ERASMUS UNIVERSITY OF ROTTERDAM

Erasmus School of Economics

Master Thesis Financial Economics

Banks‘ profitability under negative policy rates in European Union

Erasmus School of Economics

MSc Financial economics: Banking and monetary economics

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Application date: 16-03-2021

Submission date: 15-07-2021

Word Count: ca. 14,241

Preface

The basis for this research originally stemmed from my passion for banking and monetary policy. As the world moves further into the digital age, vast amount of data is produced by banks, companies and other financial institutions which opens up new possibilities for exploration of relations and sensitivities between various variables. Results provided by modern researches help us to better understand these connections and suggest solutions to global economic problems.

In truth, I could not have achieved current level of success without a strong support group. First of all, I would like to thank my family who supported me with love and understanding during my studies abroad as well as in my home country – Slovakia. Secondly, I would like to thank all professors, friends and my supervisor who provided patient advice and guidance throughout the research process.

Declaration

I hereby expressly declare that I have prepared this work on my own using no sources, aids, or resources other than those cited in it.

Košice, 13. July 2021 .....

Signature

Abstract

In June 2014, the European Central Bank introduced an unconventional monetary policy – negative interest rate policy. This decision started a lot of discussions about its potential implications and effects on the banking sector. The provided research investigates the consequences of implementing negative interest rate policy on banking profitability, specifically on net interest margins of banks in European Union according to their deposit ratio. With the use of difference-in-difference method, this thesis provides evidence that banks with more deposits yield lower profitability when rates become negative and therefore suffer more from negative interest rate policy than banks with less deposits. Furthermore, the introduction of negative interest rate policy enforced high-deposit banks to lend less and take more risk in order to accumulate for higher returns. The findings of this thesis conclude that negative rates could pose a notable risk to the financial stability of the banking sector and thus preventive measures should be implemented.

Key words: negative interest rate policy, banking profitability, commercial banks, European Union, ECB, deposit ratio, profitability determinants, difference-in-difference

Table of content

1. Introduction

In this chapter, the reader will be firstly introduced to recent events that happened in the European Union over the chosen period of time and to the topic of negative interest rates as a monetary policy tool and its possible effects on banks' profitability. Secondly, the potential gap in the literature is identified regarding profitability and factors by which it is affected. Lastly, the purpose of the research with adequate research questions are presented.

1.1. Background

In the last decades, the situation for the European banks has tremendously changed. Post-crisis world with low growth and low inflation enforced several central banks to reduce their policy rates to and even below the zero level. In June 2014, European Central Bank (ECB) reduced its deposit facility rate (DF) from 0% to – 0.10% by which it entered the unknown territory of negative interest rates (see Figure 1). Some of the other central banks around the world, namely of Denmark, Switzerland, Sweden, and Japan followed this decision and set their policy rates under zero as well (Heider, Saidi and Schepens 2021).

Figure 1: *Euro area deposit rate over time (European Central Bank, 2021).*

The policy interest rate is a tool of a central banks' monetary policy. Although it is often referred to as the price of money which represents the reward paid by a borrower to a lender for the usage of borrowed money during fixed period of time, this definition might be too simplified. A better explanation would be that interest rates are rates *"payable on debt and deposit obligations (aka instruments and securities) by the borrowers to the lenders"* while *"the prices of the debt and deposit obligations are derived from the cash flows payable on the obligations in the future"* which can be achieved *"by discounting the cash flows by the rates payable"* (Faure, 2014, p. 1).

Additionally, from the European Central Bank's point of view, interest rate can be defined as a short-term interest rate (usually referred to as overnight or policy rate) that the central banks use to influence the evolution of the monetary policy in the economy (Kahn, 2007). It is the interest rate at which banks can borrow directly from the central bank.

Even though this kind of variation in interest rates observed in recent years can be seen as a central bank policy result, newest research proves the opposite. Central banks are merely following the trends which are outside of their control, such as productivity growth and demography (Jordà and Taylor, 2019).

According to the previous definition, banks' interest rate income is mainly dependent on money they earn on given loans in a way that banks use depositors' money to provide more loans on which they collect interest. In case interest rates hit the zero-lower bound, the interest banks earn is no further greater than the amount of interest which has to be paid to clients with savings accounts. Therefore, raising deposits and granting new loans beyond a certain point may not be profitable for banks (Sharma and Gounder, 2012). This relation between interest rates and banks with different deposit ratios has significant explanatory power and can therefore predict the sensitivity of bank profitability to interest rates (Landier, Sraer and Thesmar, 2013).

Moreover, if interest rates are negative (i.e. set under the zero level) it means that a bank or any other institution that borrows money pays back less than what was previously borrowed (Buiter, 2009). Therefore, it would be rational rather to accumulate money than lend it at negative interest rates as it is assumed that money pays a zero-nominal return. This view was firstly introduced by Hicks in 1937:

"If the costs of holding money can be neglected, it will always be profitable to hold money rather than lend it out, if the rate of interest is not greater than zero. Consequently, the rate of interest must always be positive."

However, this view was argued to be false later on because of its assumptions. First of all, it is possible that the interest rates will become negative as a consequence of the above-mentioned costs. On the other hand, these costs make negative rates an imperfect policy tool which causes households to hold money even when the marginal costs exceed the benefits. The reason is simple – holding money pays a higher return.

Secondly, it might not be true that all money pays a zero-nominal return. For instance, banks can charge the same loss amount of negative interest through fees or central banks can set positive interest rate on banks' reserves (Rognlie, 2016). Many studies have been done by the economists to uncover the impacts of this negative interest rates policy (NIRP) to the banking sector, yet until recent years negative interest rates were considered to be something unthinkable.

The central bank's policy changes in terms of interest rate affect the overall level of economic activity, flow of goods and services as well as financial assets within the economy (Saunders and Lange, 1997). These changes have impact on all companies and institutions in one way or another but one group in particular is affected even more – commercial banks. The reason is that most of their profit is based on interest received from provided loans and therefore bank's profitability is more sensitive to fluctuations in interest rates than any other firm (Gul et al., 2011; Naceur, 2003). More precisely, the interest rate on loans is higher than the interest rate on deposits – the difference represents a bank's profit (Hancock, 1985). Another large fraction of commercial banks' revenue comes from noninterest income which includes items such as overdraft fees and ATM charges (DeYoung and Rice, 2004).

Besides the profitability, the negative interest rate policy also contributes to higher market stress. The study written by Kurowski and Rogowicz (2017), following the methodology of indicators of systemic stress in the financial system used by Hollo et al. (2012), concludes that apart from the already known events, such as global financial crisis or debt crisis in the last decade, NIRP gradually increases the systemic risk.

Due to the fact that banks are reluctant to pass negative rates to their depositors and that market becomes more stressed, such monetary policy raises questions about the impact on commercial banks' profitability as well as its contribution to the systemic risk. Thus, it questions the reliability and stability of the whole banking sector.

1.2. Problem definition

Over the last decades, there have been many studies and publications investigating the determinants of banking profitability. However, only some of them focused on the relation between monetary policy and bank profitability (Kumar et al., 2020). Moreover, very few of them focused especially on the different deposit ratio of banks which can be possibly one of the main determinants of commercial banks' profitability.

Under these circumstances set by the ECB banking sector had to adjust their policies to the situation as well. Banks' unwillingness to pass negative rates to their depositors prevents them from a scenario of a large number of withdrawals and thus the reduction of their net worth. On the other hand, the consequence of this policy was that banks took more risk because low interest rates reduce the profit margins of banks (Bikker and

Vervliet, 2018). Furthermore, the main assumption of this research is that there was different impact on banks profitability in terms of high-deposit banks and low-deposit banks.

The research was mainly inspired by the paper written by Heider et al. in 2019, where the authors compare the lending behaviour of two groups consisting of banks with different deposit ratios (high-deposit and low-deposit banks) before and after the ECB set negative policy rates. They conclude that negative interest rates are less accommodative and could pose risk to financial stability in case lending is done by banks with high deposit ratios. The reason behind it is that high-deposit banks reduce their loan shares for safe borrowers while increasing their loan shares for risky borrowers. The rationale lies in the probability of loan default as it is higher for risky borrowers than for safe borrowers, thus resulting in higher profit.

This thesis will extend the work of Heider et al. (2019) by using a similar methodology but instead research the banks' profitability with the use of its determinants (Petria et al., 2015) with respect to different deposit ratios of European banks under NIRP.

To confirm that deposit ratio is a suitable indicator of bank's profitability a stepping stone is provided in the paper written by Haddaweea and Flayyihb (2020), where authors measure the relationship between different types of bank deposits and profitability of the Commercial Bank of Jordan. The study revealed that there is a significant relationship with a positive correlation between different types of deposits and profitability indicators. This is in line with another paper with higher relevance written by Gul et al. (2011) where authors examine the relationship between bank-specific and macro-economic characteristics over commercial banks' profitability in Pakistan. Similarly, they conclude that the deposit ratio is significant at 0.05 level in their regression. Therefore, it can be used as a factor which determines profitability.

Although, regarding the study of Haddaweea and Flayyihb (2020), the research showed that there is a relationship between bank deposits and profitability, their sample consisted of only one bank which was not situated in the European Union (Jordan) as well as in the study of Gul et al. (2011) where authors used sample consisting of banks from Pakistan. Besides the previous papers, there is a lack of knowledge about the deposit ratio as an indicator of banks' profitability. Therefore, it opens up a gap in the literature in this area that requires further investigation.

1.3. Purpose and research questions

To address the above-mentioned gap, the research aims firstly to investigate the significance of the relationship between bank's deposit ratio and profitability. Then, it aims to differentiate the group of banks into two separates: high-deposit and low-deposit banks, which should show the difference in profitability over the chosen period of time.

The rationale behind this decision of splitting sample according to deposits is that in case the European Central Bank decreases the policy rate below the zero level, banks become overwhelmed by the deposits from their clients saving their money in banks in order not to lose them due to unfavourable economic situation and uncertain investment opportunities. Although the interest rate that banks pay to the retail on savings accounts at present appears to be set at zero, the majority of other interest rates paid or received by banks are, according to the NIRP, adjusted to the rate cuts (Eisenshmidt and Smets, 2019). Therefore, banks relying more on deposit funding might suffer more in setting of NIRP than the banks which are not that dependent on clients' deposits.

Since the impact of shifts in interest rates on net interest rate margin and profitability can vary by bank, the main research question of this thesis is:

- *Is there a significant difference in profitability of high-deposit banks and low-deposit banks after the introduction of negative interest rates?*

The introduction of negative interest rate policy in European Union was for many banks a challenge to overcome. Although banks do not choose often to lower deposit rates as interest rates decline, they still have to pass the lower rates on some of existing and new loans. Therefore, when interest rates decline bank margins tend to compress, as banks do not earn as much interest on loans than before due to the transmission of NIRP. Consequently, that can affect banks' ability to lend. In other words, it can potentially cause adverse economic consequences and financial stability risks. On the other hand, low interest rates can also have a positive impact on profitability (reduction of loan loss reserves) but it is unlikely that this effect would be strong enough to compensate for decline in net interest margins which significantly contribute to banks' profitability (Bundesbank, January 2018, p. 27). Based on that, the sub-question of this research would be:

- *What were the consequences of implementation of negative interest rate policy on banks' lending behaviour in the European Union and how did banks deal with this kind of monetary policy in terms of risk taking?*

2. Literature review

The purpose of this chapter is to explain a theoretical framework behind the research and to give the reader basic background knowledge to understand the concept of the provided research. The chapter begins with the overview of the banking sector and different types of banks. Secondly, the zero-lower bound and the interest reversal rate are discussed. Thirdly, the general structure as well as different measures of banks' profitability are presented. Lastly, potential factors determining banks' profitability are compared and categorized.

2.1. Banking sector and commercial banks

The role of the banking sector and the services offered by banks are not only a part of the market economy but serve mainly as its integrating factor – its flawless and smooth functioning greatly affects the development and quality of the entire banking system.

"The banking system is a system of relations, institutions and rules between banking and non-banking entities in the economy (banks, institutions, depositors, debtors, regulatory authorities and other participants in the banking system)" (Belás, 2010, p. 22).

First of all, it is necessary to distinguish two approaches, namely the first approach based on the economic nature of a bank and the second one which is based on its legislative definition. This is mainly due to the fact that there are institutions that have the characteristics and properties of a bank but from a legal point of view they are not banks. The definition of a bank is therefore based on its economic functions. These include mainly intermediation of cash as well as non-cash payments, investments, issuance of non-cash money and others (Medveď, Tkáč et al., 2013). Banks, like any other business entity on the market, have in addition to raising funds, providing loans and other functions also their primary goal – to make profit. Among the most important revenues from which this profit comes is the interest rate difference between active and passive transactions which a bank performs during its daily operation.

There are many different types of banks, one of them being commercial banks. They are often defined as types of institutions providing commercial loans and issue transactions deposits. Besides that, they have many different types of assets and liabilities and therefore may engage in off-balance sheet activities, which include also financial guarantees, such as loan commitments and derivates (Berger and Bouwman, 2015). Individual activities of commercial banks are characterized by certain specifics – trading in foreign capital, relatively small equity and being a subject of a banking supervision.

Commercial banks are placed with a significant trust when saving money from their depositors. Therefore, such institutions have to be regulated. This function is performed by a central bank which besides its important role in the economic system has to secure the stability and credibility of the banking sector. According to the Levine and Barth (2001) study, countries that applied policies supporting private monitoring of banks report better bank performance as well as more stability. Similarly, diversification of income streams is positively linked with bank performance and stability. On the other hand, countries with banks under the government ownership and countries with more generous deposit insurance schemes have poorer bank performance and are more fragile. Regulation of the banking sector can be further divided into four main areas, namely determination of business rules, licensing activity, execution of banking supervision and keeping a register of bank loans and guarantees (Tkáčová et al., 2017).

Due to the ongoing globalization and liberalisation in business, there are big changes in the financial markets. As financial intermediaries develop, so must the supervision of these financial institutions. Recent bankruptcies in several countries have prompted banking supervision to take steps to develop internationally agreed standards.

As a part of the regulation of the banking sector and the supervision of financial entities, many central banks have set rules of prudential regulation to ensure the reliability of commercial banks and minimise the risks that banks incur in their activities to an acceptable level. Their goal is to protect bank's creditors (depositors) from losing their savings and to ensure the smooth functioning of the banking system. The most important prudential regulation rules include e.g., compliance with capital adequacy and liquidity rules, creation of provisions to cover incurred losses from potential risks, limitation of the provision of risky loans and estimation of market risks and risks of clients (Medveď, Tkáč et al., 2013).

In order to set adequate policy and rules to secure smooth functioning of banking sector, central banks have to have information at their disposal about structure, services, profits, and losses provided by banks which are under their control, or put simply, knowledge about banks' performance. It can be measured in various ways, such as banks' efficiency, reliability, cost structure, size of a bank, loan portfolio composition, and others. In this research, many of these banks' characteristics were used to compute the most significant and reliable source of the banks' performance – profitability.

2.2. Zero-lower bound and reversal interest rate

Before the ECB introduced its policy of negative interest rates in 2014, the notion of interest rates which are below the zero level had only theoretical domain. According to the obvious long-term decline in interest rates and banks' reluctance to imply negative yield of deposit rates on their clients, it was assumed that interest rates would not reach negative territory. Nevertheless, considering transaction costs associated with storing and keeping large amounts of cash leads economists to construct the concept known as a physical lower boundary of interest rates (Cœuré, 2016). This concept can be divided into three different stages (see Figure 2) which explain what are the consequences of constantly lowering the interest rates by central banks and how low they are able to go.

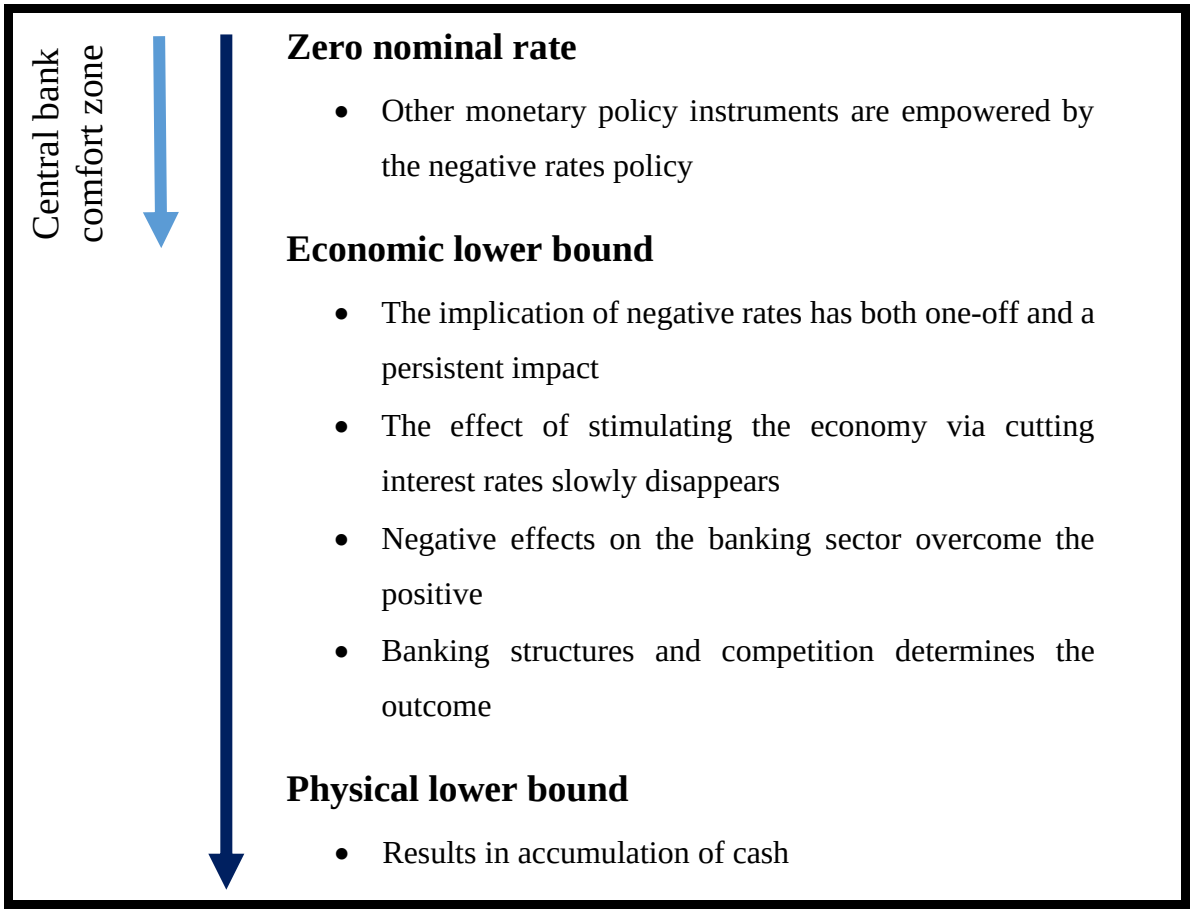

Figure 2: *How much lower can we go? (Cœuré, 2016).*

Firstly, central banks' policy of lowering interest rates will cause other policy instruments such as bank reserve requirement, market operation, credit policy to benefit from these cuts. This level is represented by the stage of zero nominal rate.

Then, after banks continue to cut their deposit rates further, they reach the economic lower bound. This stage is also often referred to as a *"Reversal interest rate"* stage by which the monetary policy implied by central banks' has the opposite (reversed) effect

and becomes contractionary for lending. It occurs in the situation when banks have to revalue their assets because of duration mismatch and find out that the difference is more than offset by all already accounted for negative effects. At this point, the strategy of diminishing policy rates, which was used to stimulate the economy in the first place and its benefits does not compensate the costs anymore and additionally influences the volumes of credit supply in a negative way (Brunnermeier and Koby, 2018).

Lastly, reaching a physical lower bound is the worst-case scenario which has not been closely studied yet. Although, it is assumed that besides excessive risk-taking and reckless lending entering this stage would result into unpredictable losses not only for the banks but for the entire economy.

2.3. General structure of banking profitability

In order to estimate the determinants of the profitability of banks, most studies follow the same specific structure. In essence, large amount of data from various banks around the world are gathered over the chosen period of time. The data are then put into a simple linear regression model (Athanasoglou et al., 2006; Budhathoki et al., 2020) which can be described as follows:

$$\boldsymbol{y_{it} = \beta_0 + \beta_1 * factor1_{it} + \cdots + \beta_n * factorN_{it} + \varepsilon_{it}}$$

where:

$\boldsymbol{y_{it}}$ stand for a dependent variable which represents the profitability metric (ROA, ROE or NIM, depending on different authors and conducted research) of a bank *i* at time *t*

$\boldsymbol{\beta_i}$ stands for matrix of variable coefficients which explain the sensitivity of banks' profitability to one unit increase in the factor *N*

$\boldsymbol{factorN_{it}}$ stands for all factors that influence the chosen profitability metric accordingly to the authors' decision for a bank *i* at time *t*

$\boldsymbol{\varepsilon_{it}}$ stands for the error term

For the purpose of this research, the above-mentioned general simple linear regression was divided into two parts. Firstly, the left side which only consists of profitability metric will be explained in the following section. Then, in the section of profitability determinants, the different factors that can have whether positive or negative influence on banks' profitability will be discussed. At the end, a summary table (see Table 1) will be created to provide a better overview of used literature. Moreover, each of the mentioned studies will be correctly assigned to a specific factor with its influence on profitability.

2.4. Measures of commercial banks profitability

In the past, most commonly used methods to assume banks profitability were the amount of net income and EBITDA. Nevertheless, recent studies proved that there are two main problems associated with these profitability measures. Firstly, they do not take into account important indicators, such as bank size, asset base or deposit amounts (Buscemi, 2015). Secondly, they are influenced by the level of inflation which means that the same amounts of net income in different time periods will have, according to these methods, different real value. For those reasons, these measures can provide a distorted picture of reality and thus reduce the comparability and spoil the obtained results.

Regarding unsuitability of the above-mentioned measures for the banking sector, economists decided to use methods which will not have this kind of problems. Accordingly, many authors conclude that there are three basic measures of commercial banks' profitability, namely Return on Assets (ROA), Return on Equity (ROE) and Net interest margin (NIM). These measures are both size-dependent and inflation invariant and therefore can provide a realistic picture of the situation in which banks find themselves.

ROA – comprehensively assesses the effectiveness of management and allocation of liabilities, respectively management of assets. It is usually the most suitable indicator of a bank's profitability. It can be calculated using the following equation:

$$\boldsymbol{ROA = \frac{Net\ income}{Total\ assets}}$$

ROE – determines the rate of return on capital invested by shareholders. Banking sector works with a much lower share of equity than the non-financial sector. Some analysts exclude dividends of preferred shareholders from calculation. It can be calculated using the following equation:

$$\boldsymbol{ROE = \frac{Net\ income}{Shareholders'\ Equity}}$$

NIM – compares the net interest income generated by a bank from its credit products (loans) with the interest paid to clients with savings accounts in proportion to the amount of their assets. It can be calculated using the following equation:

$$\boldsymbol{NIM = \frac{Net\ interest\ income - Net\ interest\ expense}{Total\ earning\ assets}}$$

For the purpose of this research, Net interest margin profitability measure was chosen to be a dependent variable in the model according to relevant papers (Borio et al., 2017; Demirguc-Kunt and Huizinga, 1998).

2.5. Bank profitability determinants

So far, there have been plenty of researches studying banks' profitability and identifying its determinants. Since there has not been any agreement on which variables to include in order to compute profitability the most accurately, the determinants can vary from one author to another. For the purpose of this research, various literature has been reviewed and analysed with the aim of choosing the most suitable and available independent variables. Then, they are divided into two groups (internal and external factors) and are discussed further one by one regarding their influence on banks' profitability (Petria et al., 2015). At the end, all of them are put into a summary table for an even better overview.

2.5.1. Internal factors

These factors are often referred to as bank-specific, that is that they are different for each of the banks. The internal factors are: bank size, deposit ratio, risk-weighted assets density, liquidity and credit risk.

2.5.1.1. Bank size

According to various studies, size of a bank is identified as an internal factor which influences the bank's performance. Although the effect is not clear, it is possible to assume that the greater the size of a bank the higher the performance. That is due to the economies of scale theory which claims that financial institutions, such as banks, can take an advantage of having possibility to access a higher number of both lenders and borrowers (Boyd and Runkle, 1993).

Moreover, different literature on subject of intermediation theory claims that small banks are not as cost-efficient as larger banks and therefore are more likely to fail or even bankrupt. This positive relation between size and profitability has been studied by many researchers, such as Demirguc-Kunt and Huizinga in 1998, Pervan et al. in 2015 and Tan and Floros in 2012a.

On the other hand, usually larger companies are associated with higher bureaucracy, inertia and rigidity which can decrease the overall performance (Athanasoglou et al., 2006; Gul et al., 2011; Kosmidou, 2008; Staikouras and Wood, 2004) and additionally during the times of financial crises bank's size can turn out as their disadvantage (Campmas, 2020; Dietrich and Wanzenried, 2011). Mathematically is this variable usually measured as a logarithm of total assets.

2.5.1.2. Deposit ratio

As stated previously, there are many researchers who use different variables in order to figure out what is the best possible combination of profitability determinants. Although there have not been found many researches which use deposit ratio, the study provided by Haddaweea and Flayyihb in 2020 shows that there is a significant relationship with a positive correlation between different types of deposits and profitability indicators.

This finding is in line with a more relevant study written by Gul et al. (2011), where authors conclude that under normal economic conditions banks with a higher deposit ratio are able to provide more loans and therefore increase their profitability. The downside is that larger banks with lots of deposits have to generate more money in order to be able to pay interest agreed on clients' savings accounts. On the other hand, banks with lower deposit ratio cannot afford to provide more loans as their deposits are limited and consequently the interest that they have to pay should be lower (Hassan and Bashir, 2003). According to these assumptions, in case of change of central bank's interest rates policy larger banks should suffer more than smaller banks.

For the purpose of this research, the deposit ratio is calculated as the sum of deposits divided by total assets.

2.5.1.3. Risk-weighted assets (RWA) density

Risk-weighted assets are commonly used to determine the minimum amount of required capital which has to be held by banks in order to reduce the risk of insolvency and therefore to avoid bankruptcy.

Since it is really complicated to evaluate the risk exposure of banks and the literature suggests different proxies, it was decided to use Risk-weighted assets density as an independent variable for this research (Ashraf et al., 2016). This variable should provide a realistic picture of different levels of risk exposure for banks' investments in assets. For instance, items on the balance sheet, such as cash or government bonds have the lowest risk weight, while loans fully secured by mortgage or commercial loans have the highest risk weight (Bank for International Settlements, 1988).

The most relevant evidence of a positive relationship between risk-weighted assets and banks' profitability was proved by Ferri and Pesic in their paper written in 2017. Authors conclude that by increasing RWA density the profitability of banks should increase as well. However, according to the research of Das and Sy in 2012, banks with lower risk-weighted assets perform better during the time of crisis and vice versa.

RWA density or as often referred to as *"density ratio"* is calculated by dividing RWA with total assets (Brie and Freon, 2016).

2.5.1.4. Liquidity

Liquidity or liquidity risk often results from the variability of income and potential instability of financial flows of assets and liabilities which are the result of a way of satisfying the demand for liquidity. (Polouček et al., 2006) In such situations, commercial banks must have prepared liquid assets or potentially possible liquid assets to counter unexpected outflow of cash resources. The business of banks is regulated by a central bank by general liquidity rules. These are characterized by the binding relationships between predetermined asset and liability items in the balance sheet of banks according to their maturity or monetary policy. In order to maintain the adequate liquidity, banks have to follow these minimal conditions (Medveď, Tkáč et al., 2013).

In terms of liquidity and its impact on bank's profitability, researchers' opinions differ. Both positive and negative relationship have been observed in their studies. The first group of authors claims that banks with more liquid assets can better absorb possible shocks (Bourke, 1989; Duraj and Moci, 2015) and so reduce the financing costs – enhance the profitability. The other argues that more liquidity is just another expense for banks (Molyneux and Thornton,1992; Goddard et al., 2004) because liquid assets bring low returns – lower the profitability.

To address the bank's liquidity properly, this variable is measured as a ratio of liquid assets to short-term funding and deposits. It should provide the information needed to secure cash sufficiency and availability of working capital to overcome potential financial disruptions. The higher the ratio, the higher the liquidity of a bank.

2.5.1.5. Credit risk

Credit risk is the risk of loss resulting from the default of the counterpartiese.g., the non-fulfilment of obligations agreed in the contract due to which the bank has become a creditor. This loss results from the partial failure of the counterparty which is in most cases the debtor's party. It arises mainly from credit products and business and investment activities. Credit risk is the most important risk that affect bank's performance (Mejstřík et al., 2014).

In the reviewed literature, this variable is usually expressed by the ratio of Loan loss reserves over Gross loans granted by a bank. The higher the ratio, the lower the credit

risk. This relation was claimed to be true with a negative correlation by Campmas in 2020, according to whom increase in Loan loss reserves results in decrease of bank's profitability.

On the contrary, Dietrich and Wanzenried (2011) find a positive correlation and argue that Loan loss reserves is statistically significant only in times of financial crisis but not during normal economic conditions. The only these two researches agree on is the negative effect of this determinant on performance of a bank.

2.5.2. External factors

Banks are besides the influence of internal factors also affected by the economic situation and climate in which they operate. These factors are known as macroeconomic. Additionally, the industry specific factor was included as well to enhance the research. The external factors are GDP growth rate, inflation, and market concentration.

2.5.2.1. GDP growth rate

GDP growth rate is the indicator of health of the bank's country. In times of economic growth, it can have multiple consequences among which is the increase of bank's activity. In the same way, authors of recent researches found out that there is a positive relationship between GDP growth rate and bank's profitability (Naceur, 2003; Kanas et al., 2012; Trujillo-Ponce, 2013). Therefore, higher deposits and granted loans as well as higher interest margins results in higher profitability. However, in case of a recession, the economic activity decreases. Consequently, the demand for deposits and loans decreases and so do the interest margins. Reasonably, such a decline would have negative impact on bank's profitability (Gul et al., 2011; Sufian and Chong, 2008; Tan and Floros, 2012b).

2.5.2.2. Inflation

Another important determinant of bank's profitability is inflation. Even though the majority of researchers claim that this macroeconomic factor is positively related to the bank's performance (Demirguc-Kunt and Huizinga in 1998; Gul et al., 2011; Kanas et al., 2012; Tan and Floros, 2012b; Trujillo-Ponce, 2013), there are authors who found the opposite relation (Abreu and Mendes, 2001; Claessens et al., 2018). In terms of bank lending activity, Huybens and Smith (1999) claim that it is negatively correlated with inflation, especially in economies with relatively high inflation rates.

Assuming a positive correlation, with higher (anticipated) inflation rates loan interest rates would increase as well. Since banks would receive higher interest from granted loans, the bank's profitability would increase. Although in case of not anticipated inflation rates, profitability can decrease as the financing costs increase (Petria et al., 2015).

2.5.2.3. Market concentration

In order to provide a better understanding and measure of distribution of market power and competition between the banks in a country, the industry specific factor is used. The Herfindahl-Hirschman Index (HHI) is calculated as the sum of the squares of the market share of banks (Dietrich and Wanzenried, 2011). Despite the fact that many researches study the effect of the market concentration on the bank's performance, the relation is still uncertain. The reason is that in case of high concentration of banks the competition decreases, and the profitability should increase – banks can charge interest rates which are the most profitable for them. However, high concentration of banks can result in tougher competition where banks compete for clients and set their interest rates just above the threshold. This kind of behaviour would indicate decrease in profitability (Naceur, 2003).

Table 1: Determinants of banks' profitability

Variable				Relation with profitability	Related literature
Dependent variable			**Net interest margin (NIM)**		(Campmas, 2020; Claessens et al., 2018; Demirguc-Kunt and Huizinga, 1998; Dietrich and Wanzenried, 2011; Staikouras and Wood, 2004; Tan and Floros, 2012a)
Independent variables	**Internal factors**	**Bank-specific variables**	**Bank size**	+	(Boyd and Runkle, 1993; Demirguc-Kunt and Huizinga, 1998; Pervan et al., 2015; Tan and Floros, 2012a)
				-	(Athanasoglou et al., 2006; Campmas, 2020; Dietrich and Wanzenried, 2011; Gul et al., 2011; Kosmidou, 2008; Staikouras and Wood, 2004)
			Deposit ratio	+	(Gul et al., 2011; Haddaweea and Flayyihb, 2020)
				-	(Hassan and Bashir, 2003)
			RWA density	+	(Ferri and Pesic, 2017)
				-	(Das and Sy, 2012)
			Liquidity	+	(Bourke, 1989; Duraj and Moci, 2015)
				-	(Goddard et al., 2004; Molyneux and Thornton,1992)
			Credit risk	+	(Dietrich and Wanzenried, 2011)
				-	(Campmas, 2020)
	External factors	**Macroeconomic variables**	**GDP growth rate**	+	(Naceur, 2003 ; Kanas et al., 2012; Trujillo-Ponce, 2013)
				-	(Gul et al., 2011; Sufian and Chong, 2008; Tan and Floros, 2012b)
			Inflation	+	(Demirguc-Kunt and Huizinga in 1998; Gul et al., 2011; Kanas et al., 2012; Petria et al., 2015; Tan and Floros, 2012b; Trujillo-Ponce, 2013)
				-	(Abreu and Mendes, 2001; Claessens et al., 2018)
		Industry specific variable	**Market concentration**	+/-	(Dietrich and Wanzenried, 2011; Naceur, 2003)

3. Methodology, data, and model specification

This chapter contains a detailed description of the thesis research philosophy, its research design, methodology and different approaches used in the process, difference-in-difference assumptions and the evidence of the suitability of the method for this thesis. The chapter ends with an analysis of collected data and a report of their resources.

3.1. Research context and design

In the previous chapter, the reviewed literature shows that the conducted research of this thesis is about a contemporary topic of great interest. Moreover, recent studies about banking profitability and its determinants differ in results as well as in conclusion. In this thesis, some conflicting effects of variables on banking profitability were pointed out in order to create a unique research and an econometric model to explain this relation.

The philosophy behind commercial banks profitability lies in taking deposits and other assets from their clients and lending them out at a maximum possible profit while minimizing the probability of default on provided loans. These deposits are banks' main and the largest source of financing, which allows banks to create credit in a unique manner as well as to provide credit facilities for their clients. Furthermore, they represent the most important form of savings with a significant contribution to support investment in countries and to stimulate the movement of investment and financing of important projects (Bouheni et al., 2016).

Besides many other financial products, commercial banks provide their clients an opportunity to invest their money through various bank accounts, such as term and savings accounts, thus encouraging them to increase their savings. From the perspective of a bank, this strategy can be really profitable because of two main reasons: the higher the deposits, the greater the amount of money to lend or to invest. In other words:

"Money makes money. And the money that makes money makes more money."
(Franklin, 1849).

Banks, in comparison to their clients, have better and more information about opportunities to invest their capital and therefore make larger profits. Additionally, they earn more interest on their investments than the guaranteed interest on savings accounts (Guillén et al., 2014).

However, if the economic situation is unfavourable and as the consequence the monetary policy of countries and their central banks change, commercial banks are affected as well and so are their clients. In terms of low interest rates, banks do not suffer from large number of withdrawals and shortage of deposits for their operations, but quite the opposite. In this case, they have a large amount of deposits which have to be prudently invested, in order to generate sufficient profit to pay the guaranteed interest on savings accounts.

In the negative interest rate environment, it is expected that banks with a greater reliance on deposit funding suffer more than banks with less deposits, as the funding becomes more costly. In order to maintain their profits, banks have to take more risk (Laeven et al., 2016). Another possibility for high-deposit banks would be to switch to different (cheaper) funding sources or to shrink their balance sheet, although banks do not follow this strategy. They rather take their deposit base as given and then evaluate available investment opportunities and decide on the best way to invest deposits, so it would cover their funding costs (Hanson et al., 2015).

Even though NIRP might be seen as highly controversial, many countries have adopted this measure to fight deflation and prevent the unintended side effects of the deteriorating economic situation in the world. On the other hand, many critics argue that this kind of policy decreases banks' interest margins, hence banks' profits. According to Sun and He (2018), the NIRP has a negative influence on banks' profitability because of two main reasons: Negative interest rates on banks' reserves held in central banks and fall of interest rates on loans.

The rationale behind these two arguments is that while the interest rate on loans falls and banks largely absorb associated losses, the interest rate on deposits (especially retail deposits) cannot be set into negative territory. In case it does, as explained previously, households may withdraw all their funds from banks. Therefore, banks avoid this decision which decreases their interest margins and weakens their credit supply.

In order to optimally test the effect of implied negative interest rates in banking sector, two different approaches are used in this thesis, namely descriptive and deductive approach. Firstly, a study with relevant literature creates a conceptual and theoretical structure which provides an understandable background of the researching topic. Then, the gathered data are described in detail and are further empirically observed and formed into results (Collis and Hussey, 2014) with the use of difference-in-difference method.

3.2. Methodology

The main aim of this thesis is to evaluate and measure the connection between an indicator of banks' profitability, negative interest rate policy set by the ECB and deposit ratio of commercial banks of all kinds in the European Union. The secondary objective is to investigate the lending behaviour of banks as well as their risk-taking under such an unconventional monetary policy.

To obtain a realistic picture and a more in-depth understanding of the effect of negative interest rates on banks' profitability, this research was structured into several logically consecutive steps.

Firstly, the descriptive approach and quantitative analysis is employed to research the significance of the relationship between bank's deposit ratio and profitability for the period 2012 – 2019 with focus on the European Union. Following the philosophy in studies of Haddaweea and Flayyihb (2020) and Gul et al. (2011), an equation including deposit ratio with an indicator of profitability is used.

Although, for the purpose of this research, ROA and ROE were replaced by a dependent variable NIM and the deposit ratio mentioned above was included among different independent variables influencing banks' profitability, namely:

a. Internal factors: Bank size, Deposit ratio, Risk weighted assets density, Liquidity, Credit risk
b. External factors: GDP growth rate, Inflation, Herfindahl-Hirschman Index

Then, the following equation is estimated:

$$\boldsymbol{y_{ijt} = \alpha + X_{it}\beta_1 + Y_{jt}\beta_2 + Z_{jt}\beta_3 + \varepsilon_{it}}$$

where:

$\boldsymbol{y_{ijt}}$ stands for net interest margin of a bank *i* at time *t* in country *j*

$\boldsymbol{X_{it}}$ is a vector of bank specific factors of a bank *i* at time *t* (size, deposit ratio, RWA density, liquidity, credit risk)

$\boldsymbol{Y_{jt}}$ is a vector of macroeconomic factors at time *t* in country *j* (GDP growth rate, inflation)

$\boldsymbol{Z_{jt}}$ is a vector of banking sector factors at time *t* in country *j* (HHI)

$\boldsymbol{\beta_i}$ stands for matrix of variable coefficients

$\boldsymbol{\varepsilon_{it}}$ is the error term

(All data are yearly based)

Consequently, the research examines the significance of a change in terms of the relation between deposit ratio and profitability before the introduction of negative interest rates in 2014 and after that.

If in case of the previous regression, the relation between *Deposit ratio* and *NIM* will be statistically significant (Gul et al., 2011; Haddaweea and Flayyihb, 2020) with positive linear relationship, then the gathered dataset of European banks can be divided into two groups: high-deposit and low-deposit banks, in order to continue the research on the effects of NIRP with respect to different amounts of deposits.

Secondly, the consequences of implementation of negative interest rate policy on banks' profitability with focus on net interest margins are studied. In order to capture the impact of the decline in interest rates (into negative territory) on banks' profitability with respect to these two groups over the chosen period of time, a commonly used method known as *"difference-in-difference"* is employed. It is assumed that the profitability of low-deposit banks provides the counterfactual for the profitability of high-deposit banks in the absence of a negative policy rates. In other words, low-deposit banks should yield unchanged or around the same profitability when rates become negative and therefore absorb the effects from negative interest rate policy better than banks with more deposits.

Therefore, the baseline regression to answer the main research question is:

$$y_{ijt} = \alpha + \beta_1 Treatment_i + \beta_2 PostPeriod_t + \beta_3 (Treatment_i * PostPeriod_t) + \beta_4 * factor1_{ijt} + \cdots + \beta_n * factorN_{ijt} + \delta_{it} + \theta_{it} + \varepsilon_{ijt}$$

where:

y_{ijt} stand for Net interest margin of a bank *i* at time *t* in country *j*

$Treatment_i$ stands for a dummy variable that equals 1 if bank *i* at the fixed point in time in the pre-period *t = 2013* has the deposit ratio in the top two quintiles of the sample and takes value 0 if its deposit ratio is in the bottom two quintiles

$PostPeriod_t$ stands for a dummy variable that equals 1 the year that the negative interest rate policy was adopted (June 2014) and takes value 0 prior to the time the policy was introduced

$factorN_{ijt}$ stands for all the above-mentioned factors for a bank *i* at time *t* in country *j*

δ_t and θ_t stands for year and bank fixed effects

ε_{it} stands for clustered errors on a bank level

(All data are yearly based)

According to the Heider et al. (2019) study, their sample was split in terciles based on the banks' deposit ratio in 2013 referring to top-tercile as high-deposit and bottom-tercile as low-deposit. Similarly, this thesis follows their methodology because of the difficulty to set an adequate threshold. The rationale behind this problem is that low-deposit banks can become high-deposit banks and vice versa regarding their deposit ratio changing over time, which would no longer provide the contrafactual for the profitability of high-deposit banks.

Thirdly, in addition to banks' profitability, the effect of negative interest rate policy on lending behaviour of banks is researched. For this purpose, similarly to the previous regression, the difference-in-difference method is applied while the same two groups consisting of banks with more deposits and banks with less deposits are used. In this case, it is assumed that high-deposit banks should grant less loans than low-deposit banks under the policy of negative interest rates and therefore provide the counterfactual as well.

Thus, to answer the thesis's sub-question, the third regression is as follows:

$$y_{ijt} = \alpha + \beta_1 Treatment_i + \beta_2 PostPeriod_t + \beta_3 (Treatment_i * PostPeriod_t) + \beta_4 * factor1_{ijt} + \beta_5 * factor2_{ijt} + \delta_{it} + \theta_{it} + \varepsilon_{ijt}$$

where:

y_{ijt} stand for Loan to assets ratio of a bank *i* at time *t* in country *j*

$Treatment_i$ stands for a dummy variable that equals 1 if bank *i* at the fixed point in time in the pre-period *t = 2013* has the deposit ratio in the top two quintiles of the sample and takes value 0 if its deposit ratio is in the bottom two quintiles

$PostPeriod_t$ stands for a dummy variable that equals 1 the year that the negative interest rate policy was adopted (June 2014) and takes value 0 prior the time the policy was introduced

$factor1_{ijt}$ stands for macroeconomic factor (GDP growth) for a bank *i* at time *t* in country *j*

$factor2_{ijt}$ stands for macroeconomic factor (Inflation) for a bank *i* at time *t* in country *j*

δ_t and θ_t stands for year and bank fixed effects

ε_{it} stands for clustered errors on a bank level

(All data are yearly based)

Regarding banks' risk-taking, it is assumed that since after the introduction of negative interest rates policy banks with more deposits witnessed a higher decrease in NIM, they would like to compensate for their losses and therefore lend to riskier borrowers. Even though this thesis does not provide any regression to empirically confirm or refute this assumption, the finding is based on deduction from the available data.

Even though the description of each variable was done in the previous chapter, a summary table of all the variables used in the analysis and regressions later in the paper with their proxies is provided for a better overview (see Table 2).

Table 2: Variables' proxies

	Proxy
Output variables	
NIM	Net interest income / Total earning assets
LTA*	Net loans / Total assets
Control variables	
Bank-specific variables	
Bank size	Logarithm of total assets (in EUR)
Deposit ratio	Deposits & short-term funding / Total assets
RWA density	RWA / Total assets
Liquidity	Liquid assets / Deposits & short-term funding
Credit risk	Loan loss reserves / Gross loans
Macroeconomic variables	
GDP growth rate*	GDP growth rate (annual %)
Inflation*	Inflation, GDP deflator (annual %)
Industry specific variable	
Market concentration	The Herfindahl-Hirschman Index (HHI)

Note: This table displays calculation of each variable used in this thesis. Since there are two outputs, the variables which are used also in the regression with LTA as a dependent variable are marked with *.

It is worth noting that the literature review provides the evidence that the profitability of banks may have different determinants. There are some empirical studies on banks' profitability which are country specific, while others have focused on a panel of countries. However, as stated previously, it is difficult to decide on the most accurate factors in terms of banks' performance.

Despite this limitation, vast majority of conducted researches conclude that there is a significant relation between an indicator of banks' profitability and certain determinants which are repeatedly used. In order to make this thesis unique, the chosen set consists of both common and less common variables.

According to the decision, this academic research should expand reader's knowledge and understanding of a discussed topic and provide both qualitative and quantitative information with logical results.

3.3. Difference-in-difference assumptions

The difference-in-difference (DID) estimator is a widely used tool for evaluating the effect of policy changes on relevant outcome variables (Abadie, 2005). In order to apply this method to the conducted research, certain underlying assumptions have to be satisfied (Bonhomme and Sauder, 2011).

- *Counterfactual statement* – the reference group (low-deposit banks) should provide counterfactual against the treatment group (high-deposit banks)
- *Exogeneity* – banks' profitability is influenced by the change in monetary policy and not the other way around
- *Time-invariant heterogeneity* – the variation of reference and treatment group is time-invariant, respectively the average variation of the dependent variables NIM and LTA for the treatment group has to be similar to the average variation of the reference group before the introduction of central banks' negative interest rate policy

Regarding the second assumption, comparing the profitability of high-deposit and low-deposit banks over the chosen period of time may though address the endogeneity of monetary policy. Firstly, negative interest rates are set by the European Central Bank because of the deteriorating economic conditions. At the same time, clients tend to deposit most of their money into banks, because when the economic conditions are unfavourable, either fewer trusted investment opportunities are available or majority of them become riskier with unguaranteed profit. Therefore, clients rather save their money than risk to lose it.

In contrast, the interest rates on savings accounts are lowered to the zero level which means that the money bears low interest and so banks do not provide almost any benefits to their clients besides the safety of the deposits. Consequently, banks are left with large deposits while they still need to pay interest on savings accounts to their clients and struggle with investing these deposits into something profitable. Under these circumstances banks eithertransmit negative rates policy to their depositors even at the cost of possible loss of clients (Switzerland) or they decide to take more risk and provide more loans.

Nevertheless, even if a bank chooses one of these two strategies, its profitability would be heavily affected in one way or another. Therefore, the estimated impact of NIRP on banks' profitability is biased, because the above-mentioned deteriorating economic conditions drive both. Thus, the exogeneity condition is met.

Additionally, assuming that both types of banks are affected by the same adverse economic conditions, this negative impact is cancelled out when only profitability of high-deposit and low-deposit banks around the setting of negative interest rates is taken into account.

The most important underlying assumption is the third one, often referred to as a condition of *"Parallel trends"*. This assumption is confirmed in Figure 3, which shows that before the introduction of negative interest rate policy, banks with different deposit ratio followed the similar pattern of movement. Although after the policy change in 2014 and continuous lowering of policy rates further on, the sharper decline of average NIM can be observed in the treatment group, while the reference group seems to absorb better and adapt quicker to the central bank's policy intervention.

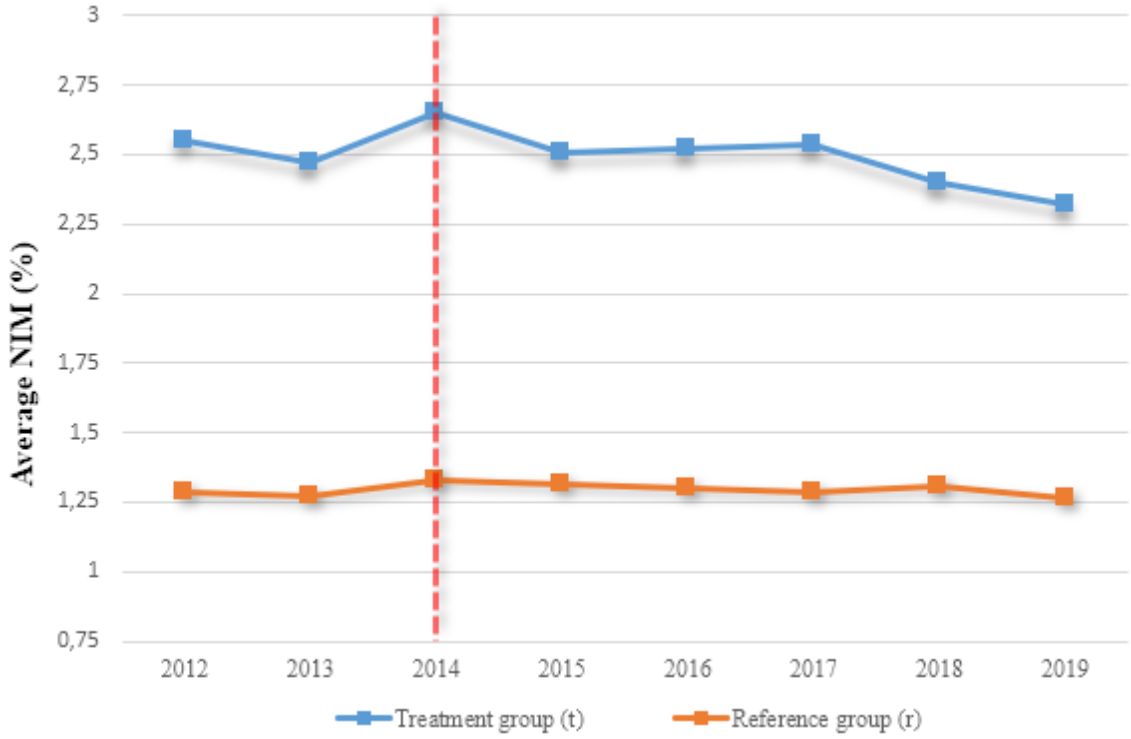

Figure 3: *Average net interest margins of high-deposit banks(t) and low-deposit banks(r).*

It is visible that both groups have been influenced by the setting of negative interest rates, although not to the same extent. While the reference group recorded a decline of only 0.01% of average NIM in 2015 the treatment group 0.14%. In terms of the long run, comparing 2014 and 2018 the decline of average NIM of low-deposit banks was around 0.03% and on the other hand the high-deposit banks 0.25% which is triple the difference of the reference group. The graph clearly shows that during 2018 the trend of average NIM changed.

Furthermore, it is assumed that negative interest rate policy might result in lower net interest margins, hence restricting banks' capacity to grant loans. To identify the change of banks' lending behaviour and thus find out if NIRP affects the amount of provided loans by banks, the second graph was created. In this case, the third assumption is confirmed in Figure 4 as well. Before the introduction of NIRP in 2014, banks with different deposit ratio had followed the similar pattern of movement from 2013. Anyhow, after the policy change in 2014 and continuous lowering of policy rates, the slower increase of average LTA can be observed in the treatment group than in the reference group which seems to grant more loans.

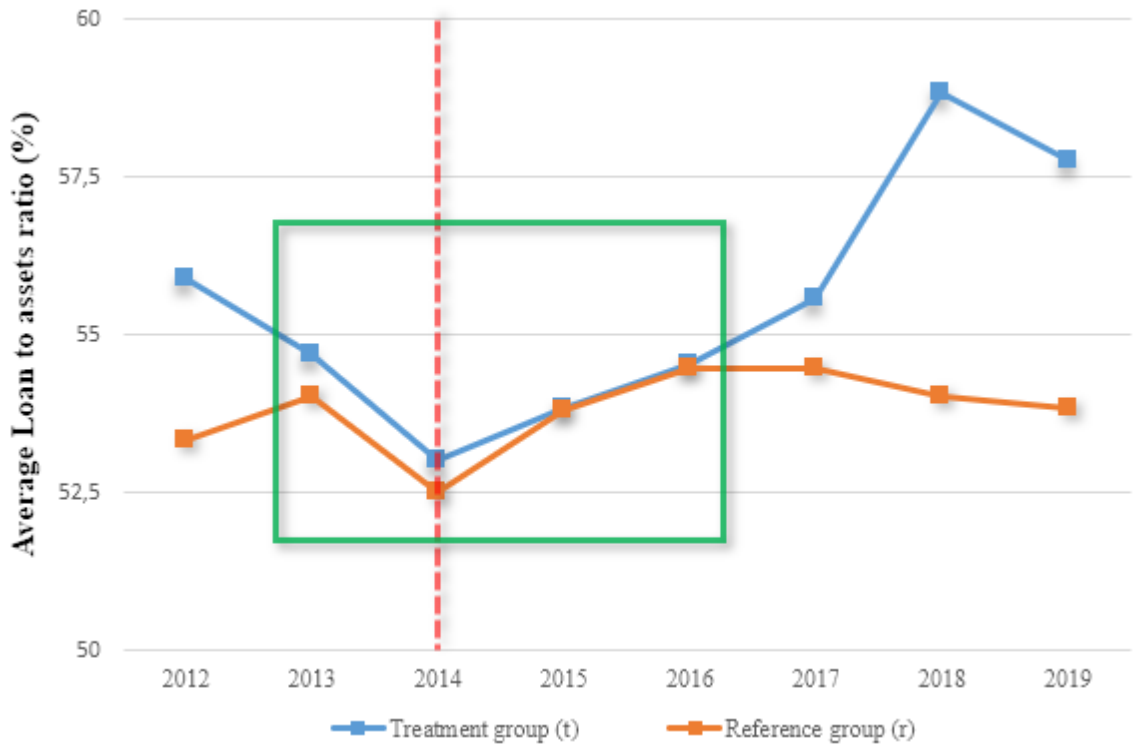

Figure 4: *Average loan to assets ratio of high-deposit banks(t) and low-deposit banks(r).*

While the reference group recorded an increase of 1.3% of average LTA in 2015 the treatment group only 0.83%. Comparing 2014 and 2016 the difference in increase in LTA/loans provided by the reference group was 0.43% higher than by the treatment group.

3.4. Data collection and analysis

For the purposes of this research, several high-quality data sources were considered. The most suitable one to fit the quantitative analysis was decided to be the BankFocus Orbis database, which consists of all different types of banks listed by Bureau van Dijk (BvD). According to various researchers, the data pooled from this database is generally considered to be credible and is used in the majority of previously referenced studies dealing with banks' profitability.

After a thorough research of data availability, several banks did not meet the requirements for this study or did not have the required type of financial report – Consolidated accounts with an unconsolidated companion (C2) that was chosen to be suitable for this research. The reason behind this decision is that the prior sample consisted of 218 results including two, three or four different financial reports for some of the banks and therefore was cut accordingly to the account type mentioned above into a smaller group consisting of 100 banks in the European Union (see Appendix A). Within the database, a history of 8 years (2012-2019) of banks' balance and performance data was used. This sample period was deliberately chosen in order to address both the environment of low interest rates and the environment of negative interest rates.

Table 3: Summary statistics

Baseline sample						
Variable	**Mean**	**SD**	**Min**	**Max**	**5th percentile**	**95th percentile**
NIM	2.02%	1.11	-0.36%	7.37%	0.56%	4.02%
Bank size	17.18	1.82	12.69	21.43	14.51	20.36
Deposit ratio	71.60%	15.61	9.75%	98.78%	39.49%	88.33%
RWA density	46.76%	18.22	11.03%	110.79%	19.54%	76.66%
Liquidity	45.43%	25.95	4.26%	257.17%	14.01%	94.80%
Credit risk	5.07%	6.55	0.01%	93.05%	0.25%	17.81%
LTA	55.60%	17.35	0.00%	88.70%	20.97%	78.57%
GDP growth	1.78%	2.30	-7.30%	25.16%	-1.84%	4.83%
Inflation	1.36%	1.09	-2.35%	7.79%	-0.10%	3.39%
HHI	0.065	0.022	0.033	0.120	0.040	0.108

Note: The baseline sample consists of all active commercial banks *i* in the European Union over the chosen period of time *t* (2012-2019). Data for all bank-specific variables is collected from BankFocus Orbis database based on annual balance-sheet and P&L data for the period spanning from 2012 through 2019 and compose 100 banks in the sample with 800 observations. Macroeconomic variables and the industry specific variable are collected from World Bank's and WITS's online databases, respectively. Bank size is the logarithm of bank total assets in EUR; Deposit ratio stands for deposits and short-term funding over total assets; RWA density represents the behaviour of risk taking; Liquidity proxy is banks' liquid assets to deposits and short-term funding; Credit risk stands for loan loss reserve to gross loans; LTA is net loans over total assets; GDP growth is annual GPD growth rate; Inflation is reflected by the annual GDP deflator; HHI is the Herfindahl-Hirschman market concentration index.

According to the chosen sample (see Table 3), it can be observed that the average net interest margin among the European banks is 2.02% with minimum at -0.36% and maximum at 7.37%. What is important for this research is the *Deposit ratio*.

In case both serial and variable correlations on the bank level are present, then there is a high probability that computed standard errors may considerably underestimate the standard deviation of the coefficients. Therefore, an error correction method has to be applied. To address as the autocorrelation so the heteroscedasticity, standard errors have to be clustered (Borio et al., 2017).

In terms of endogeneity problem, previously mentioned studies (see Section 2) revealed that such problem should not be a big concern for the thesis's empirical framework. Mainly because deteriorating macroeconomic conditions do affect the European Central Bank's choice of monetary policy, but the performance of banks in the European Union is not the key factor influencing the selection of financial policy.

In the next step, the baseline sample was divided into two different groups: Reference group and Treatment group according to the bottom (1^{st} and 2^{nd}) and top (4^{th} and 5^{th}) quintiles of deposit ratio at the fixed point in time in the pre-period (2013).

Table 4: Sample descriptive statistics for the reference group

Reference group						
Variable	**Mean**	**SD**	**Min**	**Max**	**5th percentile**	**95th percentile**
NIM	1.29%	0.66	-0.36%	3.08%	0.32%	2.64%
Bank size	25.35	1.72	21.65	28.34	22.15	27.87
Deposit ratio	56.05%	14.60	9.75%	87.32%	32.72%	78.38%
RWA density	37.15%	15.72	11.03%	84.25%	18.39%	66.77%
Liquidity	57.74%	28.86	8.99%	257.17%	24.89%	110.78%
Credit risk	3.41%	3.43	0.01%	26.32%	0.18%	9.39%
LTA	53.81%	18.91	11.93%	88.70%	19.29%	81.56%
GDP growth	1.33%	2.23	-4.06%	25.16%	-1.84%	3.27%
Inflation	1.23%	0.76	-0.39%	7.79%	0.25%	2.38%
HHI	0.055	0.019	0.036	0.120	0.037	0.100

Note: The reference group (sample of low-deposit banks) consists of all active commercial banks *i* in the European Union over the chosen period of time *t* (2012-2019) within the bottom two quintiles of deposit ratio in 2013. Data for all variables is collected from BankFocus Orbis database based on annual balance-sheet and P&L data for the period spanning from 2012 through 2019 and compose 34 banks in the sample with 272 observations. Macroeconomic variables and the industry specific variable are collected from World Bank's and WITS's online databases, respectively. Bank size is the logarithm of bank total assets in EUR; Deposit ratio stands for deposits and short-term funding over total assets; RWA density represents the behaviour of risk taking; Liquidity proxy is banks' liquid assets to deposits and short-term funding; Credit risk stands for loan loss reserve to gross loans; LTA is net loans over total assets; GDP growth is annual GPD growth rate; Inflation is reflected by the annual GDP deflator; HHI is the Herfindahl-Hirschman market concentration index.

Despite the summary statistics for the reference group (see Table 4) shows that the average NIM is considerably lower for banks with less deposits than for banks in the treatment group with higher average deposit ratio – at 83.27% (see Table 5), larger banks seem to be more frequent in the sample of reference group.

Regarding liquidity, low-deposit banks have higher average liquidity ratio (57.74%) and therefore hold more liquidity assets with respect to their total assets. This difference might be partially explained by the assumption that low-deposit banks focus more on the interests of their clients. Because the higher the liquidity ratio, the lower the perceived risk and consequently the better the position in which a bank finds itself in case of an unexpected event, such as financial crisis or present pandemic (Saleem and Rehman, 2011).

Table 5: Sample descriptive statistics for the treatment group

Treatment group						
Variable	**Mean**	**SD**	**Min**	**Max**	**5th percentile**	**95th percentile**
NIM	2.49%	1.10	0.17%	5.55%	0.80%	4.49%
Bank size	23.17	1.34	19.60	26.33	21.09	25.64
Deposit ratio	83.27%	7.37	43.64%	98.78%	74.27%	90.95%
RWA density	53.55%	18.58	14.62%	95.66%	19.56%	80.29%
Liquidity	39.14%	23.52	4.33%	170.11%	11.99%	71.61%
Credit risk	6.97%	7.66	0.12%	33.27%	0.44%	24.37%
LTA	55.51%	16.66	13.73%	87.05%	22.52%	78.39%
GDP growth	1.77%	2.26	-7.30%	7.32%	-2.64%	5.17%
Inflation	1.27%	1.19	-2.35%	6.92%	-0.37%	3.77%
HHI	0.065	0.022	0.033	0.115	0.041	0.112

Note: The treatment group (sample of high-deposit banks) consists of all active commercial banks *i* in the European Union over the chosen period of time *t* (2012-2019) within the top two quintiles of deposit ratio in 2013. Data for all variables is collected from BankFocus Orbis database based on annual balance-sheet and P&L data for the period spanning from 2012 through 2019 and compose 33 banks in the sample with 264 observations. Macroeconomic variables and the industry specific variable are collected from World Bank's and WITS's online databases, respectively. Bank size is the logarithm of bank total assets in EUR; Deposit ratio stands for deposits and short-term funding over total assets; RWA density represents the behaviour of risk taking; Liquidity proxy is banks' liquid assets to deposits and short-term funding; Credit risk stands for loan loss reserve to gross loans; LTA is net loans over total assets; GDP growth is annual GPD growth rate; Inflation is reflected by the annual GDP deflator; HHI is the Herfindahl-Hirschman market concentration index.

Similarly, higher RWA density can be observed among high-deposit banks as these banks might have decided to place majority of their assets into classes with a significant degree of price volatility – with a higher risk – in comparison to low-deposit banks.

As for the credit risk, higher ratio signifies lower credit risk which can be observed in the treatment group indicating that high-deposit banks have more appropriate ways of mitigating the credit risk than banks with less deposits (Imbierowicz and Rauch, 2014).

Lastly, the correlation matrix was constructed for both internal and external factors to test for possible multicollinearity and high correlation that might influence and tamper the estimate of the treatment effect (see Table 6).

Table 6: Correlation matrix

Correlations										
Variable	**NIM**	**Bank size**	**Deposit ratio**	**RWA density**	**Liquidity**	**Credit risk**	**LTA**	**GDP growth**	**Inflation**	**HHI**
NIM	1									
Bank size	-0.5277*	1								
Deposit ratio	0.5633*	-0.5682*	1							
RWA density	0.7253*	-0.5177*	0.5030*	1						
Liquidity	-0.4602*	0.3086*	-0.5685*	-0.4039*	1					
Credit risk	0.4442*	-0.2392*	0.339*	0.5065*	-0.2070*	1				
LTA	0.3175*	-0.2096*	0.1406*	0.2919*	-0.7145*	0.0274	1			
GDP growth	0.1895*	-0.0523	0.0635	0.0796	-0.0615	0.0411	0.0811	1		
Inflation	0.0824	-0.0721	0.0032	-0.0559	-0.0512	-0.1888*	0.0413	0.2845*	1	
HHI	0.2580*	-0.1998*	0.2480*	0.2305*	-0.2982*	-0.0418	0.2368*	0.2910*	0.1992*	1

Note: Correlation matrix reports correlation coefficients between all included variables on which this research is based on. Each of the cells in the table shows the correlation between two numerical variables. Statistical significance at the 5% level is marked as *.

In the table above, the vast majority of the observed correlations are quite low due to the nature of the data. Although, especially high correlations exist between NIM and RWA density showing a strong positive linear relationship (0.7253) and between LTA and Liquidity indicating a strong negative linear relationship (-0.7145) which are just above/below the threshold of 0.7 and -0.7. Correlations between NIM and Bank size/Deposit ratio/Liquidity/Credit risk are in the intervals -0.7 – 0.5 and 0.5 – 0.7 which stand for a moderate relation. Observed coefficient values above 0.3 or under -0.3 signify a weak relation.

4. Results

This chapter will firstly give an overview over the key metrics of the employed models. Secondly, the problem of autocorrelation and heteroscedasticity in the sample will be considered with implication of whether fixed or random effects. Lastly, results will be effectively analysed and objectively summarized followed by the explanatory discussion.

4.1. Quantitative results

The output of the first regression is summarized in Table 7, which describes the estimates with dependent variable of banks' profitability NIM and a set of bank specific variables including macroeconomic variables as well as an industry specific variable. In this regression table, the focus is on relations between NIM and its determinants over the chosen periods of time without controlling for any treatment effects or clustering the standard errors. Consequently, following results can be deduced.

The table shows a negative and highly significant relation between *Bank size* and *NIM*. This negative relation has a coefficient value varying from -0.055 to -0.076 which is significant at 1% level in post-period and in period 2012-2019. This relation indicates that a one-unit increase in *Bank size* results in a decrease of *NIM* by 0.071 regarding full period.

In terms of *Deposit ratio*, a positive and highly significant relation exists between the variable and its dependent variable *NIM*. The coefficient value of positive relation ranges from 0.006 to 0.016 which are both significant at 1% level in both periods. The finding concludes that a one-unit increase in *Deposit ratio* results in an increase of the dependent variable by 0.008 according to the last column. However, it is not economically significant.

Similarly, *RWA density* has a positive and highly significant relation with *NIM*. This positive relation has a coefficient value of around 0.028 which is significant at 1% level in all of the three observed periods. In case of a one-unit increase in *RWA density* the *NIM* increases as well by 0.028.

On the other hand, a negative relation with a high significance can be observed between *Liquidity* and *NIM* in period 2012-2019 with a coefficient value of -0.004. The finding indicates that a one-unit increase in *Liquidity* causes the *NIM* to decrease by 0.004.

Regarding the independent variable *Credit risk*, it has a significant (at 1% level) positive relation with *NIM*. This positive relation coefficient values range from 0.018 to 0.021 indicating that a one-unit increase in *Credit risk* results in an increase of *NIM* by 0.020.

As for the macroeconomic variables, both *GDP growth* and *Inflation* share a positive and significant relation with *NIM*. Although, in post-period *GDP growth* coefficient value is 0.051 (significant at 5% level) while Inflation has the coefficient value of 0.096 (significant at 1% level). Therefore, based on the chosen sample it is concluded that inflation affects stronger the *NIM* than *GDP growth* since a one-unit increase in *GDP growth* results in an increase of *NIM* by lower value than Inflation with regards to last two regressions.

Table 7: Relation between profitability determinants and Net interest margin

Period	**(Pre-period, t < 2014)**	**(Post-period, t > = 2014)**	**(2012-2019)**
Variable	**(1)**	**(2)**	**(3)**
Bank size	-0.055 (0.048)	-0.076*** (0.022)	-0.071*** (0.020)
Deposit ratio	0.016*** (0.005)	0.006** (0.003)	0.008*** (0.002)
RWA density	0.027*** (0.004)	0.028*** (0.002)	0.028*** (0.002)
Liquidity	-0.001 (0.003)	-0.005*** (0.001)	-0.004*** (0.001)
Credit risk	0.018 (0.015)	0.021*** (0.006)	0.020*** (0.006)
GDP growth	0.075* (0.040)	0.051** (0.021)	0.046*** (0.014)
Inflation	0.042 (0.085)	0.096*** (0.035)	0.093*** (0.031)
HHI	-0.013 (0.034)	0.012 (0.018)	0.007 (0.015)
Fixed year effects	No	No	No
Fixed bank effects	No	No	No
R^2	0.5680	0.6501	0.6239
# of banks	67	67	67
# of observations	134	402	536

Note: This table displays results of panel regression of Net interest margin (NIM) on GDP growth rate, inflation, and bank characteristics with focus on relation between profitability determinants and NIM in pre-period, post-period and during whole observed period with neither controlling for the fixed effects nor clustering the standard errors. NIM is annual net interest income adjusted relative to the total earning assets. Bank size is the logarithm of bank total assets in EUR; Deposit ratio stands for deposits and short-term funding over total assets; RWA density represents the behaviour of risk taking; Liquidity proxy is banks' liquid assets to deposits and short-term funding; Credit risk stands for loan loss reserve to gross loans; GDP growth is annual GPD growth rate; Inflation is reflected by the annual GDP deflator; HHI is the Herfindahl-Hirschman market concentration index. Standard errors are displayed in parentheses. Statistical significance at the 1%, 5% and 10% level are marked as ***, ** and *, respectively.

The only exception in terms of relation with *NIM* is *Herfindahl-Hirschman Index* which represents the market concentration. In the pre-period it shows negative insignificant relation while in the post-period and period 2012-2019 reports positive insignificant relation. The important finding for this research indicates however, that a one-unit increase in *HHI* causes the *NIM* to increase by 0.007.

To continue analysing this set of banks' historical data with the implication of difference-in-difference method, several tests have to be performed so the results would be credible. Namely the test for autocorrelation, heteroscedasticity and the Hausman test.

In terms of autocorrelation, its presence can cause problems in analysis mainly because of its assumptions of independence of observations. Usually, the autocorrelation occurs if the model is incorrectly specified. In the above provided regression, Wooldridge test for autocorrelation in panel data was performed with *p* value = 0 due to which H_0 hypothesis is rejected at 5% level of significance – serial correlation is present.

With respect to heteroscedasticity, it can as well have serious consequences resulting into inefficient regression predictions. Panel data regression assumes that all residuals are drawn from a population which is characterized by a constant variance – homoscedasticity. In order to trust the provided results, the residuals should have a constant variance. In the previous regression, a graph of residuals was created to illustrate the assumption stated above (see Appendix B). Apparently, according to the Cook-Weisberg test for the heteroscedasticity the observed *p* value = 0 therefore H_0 hypothesis is rejected at 5% level of significance – heteroscedasticity is present.

Therefore, as stated previously, in order to fix for possible correlations on the bank level and thus avoid the underestimation of standard deviation of computed coefficients, an error correction was applied. To address both the autocorrelation and the heteroscedasticity, standard errors were clustered.

To decide which treatment effects will be used in the following regression, the Hausman test was performed. A Fixed-effect model assumes that all dispersion in observed effects is due to the sampling error. On the other hand, a Random-effects model presumes that some of the mentioned dispersion reflects real differences in effect size. The results of the Hausman test provided *p* value = 0.0072 indicating that the Fixed-effect model is most appropriate (see Appendix C). Although, for the purpose of this research, according to the cited literature, it was decided to use only fixed year effects and fixed bank effects.

The output of the second regression is summarized in Table 8, where the difference-in-difference estimate is included along with other independent variables. Unlike in the previous regression, the focus is on the coefficient of *NIRP-impact* which reports the average variation in *NIM* between high-deposit and low-deposit banks. Additionally, this model should provide a clear picture of which variables predict core banking profitability.

Table 8: Impact of negative policy rates on banks' profitability

Period	**2012-2019**					**2012-2016**
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NIRP - impact (PostPeriod_Treatment)	-0.045 (0.146)	-0.000 (0.123)	-0.015 (0.121)	-0.023 (0.120)	-0.047 (0.121)	-0.005 (0.111)
Bank size		-0.234 (0.158)	-0.240 (0.158)	-0.242 (0.157)	-0.205 (0.160)	-0.147 (0.225)
RWA density		0.021*** (0.005)	0.021*** (0.005)	0.021*** (0.005)	0.022*** (0.005)	0.012** (0.006)
Liquidity		-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.003)
Credit risk		0.020 (0.012)	0.018 (0.012)	0.019 (0.012)	0.016 (0.012)	0.029 (0.019)
GDP growth			0.025* (0.011)	0.017 (0.011)	0.012 (0.014)	0.013 (0.018)
Inflation				0.044 (0.031)	0.046 (0.031)	0.022 (0.043)
HHI					-0.079 (0.075)	-0.088 (0.069)
Fixed year effects	Yes	Yes	Yes	Yes	Yes	Yes
Fixed bank effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.9010	0.9251	0.9259	0.9266	0.9273	0.9495
# of banks	67	67	67	67	67	67
# of observations	536	536	536	536	536	335

Note: This table displays results of panel regression of Net interest margin (NIM) on GDP growth rate, inflation, and bank characteristics. NIM is annual net interest income adjusted relative to the total earning assets. NIRP-impact is the difference-in-difference interaction term, in other words PostPeriod_Treatment. Bank size is the logarithm of bank total assets in EUR; RWA density represents the behaviour of risk taking; Liquidity proxy is banks' liquid assets to deposits and short-term funding; Credit risk stands for loan loss reserve to gross loans; GDP growth is annual GPD growth rate; Inflation is reflected by the annual GDP deflator; HHI is the Herfindahl-Hirschman market concentration index. Standard errors are displayed in parentheses. Statistical significance at the 1%, 5% and 10% level are marked as ***, ** and *, respectively.

In the first column, the coefficient of *NIRP-impact* is present. It has a negative relation implying that banks with high deposit ratio witnessed a drop in *NIM* level of 0.045 relative to those with low-deposit ratio under the setting of negative interest rates.

In order to address the difference-in-difference method properly, both dummy variables should be interpreted as well: the hidden variable *PostPeriod* in the baseline regression with a coefficient value -0.103 implies that *NIM* had a negative trend over time and thus further restricts the banks' capacity to grant loans. Additionally, the dummy variable *Treatment* (0.107) provides the evidence that high-deposit banks regardless of the negative interest rates had higher *NIM*.

The remaining columns regarding 2012-2019 period show the outcome from introducing one-by-one country and industry specific controls. The value of *NIRP-impact* coefficient in these regressions ranges from 0 to -0.047 indicating negative effects on *NIM.*

Similarly, to the first table, macroeconomic variables have positive relation with the output variable *NIM* while the only two bank-specific variables with negative relation are *Bank size* (-0.205) and *Liquidity* (-0.001). Although, the variables are not statistically significant at the accepted levels, the relation signs are in line with the provided literature.

In contrary to the first set of regressions without controlling neither for the fixed effect nor clustering the standard errors, the high R values squared (R^2), which can be observed in Table 8, provide the evidence that the chosen model explains over 90% of the fitted data in the regression model.

To examine the robustness of the provided results, the variation of estimation window (time period) has to be made. Therefore, the post-treatment period was shortened reporting the same positive/negative relations with regards to previous time periods. The difference-in-difference estimate still holds the negative relation with *NIM*.

The output of the third regression is summarized in Table 9 where the dependent variable is represented by the *LTA* (Loan to total assets ratio). Similarly to the previous table, the focus is on the coefficient of interaction term PostPeriod_Treatment which is replaced by the *NIRP-impact* notation. It shows the average variation in *LTA* between high-deposit and low-deposit banks in two different periods. The shorter period's purpose is to investigate the impact of introduction of NIRP on amount of granted loans while the longer period provides the long run overview of effects of such policy on banks' lending.

Table 9: Impact of negative policy rates on banks' lending behaviour

Period	**2013-2016**		**2012-2019**	
Variable	**(1)**	**(2)**	**(3)**	**(4)**
NIRP - impact (PostPeriod_Treatment)	-0.466 (1.776)	-0.285 (1.746)	0.124 (2.235)	0.728 (2.255)
GDP growth		-0.010 (0.299)		-0.475 (0.432)
Inflation		-0.810 (0.851)		-0.799 (0.728)
Fixed year effects	Yes	Yes	Yes	Yes
Fixed bank effects	Yes	Yes	Yes	Yes
R^2	0.9596	0.9603	0.8671	0.8699
# of banks	67	67	67	67
# of observations	268	268	536	536

Note: This table displays results of panel regression of Loan to total assets ratio (LTA) on GDP growth rate, inflation, and a bank specific variable – Credit risk. LTA is net loans over total assets. NIRP-impact is the difference-in-difference interaction term, in other words PostPeriod_Treatment. GDP growth is annual GPD growth rate, Inflation is reflected by the annual GDP deflator. Standard errors are displayed in parentheses. Statistical significance at the 1%, 5% and 10% level are marked as ***, ** and *, respectively.

It can be observed in the first regression of this table that *NIRP-impact* coefficient is for the first period negative which implies that high-deposit banks recorded a drop in *LTA* level of 0.47 relative to those with low-deposit ratio after the introduction of the negative interest rate policy. On the other hand, in the second period, the coefficient of the interaction term changes to positive implying that banks with larger deposits witnessed an increase in amount of provided loans in the long run level of 0.12 relative to banks with less deposits.

Regarding variables *PostPeriod* and *Treatment*, they have positive coefficient values in both periods (0.367; 13.841 and 1.118; 15.034) which indicate that more loans were provided over the time and that high-deposit banks regardless of the negative interest rates granted more loans.

In terms of macroeconomic factors affecting Loan to total assets ratio, *GDP growth rate* as well as *Inflation* show negative, though insignificant, relation with the output variable in both time periods.

4.1.Analysis of the results

According to the regression outcome (*NIM* – output), if banks are not able to reduce loan rates as much as deposit rates, then the implementation of negative interest rate policy would result in shrinkage of their net interest margin. Furthermore, all relations of *Negative interest rate policy* impact with *Net interest margin* were found negative but not significant in terms of the provided sample of banks. Although, according to the reviewed literature, it was initially thought that this variable would be of much relevance.

As for the lending behaviour of banks, the introduction of negative interest rates policy stimulated the loan supply by banks. However, this unconventional monetary policy did not affect banks with different deposit amounts to the same extent. The provided empirical evidence shows that high-deposit banks granted less loans in comparison to the low-deposit banks until 2016.

Then, since banks with more deposits are considered to provide most of the lending because of their stability and reliability, the lending behaviour changes accordingly. This indicates that there might be some important events that changed the lending behaviour of banks during the observed period or there were other mechanisms at work. Although, for the purpose of this research, the main focus is on the period closer to the introduction of NIRP, which is 2013-2016.

In terms of bank specific variables, *Credit risk* was found to have an insignificant positive relation with *NIM* implying that a reduction in credit risk (one-unit increase in *Credit risk*) leads to an increase of banks' profitability. Thus, it can be assumed that since *NIM* decreases over time under the policy of negative interest rates the credit risk increases, banks grant loans to riskier borrowers in order to compensate for the losses. Although there is no empirical evidence provided in this thesis, this argument was claimed to be true by Heider et al. (2019). Furthermore, it can be deduced that core banking operations yield for higher profit when banks decide to increase their loans loss reserves – money used to cover for nonperforming loans (Dietrich and Wanzenried, 2011).

Especially strong positive significant relation between *RWA density* and *NIM* indicate that the greater is the risk taken by banks in the sample, the higher is their profitability. This is expected according to the study of Ferri and Pesic (2017), since they also found out that there is a trade-off between *RWA density* and banks' profitability.

As stated previously, this is in contrast to *Bank size* and *Liquidity* which implies that banks with smaller amount of assets or smaller amount of liquidity yield higher net interest margins. Therefore, it can be concluded that in case banks are not able to increase their interest income proportionally to their total assets, their net interest margins will suffer (Boyd and Runkle, 1993; Demirguc-Kunt and Huizinga, 1998). In case of *Liquidity*, the less liquid the bank, the more money it can earn from provided loans (Goddard et al., 2004; Molyneux and Thornton,1992).

Regarding *GDP growth* positive relation with *NIM* concludes that banks within countries reporting good economic performance have higher profitability than those that operate in countries with not as high GDP growth rate. These results are in line with Kanas et al (2012) and Trujillo-Ponce (2013) who also found a positive correlation.

Moreover, *GDP growth* has negative relation with *LTA* which implies that the better the economic situation in the country is, the less loans are granted by banks (despite the fact that more money is available for borrowing in the economy) assuming that firms need less financing and clients do not need to borrow that much, which is in contrary to various authors' findings.

Similarly, *Inflation* has a positive impact on the output variable implying that the higher is the inflation in a country, the higher is the profitability of banks. This finding is according to the vast majority of mentioned studies, such as Demirguc-Kunt and Huizinga (1998), approved and argues with Claessens et al. (2018) who found the opposite relation.

Additionally, as in case of *GDP growth*, there is a negative relation between *Inflation* and *LTA* which indicates that the higher the inflation is, the less loans are provided by banks which is in line with Huybens and Smith (1999) conclusion.

In terms of *HHI*, it can be observed that the higher the banking market concentration is in the country, the lower the performance of banks and consequently, lower profitability. With regards to Dietrich and Wanzenried (2011) the relation with profitability is not unambiguously determined. However, the regression results of this research indicate that since there is a possibly tougher competition among banks in a country, banks compete for clients by drawing their attention to a bit higher interest rates which are set just above the threshold. Therefore, for the price of their own profitability banks attempt to keep/get new clients with the intention of raising deposits to increase their future profitability.

5. Conclusion

This chapter firstly links the research purpose of this thesis and the previously analysed empirical results with respect to the former presented studies. Then, main finding is concluded. Lastly, the research implications and limitations of this study are presented.

5.1. Conclusion and discussion

In 2014, the European Central Bank has implemented the conventional monetary policy of negative interest rates, entering the uncharted territory by crossing the "Zero-lower bound" charging a negative interest rate on banks' deposits. Since then, many banks in European Union have started to experiment with negative interest rates.

The purpose of this research was to investigate the relation between negative interest rates and banks' profitability. Firstly, the research gap in the literature was identified and confirmed. Then, the importance of the relation between banks' deposits and the indicator of profitability was shown for the chosen periods. Consequently, the observed sample consisting of 100 commercial banks in the European Union was split into two groups (more precisely into quintiles, excluding the third one) according to their deposit ratio in 2013 resulting into subsample with total of 67 commercial banks. Lastly, a regression with dependent variable (*NIM* – representing the banks' profitability) and independent variables (*Bank size, RWA density, Liquidity, Credit risk, GDP growth, Inflation, HHI*) with the use of difference-in-difference method was conducted.

Initially, the main point of NIRP was to improve real spending and stimulate the growth in credit supply. However, this kind of monetary policy launched a wave of criticism because of possible aspects that may hinder the transmission mechanism with intention to raise the volumes of loan supply. The reason behind it is that negative interest rate policy might result in lower net interest margins and hence restrict banks' capacity to grant loans. The provided empirical research on the impact of such a policy intervention on banks' performance is considered to be rare and therefore has a high academic contribution.

As stated previously, the focus of this study is on banks' performance after the introduction of negative interest rates in 2014 accounting for the difference in banks' deposit ratios. The main conditions of applied difference-in-difference method *"Parallel trends"* and the condition of *Exogeneity* were met. Next, the deposit ratio was proved to be highly significant as one of the determinants of banks' profitability. Afterwards, constructed regressions as well as the created graph provided the evidence – and so the answer for the

main research question – that banks with more deposits yield lower profitability when rates become negative and therefore suffer more from negative interest rate policy than banks with less deposits. This effect lasts further on since interest rates are still decreasing.

Moreover, regarding the sub-question, as the NIRP leads to the reduction of *NIM*, high-deposit banks are enforced to lend less and take more risk in comparison to low-deposit banks in order to accumulate higher returns. Normally, larger banks with high deposits are viewed as intermediary institutions providing most of the lending and being the most stable and reliable. However, in times of negative interest rate policy, the role of these banks according to their credit supply to the real economy changes. As a result, the stability of the whole financial sector is endangered. That is why the European Central Bank should implement preventive measures to avoid the financial sector vulnerability.

5.2. Research implications and limitations

This thesis contributes to the contemporary topic of great interest at the time of still ongoing decreasing interest rates with the following theoretical implications. Firstly, the main implication is that this research provides interesting new insights into the mechanisms that determine the profitability of commercial banks in the European Union. Additionally, acquired estimation results confirm findings from former studies on banks' profitability. Secondly, different types of profitability determinants were used, namely bank-specific, macroeconomic and industry-specific, which extends present knowledge of banks' profitability. Thirdly, this study considers time period from 2012 to 2019 in which not only the evidence was found but also such a long period provides better overview of banks' performance over time.

Lastly, this thesis is aware of several limitations. First limitation is within the selected sample of banks which might be considerably small regarding the number of banks in the European Union. Secondly, the gathered data for period 2012-2019 are yearly based and not monthly or quarterly based as was firstly intentioned. The reason is that the chosen database (BankFocus Orbis) did not offer these data for the observed period. Thirdly, the proposed model and interdependencies within it report insignificant relations between the output and vast majority of the chosen independent variables. Whether the different set of variables would result in different outcome, or this problem is due to the subsample size opens up space for future research. Still, given the versatile nature of the proposed model, these limitations remain unproven and therefore also offer an opportunity for future research to be tested within different types of institutions than commercial banks.

6. References

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7. *Appendix*

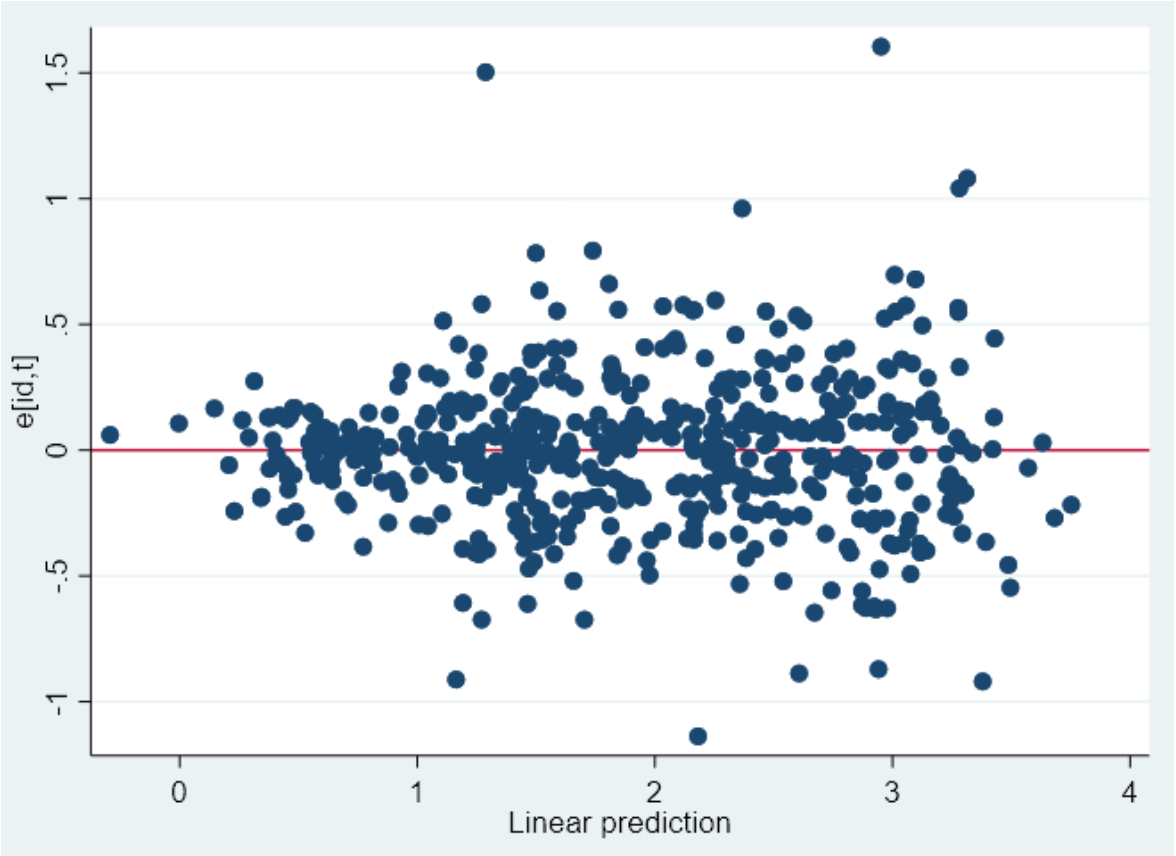
Appendix A: *BankFocus data filter*

Your search: 100 entities

Search step	Step	Search
1. Status: Active companies	3,489,529	3,489,529
2. World region/Country/Region in country: European Union [27]	644,635	432,106
3. Entity type: Bank	233,733	7,880
4. Specialisation: Commercial bank	109,758	1,670
5. Consolidation code: C2 (consolidated accounts with an unconsolidated companion)	24,995	296
6. Net Interest Margin (%): All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial data and Public authorities/States... Show more	18,472	161
7. Total assets: All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial data and Public authorities/States/Governme... Show more	21,625	161
8. Deposits & short term funding: All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial data and Public authorities... Show more	21,220	159
9. Risk weighted asset intensity (RWA / Total Assets): All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial data an... Show more	2,741	106
10. Liquid assets / Deposits & short-term funding: All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial data and P... Show more	18,308	106
11. Loan loss reserves / Gross customer loans & advances: All entities with a known value, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, for all the selected periods, exclusion of companies with no recent financial d... Show more	16,595	100
Boolean search: 1 and 2 and 3 and 4 and 5 and 6 and 7 and 8 and 9 and 10 and 11	Total:	100

VIEW RESULTS

Appendix B: *Test for heteroscedasticity - residuals*



Appendix C: *Test for heteroscedasticity - residuals*

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
DiD	-.0469777	.0180156	-.0649933	.0429696
Banksize	-.2045329	-.1748854	-.0296474	.0766726
RWA	.0215702	.0228158	-.0012455	.0007371
Liquidity	-.0013241	-.0018917	.0005676	.0003292
Creditrisk	.016275	.0226398	-.0063648	.0029449
GDP	.0120782	.0162279	-.0041497	.0077181
INF	.0464842	.0390249	.0074593	.0099098
HHI	-7.867116	-.9623127	-6.904803	2.883631

b = Consistent under H0 and Ha; obtained from xtreg.
B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 19.34
Prob > chi2 = 0.0072