database. The following expression is obtained:

$$ROA = \frac{Net\ income\ after\ tax}{Total\ assets} * 100\%$$

The second profitability measurement ratio used in this study is the *return on equity (ROE)*. ROE is defined as the net income after tax divided by the total equity of a firm, which includes the capital of ordinary shares and premiums (De Wet et al., 2007). ROE has gained prominence as a reliable performance evaluation ratio, which is why the management of commercial banks have targeted this metric over the last decades (Karr, 2005). The emphasis on ROE is mainly driven by shareholders' value, which plays a huge part in a bank's equity, and therefore affects the profitability. Banks with a low ROA could strategically choose to finance themselves with more leverage, thereby increasing their ROE. Higher ROE, in turn, attracts more investor attention, potentially increasing the bank's total value (Pennacchi & Santos, 2021). This is a primary reason why ROE is a preferred profitability metric, especially for commercial banks.

Pennacchi & Santos (2021) further elaborate that when competition within the banking sector increases, banks often respond by reducing their total capital ratio. This can be achieved by acquiring riskier assets with higher RWA. As commercial banks strive to maximize their profit, the ROE tends to increase, while ROA and EPS may decrease. Additionally, the deposit insurance premium can improve the ROE as it is usually immune to changes in risk factors. This is due to the fact that government issues debt and treasuries at a fixed interest rate. Thus, competition and the deposit insurance premium provide more insights into why banks utilise and prefer ROE as the main profitability measure.

When computing the return on equity (ROE), the net income after tax is divided by the total amount of equity and multiplied by 100. Similarly to the ROA, the ROE is also expressed in percentages. The following equation is obtained:

$$ROE = \frac{Net\ income\ after\ tax}{Total\ equity} * 100\%$$

One of the most important metrics, especially in the banking sector, is the *net interest income (NII)*. NII is also referred to as the net interest margin (NIM). NII is defined as the difference between the income on the interest earned on assets (mostly loans), and the interest paid on liabilities (mostly deposits) (Nguyen,

2012). When banks assess their profitability, NII plays a crucial role. This is mainly because most of their income heavily relies on the interest rate charged on customers, and the interest rate paid to customers. Within this margin, the operational effectiveness of a bank must prove to be adaptable and aware for potential risks, such as interest rate risk (Lileikiene & Likus, 2011).

Ho & Saunders (1981) were among the first to conduct research and write an academic paper on the operationality of the NII. Interest income of banks seemed to be extremely sensitive to the volatility of changing interest rates, which is why they decided to study this topic. Ho & Saunders (1981) created a model using cross-section regressions to determine the variables that affect the interest income of banks. Their model revealed that banks always maintained a positive interest margin, which depended on four factors: the structure of the banking sector, the interest rates, managerial risk, and the type of transactions (Ho & Saunders, 1981). Interest rates generally affect the net interest margin positively. Usually higher interest rates are favourable for commercial banks, because they are able to charge higher interest rates on loans (Demirguc-Kunt & Huizinga, 1999).

Tarus et al. (2012) investigated the determinants of net interest income for banks in Kenya. They found that credit risk significantly increases the net interest income. The authors explained that as banks take on more risky loans, they usually increase the risk of default from borrowers. When increasing the credit risk, banks must increase their capital to meet the regulatory capital requirements, which creates extra costs. To compensate for these increased costs, banks tend to charge higher interest rates to customers, thereby boosting their total net interest income.

Since the NII is already given in the DNB database, there is no need to compute this variable. As already mentioned, NII is the income acquired based on the difference that banks give out and receive on interest rates. It should almost always be positive (Ho & Saunders, 1981).

Regarding the independent variables, the debt-to-equity ratio, the CET1 capital and the total capital ratio will be used in this research. Firstly, the *debt-to-equity ratio* is calculated by dividing the total amount of liabilities by the total equity of the bank, and will be referred to as the *DE-ratio*. This ratio provides insights into the proportion of debt compared to equity used to finance the banking operations. A high ratio usually indicates that firms have a higher financial leverage, which can result in extra costs or risks. However, for banks this ratio is generally higher due to the nature of the banking business, as banks create liabilities by providing loans (Safitri et al., 2020). Therefore, a high ratio should necessarily imply poorer financial stability. To compute the DE-ratio, the following equation is used:

$$DE\ ratio = \frac{total\ liabilities}{total\ equity}$$

Secondly, the *Common Equity Tier 1 (CET1) Capital Ratio* will be used as an independent variable. The CET1 capital is often referred to as the "core capital", because it forms the main component of the total capital ratio. It primarily consists of shareholders' equity and retained earnings and serves as the largest buffer against losses (Farag et al., 2013). CET1 capital largely protects against credit risk and liquidity risk. The CET1 Capital Ratio is already given the DNB database for each bank.

Lastly, the *Total Capital Ratio* will serve as the main independent variable. The total capital ratio comprises both Tier 1 and Tier 2 capital. The Tier 1 capital is formed by combining the CET1 capital with the Additional Tier 1 (AT1) capital. Tier 2 capital is similar to the AT1 capital as they both represent subordinated debt instruments. However, Tier 2 capital focusses on absorbing long-term losses, and therefore has a minimum maturity of five years. Both AT1 and Tier 2 capital possess the characteristic of being convertible into ordinary shares (Farag et al., 2013). The total capital ratio is also given in the dataset and does not require transformation.

3.3 Control Variables

Firstly, this research will control for *Market Concentration*, which is closely related to size. This variable describes the average share in total assets of the whole banking market in the Netherlands, and is expressed in percentages. It ranges from 0% to 100% for every individual bank. Mody & Peria (2004) have analysed the effect of market concentration on the spreads in the net interest margin. They have found a significant and positive effect of market concentration on net interest income. They observed that domestic banks with a higher share within the market are able to charge lower spreads to customers, which ultimately increases their total net interest income (Mody & Peria, 2004). The market concentration was already given in the DNB dataset.

The second control variable is the 6-month Euribor interest rate, which will be referred to as the *Interest Rate* in this study. The Euribor interest rate represents the average interest rate offered between banks that are part of the European Monetary Union (EMU) (Ivanova & Gutiérrez, 2014). The Euribor interest rate serves as a benchmark for various interbank transactions, such as loans, mortgages, and also futures contracts. For this study the 6-month Euribor rate will be used since it is more suitable for medium-term perspective and is more stable compared to short-term rates.

The last control variable is the interest rate charged by the banks for mortgages, which will be referred to as *Mortgage Rate.* This variable essentially represents the costs of borrowing for costumers. A higher rate implies increased interest expenses, which is usually favourable for commercial banks. However, higher interest rates may also incentivize individuals to save money, instead of acquiring an expensive mortgage.

Previous research has identified a positive relationship between mortgage interest rates and debt-to-equity ratios (Page, 1964). Thus, higher mortgage interest rates could lead to banks financing themselves with even more debt, potentially increasing their financial exposure.

3.4 Descriptive Statistics

Table 1 represents the summary statistics of the main dependent variables, the independent variables, and the macro-economic variables.

Table 1: Summary Statistics of the variables

	mean	sd	min	max
DE-ratio	14.53	11.17	1.02	71.67
Income after tax	273.63	789.87	-400.00	4988.00
ROA	0.30	3.55	-65.63	7.27
ROE	3.31	17.14	-268.60	42.86
NII	829.63	2384.62	-12.00	14344.00
CET1CapitalRatio	29.01	31.88	8.40	308.30
Total Capital Ratio	31.37	31.69	14.20	308.30
Market Concentration	3.28	7.95	0.00	36.30
Interest Rate (Euribor)	-0.21	0.22	-0.52	0.17
Mortgage Rate	3.24	0.53	2.46	4.11
Observations	420			

Note: The sample covers 30 banks in the Netherlands between 2015-2021. Variables income after tax and NII are given in millions of Euro's, while the remaining variables are expressed in percentages.

The table above shows that ROA and ROE differ for most banks. Banks with a small market concentration seem to express a largely positive or largely negative ROA and ROE. On the other hand, banks with a relatively high market concentration tend to have ROA ranging between 0.2% and 0.5%, and ROE ranging between 4.0% and 7.0%. This difference is explained by the variation in the DE-ratio. Larger banks have a more stable DE-ratio, ranging between 15.0% and 20.0%, while smaller capitalized banks exhibit either a low or extremely high DE-ratio. Moreover, banks with a higher market concentration seem to have a high NII compared to the less competitive banks. Analysing the CET1 capital ratio, it is observed that the more competitive banks tend to have values close to the minimum. This hints towards a more aggressive strategy, usually associated with owning riskier assets. Additionally, the table indicates that most banks have a sufficient capital ratio and comply with the regulatory requirements.

Table 2: Correlation Matrix of the variables

	DE-ratio	Income after tax	ROA	ROE	NII	CET1 Capital Ratio	Total Capital Ratio	Market Concentration	Interest Rate	Mortgage Rate
	b	b	b	b	b	b	b	b	b	b
DE-ratio	1.00									
Income after tax	0.08	1.00								
ROA	-0.03	0.03	1.00							
ROE	-0.02	0.11	0.65	1.00						
NII	0.08	0.95	0.01	0.06	1.00					
CET1CapitalRatio	0.23	-0.13	-0.10	-0.02	-0.14	1.00				
Total Capital Ratio	0.27	-0.10	-0.11	-0.03	-0.10	1.00	1.00			
Market Concentration	0.19	0.89	0.00	0.06	0.94	-0.13	-0.09	1.00		
Interest Rate	0.09	-0.01	-0.00	-0.05	-0.01	-0.07	-0.07	-0.02	1.00	
Mortgage Rate	0.09	0.00	0.01	-0.05	-0.01	-0.07	-0.07	-0.02	0.92	1.00

Note: The sample covers 30 banks in the Netherlands between 2015-2021.

Table 2 above represents the correlation matrix of all variables. The income after tax seems to be strongly correlated with the NII and Market Concentration. Therefore, Market Concentration has a significant effect on the NII of banks. Specifically, banks owning a higher share of the market tend to generate higher levels of income. Hence, the Market Concentration variable can provide better insights into the NII and is therefore chosen as a control variable.

Furthermore, the CET1CapitalRatio and Total Capital Ratio are negatively correlated with the profitability measures ROA, ROE, and NII. This suggests a negative relation between the capital ratios and the profitability of banks. However, the magnitude of these correlations is not strong, indicating a weak relationship.

CHAPTER 4 Method

In this section of the paper, the methodology used to analyse the data is discussed. To analyse the collected data from the DNB database, I will use multiple linear regressions trough Stata. In order to avoid heteroskedasticity and achieve more accurate results, robust standard errors will be utilized in these regressions. To analyse the panel data, panel regressions will be used. Panel regressions control for omitted variable bias by incorporating fixed effects or random effects. Hausman tests will indicate whether fixed effects or random effects will be used for each regression.

In this study, the fixed effects help to account for time-invariant heterogeneity for each bank. By including fixed effects, the model captures and discards all the unobserved heterogeneity within groups, making it easier to identify a causal relationship, compared to a standard regression (Brüderl & Ludwig, 2015). Additionally, random effects captures the unobserved individual-specific effects to ensure robustness. When combining the panel dataset with fixed effects, the following regression is obtained in standard format:

1. $Y_{i,t} = \beta 0 + \beta 1 * X1_{i,t-1} + \beta 2 * \mathbf{Control\ variables_{i,t-1}} + \alpha_i + \varepsilon_{i,t}$

The 30 different individuals are banks in this case and are specified by *i=1,2,etc*. The multiple half year periods are specified by *t=1,2,etc.* $Y_{i,t}$ represents the dependent variable at time *t* for each individual bank *i*. The dependent variable will account for the variables ROA, ROE, and NII. $X1_{i,t}$ represents the independent variable at time *t* for each individual bank *i*. The independent variable will account for DE-ratio, CET1Capital, and the Total Capital Ratio. The control variables include the Market Concentration, the Interest Rate, and the Mortgage Interest Rate. The main bank-specific control variable is Market Concentration, while Interest Rate and Mortgage Rate serve as macro-economic control variables. The independent variable and the control variables are lagged by one period to avoid reverse causality or endogeneity. By using lagged variables, the model captures the effect on the dependent variable more accurately. For instance, the DE-ratio affects the profitability of a bank in the next period, as the effect takes time to occur. α_i indicates the fixed effects for individual banks *i*. It represents the differences across banks that stay constant over time by absorbing time-invariant heterogeneity. This time-invariant heterogeneity refers to the individual characteristics that stay fixed during every period. $\varepsilon_{i,t}$ is used for the error term. The following regressions are used:

2. $ROA/ROE_{i,t} = \beta 0 + \beta 1 * DE\text{-}ratio_{i,t-1} + \beta 2 * \mathbf{Control\ variables_{i,t-1}} + \alpha_i + \varepsilon_{i,t}$
3. $ROA/ROE/NII_{i,t} = \beta 0 + \beta 1 * CET1CapitalRatio_{i,t-1} + \beta 2 * \mathbf{Control\ variables_{i,t-1}} + \alpha_i + \varepsilon_{i,t}$
4. $ROA/ROE/NII_{i,t} = \beta 0 + \beta 1 * TotalCapitalRatio_{i,t-1} + \beta 2 * \mathbf{Control\ variables_{i,t-1}} + \alpha_i + \varepsilon_{i,t}$

In order to assess whether a fixed effect or a random effect should be employed, a Hausman test will be performed prior to each regression. This test examines statistically whether the fixed effect model is a more suitable fit compared to the random effects model. If the P-value is significant, a fixed effect model will be implemented due to the effectiveness. Contrarily, if an insignificant P-value follows from the Hausman test, the random effect model is more appropriate.

To ensure statistical inference in the OLS regressions, the 5 Classical Linear Regression Model (CLRM) assumptions must be met. Firstly, the fifth assumption states that the error term is normally distributed. This assumption should be met since the number of observations is relatively high. The central limit theorem suggests that the observed values will follow the normal distribution pattern. Subsequently, assumption 1 states that the expected average error term should be zero. Maintaining an average error term of zero is not always feasible in practice. Therefore, the interpretation of the constant and error term should not be given much attention. Assumption 2 requires the model to have homoscedasticity, implying that the variance of the residuals should be constant for all observations. By clustering the standard errors for individual banks in the regressions, heteroskedasticity will be avoided. Additionally, a Breusch-Pagan test will be used to formally test for homoskedasticity. Furthermore, the third assumption states that there must be no correlation between the error terms for all observations. By using clustered standard errors for each bank, this assumption is met. Hence, robustness is ensured for these assumptions. Finally, the natural logarithm will be taken from some variables to perform additional regressions for robustness checks.

CHAPTER 5 Results & Discussion

In this section of the paper, the regression results will be discussed and interpreted. The reasoning behind the chosen models and regressions will also be evaluated. Additionally, the explanatory power and statistical significance of the results will be discussed. Thereafter, the hypotheses will be tested and answered.

Table 9 in Appendix A represents the results of the Hausman for the relationship between ROA and ROE with the DE-ratio. Since the P-value is 0.00, the null hypothesis is rejected, which proves that the individual effect is correlated with the independent variables. This test indicates that the fixed effects model is indeed preferred over the random effects model, since the test proves to be significant. Therefore, in this case, the fixed effects model is used in combination with panel regressions and clustered standard errors for the individual banks.

In each model, robust standard errors and VCE clustered standard errors yield lower standard error values compared to normal standard errors. Robust standard errors and VCE clustered standard errors lead to similar standard error values. However, as panel data is used, VCE clustered standard errors are preferred due to their ability to account for correlation within clusters. Hence, more accurate relations can be established.

Table 3 below shows the results of the fixed effects regression of ROA on the DE-ratio. In the first column the coefficient of the independent variable DE-ratio on the ROA is shown. This coefficient is -0.0302, which implies that if the DE-ratio increases by 1%, the ROA decreases by 0.0302. Thus, the DE-ratio negatively affects the ROA. In the second column, the main control variable Market Concentration is added. By adding this variable the negative effect of DE-ratio on ROA becomes even more negative effect. This indicates that banks with a higher Market Concentration have a lower ROA. Hence, an increase in their market share, results in a diminishing return on their assets. However, the effect remains statistically insignificant. Subsequently, the third column shows the regression with all control variables, including Interest Rate and Mortgage rate. This model has an overall R-squared of 0.0060, which indicates that only 0.6% of the variance in ROA is explained by the DE-ratio. Model 2 appears to be the most effective in explaining the relationship, as this model has the highest overall R-squared value. In model 3, the coefficient of the DE-ratio on ROA has a slightly more negative sign than model 2. This suggests that the Interest Rate and Mortgage Rate also negatively affect the ROA. The effect of the Interest Rate on the ROA is statistically significant at a 95% confidence level. If the DE-ratio increases by 1%, the ROA decreases by 0.0522, as shown in table 3. This effect is highly insignificant, which implies that there is insufficient evidence of the DE-ratio impacting the ROA.

Table 3: Fixed effects regression results of ROA on DE-ratio. Panel regressions with VCE clustered standard errors are used. Column 1 shows the regression of ROA on DE-ratio. Column 2 includes the main control variable Market Concentration. Column 3 includes all the control variables. Every regression is insignificant.

	(1) ROA	(2) ROA	(3) ROA
DE-ratio	-0.0302	-0.0549	-0.0552
	(0.0280)	(0.0851)	(0.0978)
Market Concentration		-0.0051	0.0820
		(0.1025)	(0.2080)
Interest Rate			-1.9063**
			(0.8057)
Mortgage Rate			1.2640
			(0.9203)
Constant	0.7471*	1.0724	-3.6618
	(0.4106)	(0.9327)	(2.5984)
Observations	379	289	289
R^2 (within)	0.0005	0.0008	0.0052
R^2 (between)	0.0443	0.0338	0.0188
R^2 (overall)	0.0086	0.0084	0.0060

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column 1 has 379 observations, while column 2 and 3 have 289 observations.

Table 4 below shows the results of the fixed effects regression of ROE on the DE-ratio. In the first column, the effect of solely the DE-ratio on the ROE is illustrated. The DE-ratio seems to negatively influence the ROE, as the sign is negative. If the DE-ratio increases by 1%, the ROE decreases by 0.51. However, this effect is insignificant. The overall R-squared is close to 0, indicating a low explanatory power of the model. In the second column the Market Concentration control variable is added to the regression. It is observed that Market Concentration negatively affects the ROE. Thus, bigger banks within the Dutch banking market have a lower ROE. Surprisingly, with the inclusion of this variable, the effect of the DE-ratio on ROE becomes positive. Additionally, the overall R-squared increased to 0.0049, although it remains low. In the third column, Interest Rate and Mortgage Rate are included in the regression. The Interest Rate appears to have a negative effect on the ROE, while this effect is statistically significant at a 99% confidence level, as the P-value is lower than 0.01. On the other hand, the Mortgage Rate has a positive but insignificant effect on the ROE. By including all the control variables in the regression, the coefficient of the DE-ratio on the ROE increases positively. Hence, when controlling for Interest Rate and Mortgage Rate, a higher DE-ratio results in higher levels of profitability for Dutch banks. If the DE-ratio increases by 1%, the ROE increases by 0.1141. Since this relation is still insignificant, there is no empirical evidence of a strong relation.

Table 4: Fixed effects regression results of ROE on DE-ratio. Panel regressions with VCE clustered standard errors are used. Column 1 shows the regression of ROE on DE-ratio. Column 2 includes the main control variable Market Concentration. Column 3 includes all the control variables. Every regression is insignificant. Column 1 shows a negative effect of DE-ratio on ROE, while column 2 and 3 indicate a positive relation.

	(1) ROE	(2) ROE	(3) ROE
DE-ratio	-0.5094	0.0743	0.1141
	(0.6279)	(0.3751)	(0.4177)
Market Concentration		-0.2809	-0.1284
		(0.6071)	(0.7582)
Interest Rate			-9.2970***
			(2.9959)
Mortgage Rate			4.2228
			(2.5417)
Constant	10.8606	3.7913	-12.9287
	(9.2024)	(4.4069)	(8.9717)
Observations	379	289	289
R^2 (within)	0.0064	0.0002	0.0068
R^2 (between)	0.0002	0.0214	0.0342
R^2 (overall)	0.0003	0.0049	0.0019

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column 1 has 379 observations, while column 2 and 3 have 289 observations.

The regressions from table 3 and 4 show that banks with a higher DE-ratio tend to have a lower ROA and a higher ROE. Hence, an increase in the amount of debt or a decrease in equity could lead to an increase in risk or operational inefficiency. These findings indicate that the capital structure does not impact the profitability of banks, which is why investors rarely put their attention on the DE-ratio when determining the firm value (Safitri et al., 2020). These results contradict the findings of Berger & Bouwman (2013), who observed a significantly positive effect of higher capital on the profitability of banks. Berger & Bouwman (2013) controlled for credit risk in their regression, which explains the positive outcome. They argue that higher capital reduces bank risk, which leads to cheaper sources of financing for banks. Therefore, banks achieve lower levels of costs, which increases their profitability.

The results following from the regressions in table 3 and 4 do not support Hypothesis 1, because of the insignificant effect of the DE-ratio on the ROA and ROE. Thus, Hypothesis 1 which states that a higher DE-ratio leads to a lower ROA or ROE, cannot be rejected based on these results. These findings align with the statement from Miller & Modigliani (1958), who argued that the capital structure of a firm does not affect its profitability or value.

Table 5 below shows the 6 panel regression of the ROA, ROE, and NII on the CET1CapitalRatio. Columns 1,3, and 5 exclude the control variables, while columns 2,4, and 6 include them. In the first and second columns, the effect of CET1CapitalRatio on ROA is shown. The third and fourth columns illustrate the effect of the CET1CapitalRatio on the ROE. Model 1, 2, 3, and 4 exhibit extremely low R-squared coefficients, indicating that the CET1CapitalRatio does not explain the variance of the ROA and ROE. The fifth and sixth column show the effect of the CET1CapitalRatio on the NII. Table 10 in Appendix A shows the results of the Hausman test. For the ROA fixed effects are used, while random effects are used for ROE, and NII since the P-value of this test is insignificant.

Table 5: Fixed and random effects regression results of ROA, ROE, and NII on CET1CapitalRatio. Panel regressions with VCE clustered standard errors are used. Column 1, 3, and 5 show the regressions of ROA, ROE, and NII on the CET1CapitalRatio. Column 2, 4, and 6 add the control variables to these regressions. Every regression is insignificant. Column 1, 2, 3, and 4 show a positive effect of CET1CapitalRatio on ROA and ROE, while column 5 and 6 indicate a negative relation between the NII and CET1CapitalRatio.

	(1) ROA (fe)	(2) ROA (fe)	(3) ROE (re)	(4) ROE (re)	(5) NII (re)	(6) NII (re)
CET1CapitalRatio	0.0031	0.0206	0.0274	0.0153	-1.0641	-1.3936
	(0.0049)	(0.0171)	(0.0396)	(0.0285)	(0.7101)	(1.1093)
Market Concentration		0.0570		0.0967		282.3668***
		(0.1448)		(0.0641)		(10.6277)
Interest Rate		-1.9347**		-8.2040***		-891.3016**
		(0.9381)		(2.8875)		(413.8828)
Mortgage Rate		1.3546		3.5124		143.7292**
		(0.9998)		(2.3359)		(58.6017)
Constant	0.2159	-5.2594	2.5075	-10.1958	861.1939**	-731.4145**
	(0.1377)	(4.0348)	(2.0970)	(8.7219)	(437.7768)	(297.0352)
Observations	379	289	379	289	379	289
R^2 (within)	0.0001	0.0067	0.0029	0.0090	0.0000	0.0261
R^2 (between)	0.0001	0.0013	0.0001	0.0022	0.0257	0.9808
R^2 (overall)	0.0000	0.0001	0.0007	0.0053	0.0201	0.8722

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column 1,3, and 5 have 379 observations, while column 2,4, and 6 have 289 observations.

CET1CapitalRatio seems to have a positive but modest effect on ROA and ROE, since the coefficients in model 1 and 3 are positive. However, as these effects are insignificant, there is no clear relationship between CET1CapitalRatio and the ROA or ROE. When controlling for Market Concentration, Interest Rate, and Mortgage Rate, the magnitude of the coefficient increases positively in model 2. However, the

effect on ROE seems to decrease. Nonetheless, both coefficients remain highly insignificant. The Interest Rate in both model 2 and 4 has a negative and significant effect on both the ROA and ROE. This indicates that a higher interest rate results in lower returns for banks, contrary to the effect in practice. Usually, a higher interest rate allows banks more flexibility in offering wider interest spreads to customers. This negative effect may be explained due to the fact that there has been a negative interest rate from 2015 until 2021. Lastly, the Market Concentration and Mortgage rate have a positive but insignificant effect in these models.

Model 5 indicates a negative relation between the CET1CapitalRatio and the NII. By adding the control variables, this effect becomes even more negative, as shown in model 6. The coefficient of -1.39 states that if the CET1CapitalRatio increases by 1%, the NII decreases by €1.39 million. Unfortunately however, with a P-value of 0.21, this effect seems to be insignificant. The negative effect can be explained due to the increase in cost of capital. If a bank decides to acquire more common equity tier 1 capital, the maintaining costs of this capital could reduce the profitability by resulting in a lower NII. This result contrasts with the finding of Bitar et al. (2018), which illustrates empirical evidence of a positive effect of CET1Capital on NII. Hypothesis 2, which states that for banks in the Netherlands the CET1 capital positively affects the ROA, ROE, and NII, cannot be rejected. Although the coefficient of the CET1CapitalRatio in model 6 indicates a negative relation with the NII, it is still insignificant. On the other hand, the high explanatory power offers evidence to oppose Hypothesis 2.

In contrast to all other models in table 5, model 6 has a higher overall R-squared value of around 0.87. This indicates that 87% of the variance in the NII is explained by the CET1CapitalRatio and the control variables. Especially the within R-squared is relatively high in this model, having a value of approximately 0.98. This suggests that the CET1CapitalRatio and the control variables explain 98% of the variation in NII within every individual bank, after controlling for the random effects of individual banks. Hence, the independent variables seems to capture almost the complete systematic variation in NII. As the control variables offer additional statistical significance to model, it is important to explain the effect of these control variables.

Firstly, Market Concentration has a positive and significant effect on NII at a 99% confidence level, indicated by the positive coefficient and a P-value lower than 0.01. This indicates that banks with a relatively larger share in the Dutch banking sector have a higher NII. Thus, this empirical evidence supports the research of Mody & Peria (2004), which explain that banks with a higher market concentration are able to charge a lower spread to their costumers, resulting in a higher profitability. Surprisingly, the effect of Interest Rate on the NII is negative. This coefficient is significant at a 95% confidence level, due to a P-value below 0.05. Demirguc-Kunt & Huizinga (1999) argue that higher interest rates are typically favourable for banks, as they can charge higher interest rates on loans. The

result from this study contradicts this claim. Higher interest rates may possibly deter costumers from taking loans, thereby reduce the profitability of banks. Lastly, the Mortgage Rate has a positive and significant effect on NII in this regression. This indicates that when banks charge higher mortgage rates, they increase their profitability.

Table 6 below represents the regressions of ROA, ROE, and NII on the Total Capital Ratio. The first and second columns examine the effect of Total Capital Ratio on ROA. Fixed effects are used for this regression, based on the results from the Hausman test shown in table 11 in Appendix A. This test also indicates that random effects should be incorporated in the models where ROE and NII are used as the main dependent variables, as the P-value is insignificant for the Hausman test. Columns 3 and 4 in table 6 demonstrate the effect of the Total Capital Ratio on ROE, while columns 5 and 6 illustrate the effect of the Total Capital Ratio on NII. These models are very similar to the results in table 5, where the same dependent variables are regressed on the CET1CapitalRatio. The overall R-squared of model 1, 2, 3, and 4 is again close to zero, indicating little explanatory power of the Total Capital Ratio on the variance of ROA and ROE. The coefficients are again positive, but statistically highly insignificant due to a P-value greater than 0.22. Model 2 shows that if the Total Capital Ratio increases by 1%, the ROA increases by 0.0214, while model 4 suggests a 0.0162 increase in the ROE. By including the control variables the coefficient of the Total Capital Ratio on the ROA increases, while the coefficient of the Total Capital Ratio on the ROE decreases. The interest rate again has a negative effect on both ROA and ROE, while the effect is significant. There is no empirical evidence of the effect of the Total Capital Ratio on ROA and ROE, as the Total Capital Ratio coefficient is insignificant. Models 5 and 6 illustrate a negative effect of the Total Capital Ratio on the NII. The overall R-squared is relatively high in model 6, with the Total Capital Ratio explaining 87% of the variation in NII. The negative coefficient implies that a 1% increase in the Total Capital Ratio would lead to a decrease in the NII by €1.83 million. However, this coefficient is statistically insignificant. Table 12 in Appendix A shows the results of the Breusch-Pagan test of NII on Total Capital Ratio for random effects. The P-value of 0.11 indicates that the null hypothesis of homoskedasticity cannot be rejected. Thus, constant variance in the error terms is ensured in the regression of model 3, thereby satisfying CLRM assumption 2 of homoskedasticity.

Table 6: Fixed and random effects regression results of ROA, ROE, and NII on Total Capital Ratio. Panel regressions with VCE clustered standard errors are used. Column 1, 3, and 5 show the regressions of ROA, ROE, and NII on the Total Capital Ratio. Column 2, 4, and 6 add the control variables to these regressions. Every regression is insignificant. Column 1, 2, 3, and 4 show a positive effect of Total Capital Ratio on ROA and ROE, while column 5 and 6 indicate a negative relation between the NII and Total Capital Ratio.

	(1) ROA (fe)	(2) ROA (fe)	(3) ROE (re)	(4) ROE (re)	(5) NII (re)	(6) NII (re)
Total Capital Ratio	0.0030	0.0214	0.0255	0.0162	-0.8956	-1.8254
	(0.0047)	(0.0173)	(0.0372)	(0.0292)	(0.6163)	(1.5085)
Market Concentration		0.0526		0.0941		282.4849***
		(0.1497)		(0.0633)		(10.5001)
Interest Rate		-1.9457**		-8.2115***		-894.1745**
		(0.9478)		(2.8881)		(414.2816)
Mortgage Rate		1.3615		3.5202		144.0536**
		(1.0020)		(2.3384)		(58.7786)
Constant	0.2126	-5.3433	2.5031	-10.2812	858.3524**	-716.3284**
	(0.1446)	(4.0607)	(2.1365)	(8.7788)	(436.0446)	(295.6834)
Observations	379	289	379	289	379	289
R^2 (within)	0.0001	0.0069	0.0026	0.0094	0.0000	0.0261
R^2 (between)	0.0002	0.0012	0.0000	0.0020	0.0134	0.9810
R^2 (overall)	0.0000	0.0001	0.0005	0.0052	0.0102	0.8725

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Column 1,3, and 5 have 379 observations, while column 2,4, and 6 have 289 observations.

The profitability measures ROA and ROE do not yield significant effects in these models. Since the CET1TotalCapital Ratio and the Total Capital Ratio models seem to have high explanatory power for the NII in combination with the control variables, this study will continue to focus on this relation, while aiming to identify a significant effect. In order to find significance, the natural logarithms of the NII, CET1CapitalRatio, and Total Capital Ratio will be used. For the NII there are a few negative values, which are considered as outliers. In practice the NII for commercial banks is rarely negative (Ho & Saunders, 1981). Hence, the negative values are discarded in the following model by using the natural logarithm function, which only takes positive values into account. Table 7 below displays the regression coefficients of the natural logarithm NII on the natural logarithm CET1CapitalRatio, including control variables. The overall R-squared is lower compared to model 6 in table 5. The coefficient for CET1CapitalRatio has a negative value of -0.53. Hence, if the CET1CapitalRatio increases by 1%, the NII decreases by 0.53%. This coefficient is significant at a 95% confidence level with a P-value lower

than 0.05. Consequently, this finding supports the claim that Hypothesis 2, which states that the CET1Capital positively affects the NII, cannot be rejected.

Table 7: Random effects ln regression results of NII on CET1CapitalRatio. The CET1CapitalRatio has a negative effect on NII. All of the coefficients are significant.

	Ln(NII), re
Ln(CET1CapitalRatio)	-0.5316**
	(0.2203)
Market Concentration	0.1766***
	(0.0288)
Interest Rate	-1.0359***
	(0.1788)
Mortgage Rate	0.0948
	(0.1167)
Constant	4.9407***
	(0.9700)
Observations	260
R^2 (within)	0.1061
R^2 (between)	0.6230
R^2 (overall)	0.6136

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8 below represents the results of the ln regression of NII on Total Capital Ratio. Similar to table 7, the overall R-squared is lower in this model. While model 6 in table 6 has a higher overall R-squared, in this model the Total Capital Ratio explains 60% of the variance in NII. The coefficient for Total Capital Ratio is -0.55, which indicates that a 1% increase in Total Capital Ratio decreases the NII by 0.55%. Additionally, this coefficient is significant with a P-value lower than 0.05. Therefore, there is empirical evidence of a negative relationship between the Total Capital Ratio and the NII.

Hypothesis 3, which states that the Total Capital Ratio of banks in the Netherlands positively affects the ROA, ROE, and NII, cannot be rejected based on the results from table 6 and table 8. These results contradict the findings of Bitar et al. (2018), who found a positive relation between the Total Capital Ratio and the NII. Bitar et al. (2018) used the net loans margin as the main dependent variable, while also using control variables for liquidity and various risks. This difference in methodology may explain the difference in the final results.

On the other hand, my findings support the results of Osborne et al. (2012), who also found a negative relationship between the capital ratio and banking profitability. Acquiring additional capital increases the

costs of capital, thus reducing the profitability of banks. Therefore, banks may choose to maintain a higher capital ratio to create a greater buffer against risks by trading in a part of their profitability. However, as indicated by these results, this strategy does not seem to be effective. Holding an excess of capital diminishes the profit of Dutch banks. Therefore, banks should aim to maintain sufficient capital to meet the Basel minimum capital requirements and create a slight buffer to protect themselves against various risks, primarily credit risk. Any additional capital incurs extra costs which negatively affect the profitability.

Table 8: Random effects ln regression results of NII on Total Capital Ratio. The Total Capital Ratio has a negative effect on the NII. All coefficients are significant, except Mortgage Rate.

	Ln(NII), re
Ln(Total Capital Ratio)	-0.5533**
	(0.2320)
Market Concentration	0.1815***
	(0.0300)
Interest Rate	-1.0069***
	(0.1797)
Mortgage Rate	0.0808
	(0.1107)
Constant	5.0998***
	(0.9916)
Observations	260
R^2 (within)	0.1113
R^2 (between)	0.6125
R^2 (overall)	0.6038

Note: Standard errors are clustered for each bank and are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

CHAPTER 6 Conclusion, limitations and suggestions

6.1 Conclusion

In this thesis, I investigated the effect of capital ratio on the profitability for banks in the Netherlands. Previous research conducted in various countries have found mixed results. Some studies discovered a positive effect of capital ratio on the profitability, while others established empirical evidence of a negative relation. In particular, there had been little research conducted for the Dutch banking sector regarding this relationship. The unique structure of the Dutch banking sector is interesting to study due to its divided market concentration. The larger banks seem to own a large proportion of the total market shares. Therefore, I decided to study the following question: "How does the level of capital affect the profitability of banks with regards to the Basel framework?"

To answer this research question, I collected data from the De Nederlandsche Bank (DNB) database, which included financial results from every bank in the Netherlands. This dataset contained key figures such as total capital ratios, income after tax, and multiple profitability measures. By transforming this data into a panel dataset, I conducted panel regressions with fixed and random effects, while using clustered standard errors for individual banks. The first regression showed that the capital structure does not have a significant impact the profitability of banks in the Netherlands. Subsequently, the second regression revealed that the CET1CapitalRatio, also referred to as the "core capital", negatively affects the profitability of banks in the Netherlands. Lastly, the final regression indicated that the Total Capital Ratio negatively affects the profitability of Dutch banks. Regarding the effects of the DE-ratio, CET1CapitalRatio, and Total Capital Ratio on profitability measures ROA and ROE, no significant effects were found. However, by using natural logarithmic functions, the CET1CapitalRatio and Total Capital Ratio showed a significant negative effect on the NII. To ensure robustness of the effect of the Total Capital Ratio on NII, a Breusch-Pagan test was conducted, which proved there was constant variance in the error terms.

These results collectively specify that banks should not hold extensive capital, in order to achieve higher levels of profitability. The Basel minimum capital requirements should be met and a small buffer should be advised on top of this in order to avoid credit risk. An excess of capital increases the cost of capital and does not provide additional an income. Therefore, a too high capital ratio does not contribute to the efficiency and profitability of banks in the Dutch sector. Additionally, investors should not pay attention to the DE-ratio of banks when evaluating their performance, since the capital structure does not affect the profitability and value of Dutch banks.

6.2 Limitations and future research

Unfortunately, complete data for the years 2022 and 2023 was not available in the DNB Database. There was some data listed for the first half year of 2022, but a lot of necessary figures, such as the capital ratio were missing. Given the increased interest rates and the high inflation recently, it would be interesting to examine whether these fluctuations would yield the same results as found in this study. Additionally, there was no available data regarding the liquidity and loss absorbing measures through the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR), which are implemented under Basel 3. These metrics could provide useful information that may have affected the final results. Potentially, future researchers could collect this data and compare the results by differentiating between Basel 3 and Basel 4 restrictions to examine the effectiveness of these regulatory requirements. It would be interesting to explore whether Dutch banks have experienced changes in profitability from this transition.

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APPENDIX A Robustness Checks

Table 9: Hausman test ROA and ROE on DE-ratio. The P-values are significant for both the ROA and ROE at a 95% confidence level. Therefore, fixed effects will be used in the regressions in table 3 and 4.

	ROA	ROE
Chi-square	19.87	16.71
P-value	0.00	0.00

Note: the number of observations is 289 and coefficients are reported in 2 decimals.

Table 10: Hausman test ROA, ROE, and NII on CET1CapitalRatio. The P-value of ROA proves to significant at a 95% confidence level. Therefore, fixed effects will be used for the regression of ROA on CET1CapitalRatio. The P-values of the ROE and NII are insignificant. Therefore, random effects will be used for the regressions of the ROE and NII on the CET1CapitalRatio.

	ROA	ROE	NII
Chi-square	13.17	0.62	0.68
P-value	0.00	0.43	0.41

Note: the number of observations is 289 and coefficients are reported in 2 decimals.

Table 11: Hausman test ROA, ROE, and NII on Total Capital Ratio. The P-value of ROA proves to significant at a 95% confidence level. Therefore, fixed effects will be used for the regression of ROA on CET1CapitalRatio. The P-values of the ROE and NII are insignificant. Therefore, random effects will be used for the regressions of the ROE and NII on the CET1CapitalRatio.

	ROA	ROE	NII
Chi-square	13.15	0.82	0.37
P-value	0.00	0.37	0.54

Note: the number of observations is 289 and coefficients are reported in 2 decimals.

Table 12: Breusch-Pagan test NII on Total Capital Ratio for random effects. The P-value proves to be insignificant at a 95% confidence level. The null hypothesis of homoskedasticity cannot be rejected. Hence, there is constant variance in the error terms for the regression of NII on Total Capital Ratio.

	Coefficient
Chi-square	1.54
P-value	0.11

Note: coefficients are reported in 2 decimals.