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Vilma Venäläinen

# **The impact of negative interest rates on bank lending**

Evidence from Sweden

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**UNIVERSITY OF VAASA****School of Accounting and Finance**

**Author:** Vilma Venäläinen  
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**ABSTRACT:**

After the Global financial crisis, new ways of maintaining economic stability have had to be thought of. Central banks have introduced unconventional monetary policy tools aimed at keeping the inflation level at the desired level. One of the unconventional monetary policy tools is negative interest rates which have been used to make it more appealing for banks to issue loans to get the money to circulate in the economy. This should appear in the economy so that the inflation will rise closer to the desired level. Negative interest rates are a relatively new phenomenon as a monetary policy tool. Therefore, there is not a great amount of previous literature available, and the purpose of this thesis is to find out if the loan issuance has increased as a consequence of negative interest rates or not. Results from previous studies have been obtained in both directions, so it is not possible to estimate in advance what results should be obtained from this study in order for those to be in line with previous studies.

This thesis observes the impact of negative interest rates on bank lending between the years 2011 and 2019. The sample period includes the time before and after the negative interest rates. The thesis also aims to find out whether high-deposit banks issue more loans during negative interest rates than low-deposit banks. The sample is gathered from Sweden where negative interest rates were introduced as a part of the monetary policy during the year 2015 which is a while after the European Central Bank had first introduced those in 2014.

The method used in the empirical research part is the panel data method using fixed-effects model. This method is suitable for this kind of research where evidence is gathered from only one country and therefore it is used in this study. The empirical research of this thesis aims to answer the research question with three different regression models.

The results of this research show that the interest rates and loan growth have a negative relationship meaning that when loan growth increases, interest rates are decreasing and vice versa. However, the results were not statistically significant when observing the loan growth of high-deposit banks during the negative interest rates with the help of a dummy-variable. Also, the results were not statistically significant either when a dummy variable was added to the regression to describe the period after negative interest rates. Nonetheless, it can be stated that declining interest rates have had an increasing impact on loan growth in Sweden over the years from 2011 to 2019 but statistically significant conclusions of the loan growth of high-deposit banks and low-deposit banks cannot be made based on this study.

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**KEYWORDS:** Negative interest rates, bank lending, monetary policy, central banks

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**TIIVISTELMÄ:**

Globaalin finanssikriisin jälkeen on jouduttu miettimään uusia keinoja talouden vakauden ylläpitämiseksi. Keskuspankit ovat ottaneet käyttöön epätavanomaisen rahapolitiikan keinoja, joilla on pyritty pitämään inflaatio halutulla tasolla. Negatiiviset korot ovat yksi epätavanomaisen rahapolitiikan keino, joiden tarkoituksena on saada pankit myöntämään enemmän lainaa, jotta raha saataisiin taloudessa kiertoon. Tämän pitäisi näkyä taloudessa niin, että inflaatio nousee lähemmäs tavoiteltua tasoa. Negatiiviset korot ovat vielä suhteellisen uusi ilmiö rahapolitiikan keinona. Näin ollen niistä ei ole vielä tehty valtavia määriä aiempia tutkimuksia, ja siten tämän tutkielman tarkoituksena onkin selvittää, että onko lainananto kasvanut negatiivisten korkojen seurauksena vai ei. Aiemmista tutkimuksista on saatu tuloksia molempiin suuntiin, joten etukäteen ei voida arvioida, että mitä tuloksia tästä tutkielmasta tulisi saada, jotta se olisi linjassa aiempien tutkimusten kanssa.

Tässä tutkielmassa tarkastellaan negatiivisten korkojen vaikutusta pankkien lainanantoon vuosien 2011 ja 2019 välisenä aikana, jolloin tutkielma käsittää sekä ajan ennen negatiivisia korkoja että ajan niiden käyttöön ottamisen jälkeen. Tutkimuksessa pyritään myös selvittämään, että antavatko pankit, joilla on paljon talletuksia, enemmän lainoja negatiivisten korkojen aikana kuin pankit, joilla on vähemmän talletuksia. Tutkimuksen kohdemaaksi on valittu Ruotsi, jossa negatiiviset korot esiteltiin osana rahapolitiikkaa vuonna 2015 eli hieman sen jälkeen, kun Euroopan keskuspankki oli ne ensin vuonna 2014 esitellyt.

Empiirinen tutkimus toteutetaan paneelidataa käyttäen kiinteiden vaikutusten mallin avulla. Kyseinen menetelmä soveltuu hyvin tämän tyyppisen aineiston tutkimiseen, sillä tutkimuksen kohteena on vain yksi maa, jonka vuoksi tämä menetelmä on valittu käytettäväksi tutkielmassa. Empiirisessä tutkimuksessa tässä tutkielmassa tutkimuskysymykseen pyritään vastaamaan kolmen eri regressiomallin avulla.

Tutkimus ja sen tulokset osoittavat, että koroilla ja lainan kasvulla on negatiivinen suhde. Tämä tarkoittaa sitä, että kun lainojen määrä kasvaa, niin korot laskevat. Sama pätee toiseen suuntaan. Tulokset eivät olleet tilastollisesti merkitseviä, kun tarkastellaan korkean talletusasteen pankkien lainanantoa negatiivisten korkojen aikana dummy-muuttujan avulla eikä silloin, kun regressiomalliin lisättiin dummy-muuttuja kuvaamaan negatiivisten korkojen aikaa. Voidaan siis todeta, että laskevilla koroilla on ollut kasvava vaikutus pankkien lainanantoon Ruotsissa vuosien 2011 ja 2019 välisenä aikana, mutta korkean ja matalan talletusasteen pankkien lainanantosta ei voida tehdä tilastollisesti merkitseviä johtopäätöksiä tämän tutkimuksen perusteella.

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**AVAINSANAT:** Negative interest rates, bank lending, monetary policy, central banks

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## 1 Introduction

After the global financial crisis, central banks needed to develop new ways to get the economy to recover from the crisis. Central banks came up with accommodative monetary policies, including unconventional monetary policies (UMPs) which were introduced when expected results were not seen in nominal spending. These unconventional monetary policies include large-scale asset purchases (LSAPs) and negative interest rate policy (NIRP) which aim to increase the spending and economic growth. (Molyneux et al., 2020).

The tool for central banks to have an impact on the monetary policy is to make changes to the refinancing rate. Central banks are changing this rate to reach the monetary policy targets that are set. The European Central Bank does these monetary policy decisions to be able to maintain the price stability and to make the economy grow faster. (Brämer et al., 2013).

The reason why European Central Bank introduced negative interest rates on the first place was to increase the inflation since it had been on a too-low level. The purpose of this act is to maintain price stability. The desired result of implementing the negative interest rate policy is that consumers and corporates do have the incentive to spend rather than save money which would ultimately increase inflation when money would circulate in the economy. (European Central Bank, 2022a).

All macroeconomic decisions such as monetary policy actions of the central banks do have an impact on banks. Therefore, these unconventional monetary policy decisions may cause variation in the key functions of banks such as in their customer lending or deposits.

## **1.1 Purpose of the study and the research question**

The purpose of this study is to show what kind of impact do negative interest rates have on bank lending. It is done by going through the theory and the reason behind negative interest rates. When understanding the function of negative interest rates well, it is also important to understand traditional core banking activities, such as lending and deposits, to be able to conduct the empirical part of this study well.

Also, the purpose is to research the impact of negative interest rates on bank lending with a more concentrated sample than what most previous researchers have done. Therefore, the sample will only contain one country, Sweden, where negative interest rates have been implemented eight years ago. Thus, this study would also give new information because of the specific country selection, compared to most other studies.

The impact of negative interest rates on bank lending is researched in this study with the panel data method. The research considers years from 2011 to 2019 so that it is possible to know how the banks are reacting to interest rate changes during this period in Sweden from the aspect of lending growth. Also, deposit structure is considered in this study so that the effect of negative interest rates on high-deposit banks and low-deposit banks is examined. High-deposit banks are used as a treatment group and low-deposit banks as a control group similarly as, for instance, Tan (2019) and Heider et al. (2019) have examined in their research papers.

The main research question of this study is the following:

Do negative interest rates affect bank lending?

## **1.2 Structure of the study**

The structure of the study consists of seven chapters in total. The first chapter includes an introduction and chapters two to four form the theory part of the study. The second chapter goes through monetary policy of central banks. Also, the second chapter introduces negative interest rates and gives an insight into what those are and why negative interest rates have been introduced as part of the unconventional monetary policy tools. Other monetary policy-related topics, as well as lending channel and other channels, are also discussed in chapter two.

Followed by the monetary policy chapter, chapter three discusses traditional banking activities that forms the other half of the theory. Therefore, bank lending and deposits are discussed more carefully to fully understand the traditional core banking activities. Lending, especially, plays a very important role in this study. The fourth chapter includes the literature review where previous studies about similar topics are discussed and presented.

Chapter five presents the data and methodology used in the empirical part of the study and chapter six presents the empirical results and the analysis of the results. The last and seventh chapter concludes the thesis and the results.



## **2 Central banks and monetary policy**

There is a central bank in every country that maintains monetary system. Central banks are in charge of steering key interest rates as well as regulating the money supply indirectly. Also, central banks are typically responsible for supervising the actions of financial institutions. Consequently, this is called monetary policy. (Acemoglu et al., 2016, p. 631).

Monetary policy decisions often have something to do with interest rates. Interest rates are a channel that central banks use to maintain stability in the macroeconomy. Usually, those are used when shocks appear in the economy and then monetary policy is needed to calm the situation. Central banks steer short-term interest rates to affect inflation and to reach the inflation targets they have set. (Mahadeva & Sinclair, 2004 p. 4, 7-8).

The purpose of this chapter is to introduce the monetary policy of central banks and to give an insight into the monetary policy of the Riksbank, negative interest rates, and balance sheet policy. Also, a theoretical framework of different monetary policy channels is applied here. These topics give a broad understanding of negative interest rates and bank lending which supports understanding the empirical part of this study better later on.

### **2.1 European Central Bank's monetary policy**

The European Central Bank (ECB) on the 1<sup>st</sup> of January in 1999 started to operate monetary policy in the eurozone, forming the largest economic area right after the United States (European Central Bank, 2011, p. 9). The euro area considers 20 EU Member States that use euro as their currency and there are also countries, such as Sweden, that are a part of the European Union but do not meet the criteria of necessary conditions that would allow them to be a part of the euro area yet (European Commission, 2023). The European Central Bank's monetary policy consists of two main pillars which

are maintaining price stability as well as being independent (European Central Bank, 2011, p. 9).

The European Central bank has set in 1998 a target of less than, but nearly, two percent for the annual increase of the Harmonised Index of Consumer Prices (HICP) over the medium term. It would be inconsistent with the price stability if the inflation would increase to a level over two percent or decrease remarkably below that. Thus, it would conflict with the European Central Banks' core principles. (European Central Bank, 2011, p. 9). The HICP inflation rates' overall index seems to have varied a lot over the past twenty years. Especially during the financial crisis, negative interest rates, and when Covid-19 shook the world, the index has not seemingly reached the targeted level in the euro area. (European Central bank, 2021a).

There are different types of instruments available, besides interest rates, that the Eurosystem uses in carrying out its monetary policy. These are market operations, minimum reserve requirements, and standing facilities. After the financial crisis, the Eurosystem has introduced also some unconventional monetary policy tools, such as asset purchase programs, to be able to reach the price stability. (Bank of Finland, 2021).

### **2.1.1 Targets of monetary policy**

The targets of monetary policy can vary between countries and their central banks but usually, the focus is on the same functions everywhere. The main target of monetary policy in several countries applied after the year 1990 when inflation targeting was implemented as a new strategy for central banks to use. The central banks decided not to use money growth as the main target anymore since it was noticed to be more efficient to set inflation targets that are considered as more of a long-term target. However, besides all the benefits, inflation targeting has also its weaknesses. One of them is that the effect of inflation on policy actions takes time and thus central banks can face difficulties

when deciding what actions need to be implemented so that they are able to reach the inflation target set. (Abel et al., 1998, p.601-602).

Managing the price stability is the main duty of the European Central Bank. Price stability helps the economy to be at a stable level as well and thus long-lasting deflation and inflation can be prevented. When the central bank makes sure that the price stability remains at a sufficient level, it affects the economy in a long run so that the economy is able to develop, and it also has an indirect impact on the income growth. (European Central Bank, 2011, p.55-56, 58).

Nevertheless, the target of the Riksbank is also to keep the price stability on a set level. The inflation target is two percent, and it is measured by the CPIF which refers to the consumer price index with a fixed interest rate. When maintaining this inflation level, it helps the economy to grow. (The Riksbank, 2023).

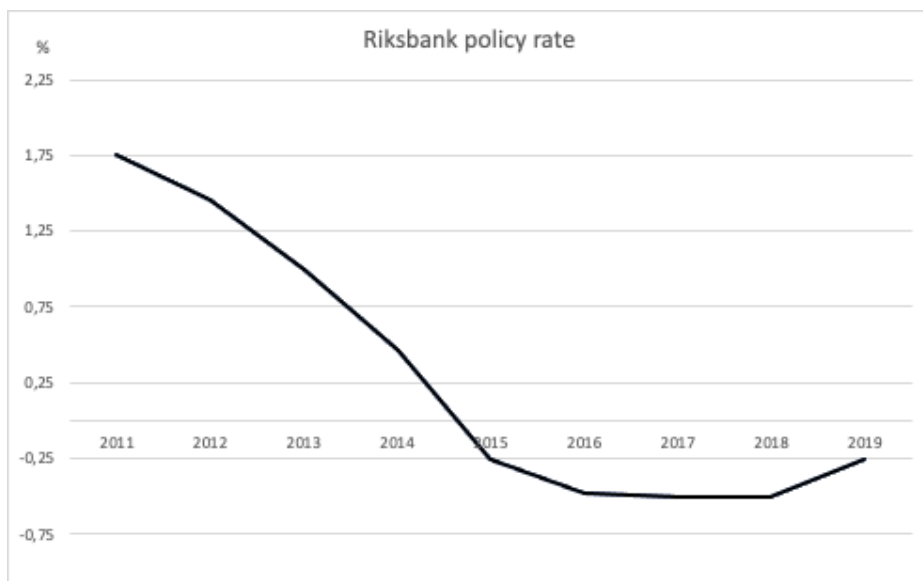
Also, the European Central Bank is able to control short-term interest rates as well as have an impact on the money market conditions. Therefore, the central bank can affect the economy by controlling the interest rates and money market conditions. The central bank is also the only issuer of the monetary base so it can have an effect on the economy through different actions. However, the central bank is not able to control the growth of the economy in the long run by affecting the money supply, it can only indirectly have an impact on it. (European Central Bank, 2011, p. 55-56).

### **2.1.2 Negative interest rates**

After the financial crisis when inflation was at a very low level and the economy was slowly recovering from the crisis, some central banks decided to cut their main policy rates to a negative level. The European Central Bank decided in June 2014 to decrease the deposit facility (DF) rate into the negative territory, to -0.10 percent at the time, and after the decision, the DF rate decreased even more. However, the European Central

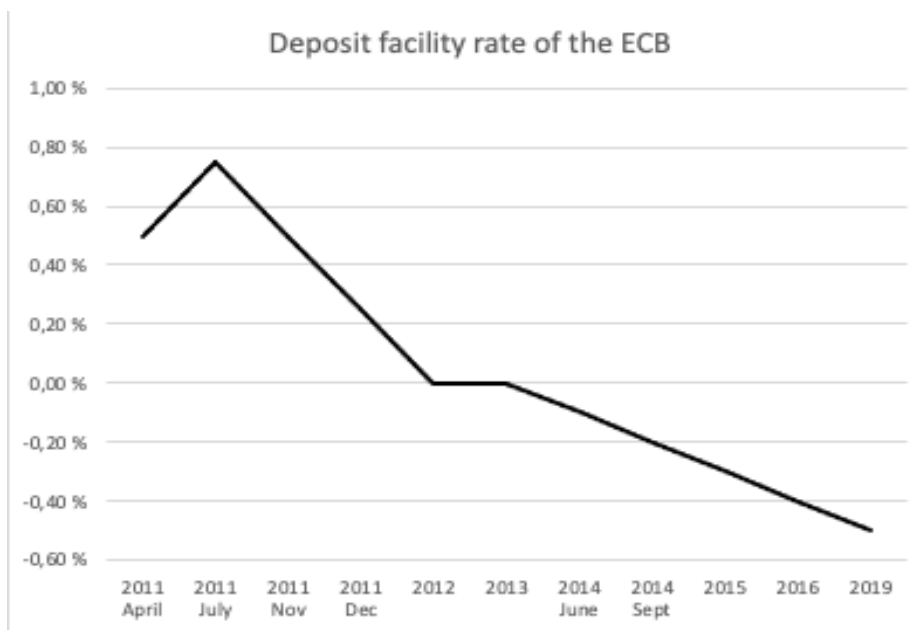
bank was not the only one to reduce the policy rates. Also, the central banks in Sweden, Denmark, Switzerland, and Japan decided to go to a negative level with their policy rates. (Heider et al., 2019).

Figure 1 shows the development of one of the main interest rates of Riksbank. As can be seen from the figure, interest rate radically decreased after the year 2011. The interest rate went to a negative level in 2015 and remained on that level for four years and as can be observed from the figure, interest rate is rising again in 2019.



**Figure 1.** Riksbank policy rate. (The Riksbank, 2022).

Figure 2 shows the deposit facility rate of the European Central bank. The DF rate has decreased steadily after July 2011 and is still on a negative level in 2019. In year 2019 the deposit facility rate is at the lowest it has been during the observation period, being -0.50 percent.



**Figure 2.** The deposit facility rate of the ECB (European Central bank, 2021b).

The main target of the negative interest rates is to get money to circulate in the economy. To get money to circulate in the economy, businesses and households should spend or invest more money so that the economy would function better, and the negative interest rates would not be needed anymore. Negative interest rates provide monetary stimulus, which will have an impact especially on banks so that they will have then an incentive for lending to the real sector to avoid paying negative deposit rates. (European Central Bank, 2022a).

In Sweden, the repo rate was the policy rate that went negative in February 2015, for the first time in history, to help to increase the inflation to the targeted two percent level. The Riksbank, the central bank of Sweden, decided to implement the negative repo rate by gradually decreasing it over the months. Also, the negative repo rate has not affected the household deposit rates, unlike in Denmark and in Germany, and thus banks have not faced any unusual rush from the customers to try to withdraw their savings from the banks. In December 2019, the Riksbank decided that the repo rate no longer must

remain negative. After that decision, the repo rate was increased to zero. (The Riksbank, 2019).

### **2.1.3 Central Bank's balance sheet policy**

Central banks have balance sheets like any other company or bank also have. By paying attention to central banks' balance sheets, it is possible to know the central bank money supply. When observing the changes in central banks' balance sheets' assets and liabilities, it is possible to find out which of their operations do have an impact on the base money. (Tarkka, 1993, p.171).

The global financial crisis has left a permanent mark on the economy and on the function of central banks. Central banks have introduced new policies after the financial crisis, as they have decided to expand their balance sheets. Central banks also have changed the structure of their balance sheets. Tools that they have used to implement the new policies are mainly large-scale asset purchase programmes and special credit operations. Especially asset purchase programmes have been often used as a monetary policy tool for the central banks after the financial crisis. (BIS Markets Committee, 2019).

The reason why central banks implemented large-scaled asset purchase programmes, known also as Quantitative Easing (QE), as one of the monetary policy tools is that by doing so, they are able to affect the long-term interest rates (Chen et al., 2012). Asset purchase programme (APP) of the European Central Bank aims to keep the inflation target, and therefore the price stability, on a set level by purchasing, for instance, bonds (European Central Bank, 2022b).

Several reasons have been identified for the central banks' increased use of balance sheets as part of their monetary policy. One of the main reasons is to prevent the onset of a new financial crisis and central banks can reach this target by responding to financial stress by using monetary policy instruments. Another reason for the increased use of balance sheets is the central banks' need for providing supplementary monetary

accommodations to ease the current financial stress. The central banks can execute this by decreasing long-term interest rates. (European Central Bank, 2015).

The balance sheet of the Riksbank has increased in large measure over the past years when comparing to the size of the balance sheet during the financial crisis. This is the result of substantial asset purchases and lending to banks. These actions are implemented for the Riksbank to stimulate the economy and to meet the inflation target eventually. (The Riksbank, 2020).

## **2.2 Channels of monetary policy**

In this chapter, three different monetary policy transmission channels are introduced. These are the *interest rate channel*, the *credit channel* which is divided into the *bank lending channel* and *balance sheet channel*, and the *exchange rate channel*. The purpose is to take a closer look at these theories to understand how monetary policy is transmitted into the real economy.

### **2.2.1 The interest rate channel**

The interest rate channel can be considered to influence real long-term interest rates, not nominal interest rates. Central banks can have an impact on the short-term nominal interest rate which in turn affects directly short-term real interest rate as well because the expansionary monetary policy and sticky prices are causing it. (Mishkin, 1996). Also, when policy rates are modified, deposit rates, as well as lending rates, can be indirectly affected when the modification impacts money-market rates (Beyer et al., 2017).

The central banks hold the base money which is distributed to the banking system in order for the banks to be able to, for instance, meet the minimum reserves requirements of the central banks. Hence, the central bank can manage its interest rates since it

oversees the base money and therefore it is also in charge of the funding cost that banks need to compensate of the liquidity. This in turn transmits to the clients of the banks when giving loans to them because the banks must compensate for their expenses. This enables the central bank to affect money market interest rates and thus have an impact on other interest rates as well. (European Central Bank, 2011, p. 59).

The interest rate channel can also have an impact on inflation. When real interest rates are affected by the movements of nominal interest rates, households and companies do get their share of the impact of these movements. For instance, increasing cost of borrowing can influence the demand and supply of goods which in turn may decrease inflation. (Beyer et al., 2017).

### 2.2.2 The credit channel

The credit channel can be divided into two sub-categories. These categories are the bank lending channel and the balance sheet channel which are viewed when asymmetric information is observed amongst the financial markets. When asymmetric information is observed amongst the credit market, banks are seen as an important part of the financial system since they are able to find solutions to the issues that credit markets are facing during that time. (Mishkin, 1996).

$$M \uparrow \rightarrow \text{bank deposits} \uparrow \rightarrow \text{bank loans} \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow, \quad (1)$$

Formula 1 above, formed as Mishkin (1996) has introduced it, shows what will happen when expansionary monetary policy actions are implemented in the economy. First, expansionary monetary policy ( $M \uparrow$ ) expands the amount of deposits and reserves that banks hold, and therefore the amount of available bank loans also grows. Hence, this effect will also boost investment and other spending as well. (Mishkin, 1996).

When interest rates are increasing, it affects the borrower's ability to pay back the loans that they have taken. This in turn affects banks so that they are reluctant to lend money



to borrowers that are at risk for not paying back their loans. This is called as the bank lending channel. (European Central Bank, 2011, p.60).

The balance sheet channel refers to situation where the interest rates have affected borrowers as it was described in the previous paragraph and as a result the borrowers are not able to make new investments or to consume normally. Also, higher interest rates do affect the balance sheets of firms by weakening their net worth and therefore, firms cannot get loans as easily. (European Central Bank, 2011, p.60).

### **2.2.3 The exchange rate channel**

The exchange rate channel is one of the channels that is used as transmission mechanisms of monetary policy. This channel considers the interaction between the domestic nominal interest rate and the foreign nominal interest rate. When the foreign nominal interest rate is below the domestic nominal interest rate, the domestic currency begins to strengthen to the direction of the foreign exchange rates. When this happens, the domestic currency can then be seen as a more appealing currency to invest in. Also, there can be a situation where it is more expensive to buy domestically produced products than products that are produced abroad which is due to the problem of slowly adjusting prices. (Beyer et al., 2017).

The exchange rate channel is closely related to inflation. For instance, inflation can diminish when imported goods gets cheaper through increasing exchange rate and if these goods are used in the process of making other products, then lower prices are transmitting also to the end products. Overall, when the exchange rate is strengthening inflation is in turn decreasing. However, the effect of the exchange rate is smaller for economies that are larger than smaller economies. (European Central Bank, 2011, p.61).

Also, when prices are at a sticky level, the exchange rate channel passes through the impact of fiscal policy. Therefore, the fiscal policy can have an impact on the

macroeconomic performance. This can be an issue if the profitability of companies is decreasing because of the increased spending of government. The situation can be like this when the foreign currency prices are exogenous and if at the same time the domestic nominal wages are not elastic enough. (Lane & Perotti, 2003).

### **2.3 The reversal interest rate**

Brunnermeier and Koby (2018) introduce a theory of the reversal interest rate. They refer by it to the situation where accommodative monetary policy have a reversal impact to it, and as a result, bank lending is decreases by it. They created this theory to get to know what is the lower bound that monetary policy has and is at the same time still effective. They emphasize that the reversal interest rate can also be negative or positive, and does not have to be zero.

The reversal interest rate is not taking into account all the different monetary policy channels that can impact the real economy and banks. The theory of the reversal interest rate only considers the bank lending channel and the balance sheet channel. Therefore, for example, the European Central Banks' long term refinancing operations are not taken into account in this theory since the bank margins could have been reduced by the impact that low interest rates have on the margins. (Brunnermeier & Koby, 2018).

The reversal interest rate, that Brunnermeier and Koby (2018) have presented, has four different factors; long-term fixed-income funds of the banks, the capitalization of the equity that banks have, flexibility in the supply of bank deposits, and how strict the capital constraints are. They claim that when the initial holdings of banks' assets are on a higher level, and therefore the revaluation of assets is more substantial, the reversal interest rate is declining. In turn, they show that the reversal interest rate is increasing when the deposit supply flexibility rises during the interest rates are declining, and also the profits of the banks are quickly decreasing.

Brunnermeier and Koby (2018) also point out that Quantitative Easing (QE) affects reversal interest rate by raising it. They say that long-term fixed-income investments are removed from the balance sheets of the banks because of the QE. They argue that after the cuts would be made to the interest rates, Quantitative Easing should be used, not before that.

### **3 Traditional banking activities**

This chapter introduces traditional banking activities, which are in this case lending and deposits. These are critical aspects for banks since deposits and lending are an important part of the core business of the banks. The purpose of this chapter is to give an insight on bank lending and deposits to be able to fully understand the empirical part of the thesis later on as well as the literature review.

#### **3.1 Bank lending**

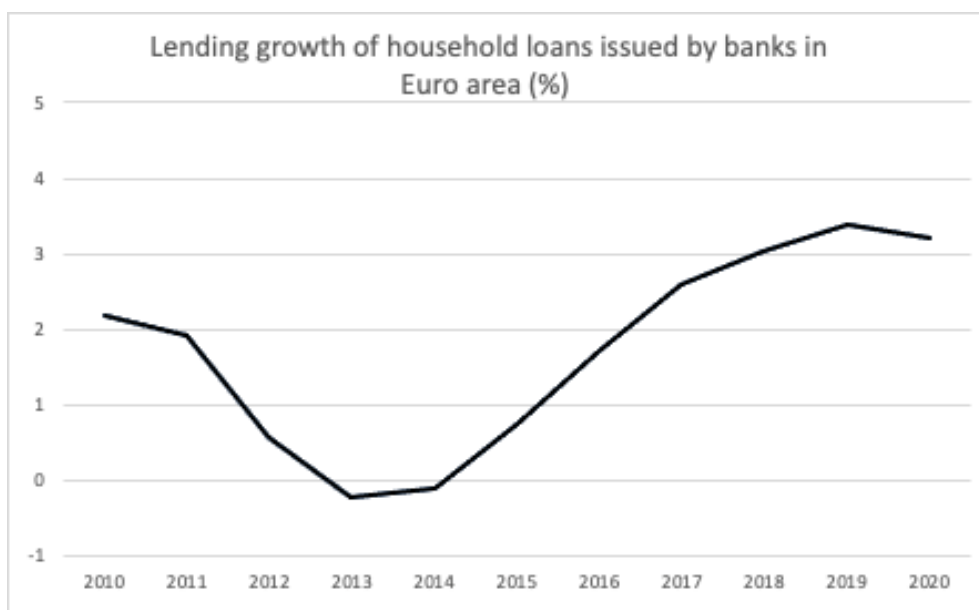
Loans are the most important asset for commercial banks and thus these banks would not function properly without issuing loans. Loans solely form on the average two-thirds of all the assets that commercial banks hold. Loans can be categorized into five different categories. These categories are business loans, consumer loans, real estate loans, inter-bank loans, and other types of loans. There is also variation between the loan issuing banks since for example commercial banks tend to grant loans mainly to companies and credit unions on the other hand issue mainly customer loans. (Cecchetti, 2008, p. 274-275).

Even though loans are profitable and important for banks to issue, there are some weaknesses too. Loans are illiquid products and thus banks are not in most cases able to liquidate those in cash in advance before their maturity. Also, loans are a very risky asset from the perspective of the bank. The reason for this is because of the previously mentioned illiquidity but also because of the possibility of default. (Lucket, 1984, p. 215).

The interest rates of loans consist of three components. These are usually the costs of the funds of the banks, default risk, and the interest that a bank can receive from the investments that it holds. Interest rates of the loans are formed so that the lending rates are on a higher level than the deposit rates. Otherwise, it wouldn't be profitable for banks to lend money. The interest rate depends on the type of loan. Therefore, the riskier

the loan and thus the bigger the risk of default, the higher the interest rate that banks will charge. (Smith, 1991, p. 157).

Figure 3 shows the average adjusted lending growth of household loans issued by banks in the Euro area between years 2010-2020. As it can be seen from the figure, banks have grown the household lending in their balance sheets after 2013. Also, what is interesting to see is that after the European Central Bank announced that negative interest rates are going to be a part of the monetary policy in the euro area, bank lending increased. Koskinen & Kerola state in their article (2019) that the increased lending during declining interest rates may be the result of competition for customers amongst banks and it makes the financing costs decrease which in turn can lead to higher issuance of loans.



**Figure 3.** Lending growth of household loans in the Euro area (Euro area statistics, 2021).

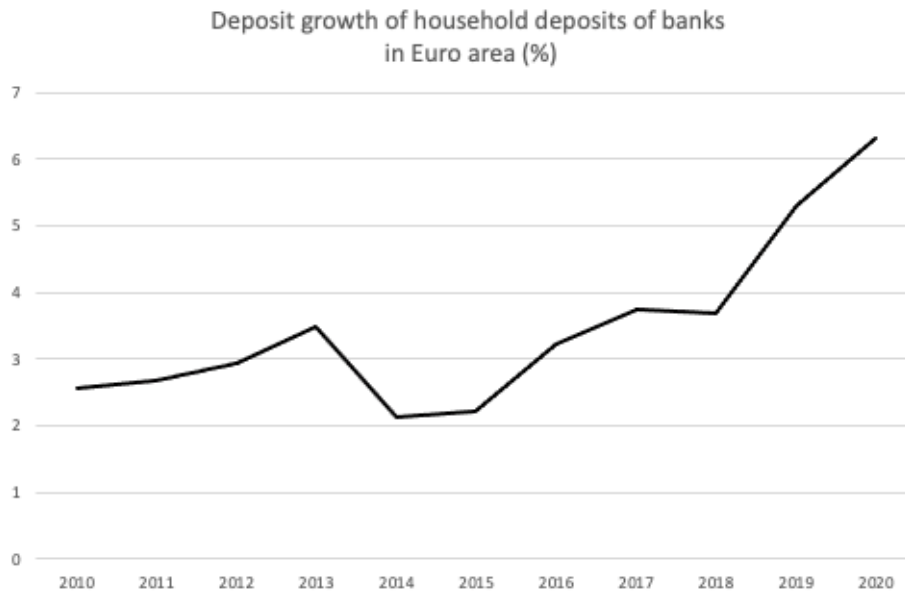
### 3.2 Deposits

Deposits are concerned in banks as liabilities. This is because when, for example, customers decide to save money on their bank accounts, they are really lending their savings to banks. Therefore, banks are able to use the deposits of their customers to fund other functions in order to gain more profits. (Lucket, 1984, p. 207).

Deposits are protected with the European deposit insurance scheme (EDIS) in the European Union's area. This means that deposits that are not exceeding the limit of 100 000 euros are protected and if a bank goes bankrupt, then the national deposit guarantee scheme (DGS) and EDIS step in and the deposits are paid back to those concerned up to the agreed 100 000 euros. (European Commission, 2021). In Sweden, the deposits are protected up to the amount of 1 050 000 Swedish Kronas and the state of Sweden covers the possible losses to the depositors (Riksgälden, 2023). This enables the depositors to feel more comfortable trusting the bank with their assets and they do not necessarily have to think about how solvent the bank is.

Not only do banks hold deposits, but they also have to make deposits themselves. They have to make deposits to central banks. Banks have a minimum reserve requirement, which means that all the banks in the euro area are demanded to place deposits in their national central bank's account and the amount is set in advance. Banks have to hold on their central bank account their calculated minimum reserves on average over the maintenance period in order to be able to fill the requirements of their minimum reserve. (Bank of Finland, 2021).

The below figure 4 shows the average deposit growth for household deposits between the years 2010 and 2020 measured by balance sheets of banks. The deposit growth is measured in the euro area. As can be observed from the below figure, deposit growth has a decreasing trend from 2013 to 2014 and after that, when negative interest rates were first introduced by the European Central Bank, deposit growth has been increasing. After negative interest rates were introduced, it can be seen from the figure 4 that the deposit growth increased radically and has had an increasing trend after that except for the time between years 2017 and 2018 when it briefly decreased for a moment.



**Figure 4.** Deposit growth of household deposits of banks in Euro area (Euro area statistics, 2023).

## 4 Lending under negative interest rates

Since negative interest rates are a relatively new phenomenon compared to some other occurrences in the economy, there is not a wide range of published scientific articles available about negative interest rates and bank lending yet. However, over the past few years, the amount of published scientific articles has increased. This chapter provides a brief review of the most relevant articles about the relation of the negative interest rates and bank lending, regarding this study.

Boungou (2021) research the relation between the negative interest rate policy (NIRP) and the monetary policy lending channel. The sample is gathered between years 2009-2018 and it contains total of 54 countries. The author measures the NIRP-effect on cost of lending, lending maturity, and lending supply and the cross-country research is executed by using the difference-in-differences method.

The findings of the research of Boungou (2021) show that the lending cost has decreased, more loans are granted and especially the supply of loans with maturities from three to twelve months and over five years have increased under the period of negative interest rates. The findings also indicate that the bank-specific characteristics, for example, the size of the banks has a significant impact on the results. The author also finds that large banks holding high amount of deposits, are more affected by the negative interest rates than other banks.

Molyneux et al. (2020) study the negative interest rate policy (NIRP) effect on bank lending with a sample of 33 OECD member countries during the observation period between years 2012-2016. The research compares the countries that have adopted the negative interest rate policy to those that have not implemented the policy and how these countries are behaving regarding their lending volumes during NIRP. They use mortgage loans, gross loans, and commercial and industrial loans as loan categories observed in their research. The method used in their research is the difference-in-differences method as well as propensity score matching (PSM).



As a result, Molyneux et al. (2020) find that NIRP-adopter countries granted fewer loans than non-NIRP-adopter countries. They also discover that this finding is more common to banks which size is smaller, are more subject to interest income and retail deposit funding and are not well capitalized. This implies that negative interest rates do have an impact on bank lending by diminishing it in NIRP-adopter countries. When comparing to the results that Bounie (2021) got, the results are somewhat contradictory since Bounie (2021) implied that the loan supply has increased. However, the sample is gathered over longer period of time so it can cause also the difference in results when comparing these two examinations.

Also, Tan (2019) research the relationship between negative policy rates and bank lending. He studies credit supply, profitability measures and lending rate spreads in the euro area to see if negative interest rates do have any impact on these variables. The research is focused on high-deposit banks as the treatment group and low-deposit banks as the control group. The loan category used in the study is mortgage loans. Difference-in-differences method is also used in this study and the sample is gathered over the years 2013-2015.

The findings of the study, executed by Tan (2019), show that the retail deposit channel functions as a transmission channel for the negative interest rates. The results imply that the banks that were more influenced by the negative interest rates granted more loans than banks that were less influenced by it. Thus, the results differ for instance from the study of Molyneux et al. (2020) for the result.

Heider et al. (2019) study the effects that the negative interest rates have on bank lending and how negative rates were passed on the real economy. Similarly, as Tan (2019), they also study the high-deposit banks and low-deposit banks. However, they are restricting their study only on the syndicated loans, so the research is probably not as extensive as the study of Tan (2019) is but gives specific results. The study focuses on years

from 2013 to 2015 and thus is shorter than the observation periods of Boungou (2021) and Molyneux et al. (2020), but similar to the period that Tan (2019) has.

The results of Heider et al. (2019), also using difference-in-differences method in their research, suggest that negative interest rates have a decreasing effect on the lending of high-deposit banks in contrast to low-deposit banks. Also, these banks seem to be taking more risk than low-deposit banks by granting loans to riskier companies. Their results consider only syndicated loans, and they state that their results do not suggest that the overall lending of banks has declined, they actually point out that the overall lending has rather increased after introducing the negative rates.

The research of Eggertsson et al. (2019) has a slightly different approach than the previously introduced studies. They examine how bank lending channel transmits negative interest rates to the macroeconomy. Also, they study whether the negative rates are transmitted to the deposit rates as well as to lending rates, and to the equity of banks as well as to the volumes of the credit. Their sample is gathered from Sweden, and they are using different methods in their study, for example they create a New Keynesian model. Therefore, their study differs also from the previously mentioned studies by using only one country in their sample.

The results that Eggertsson et al. (2019) have introduced are indicating the transmission of negative policy rates into deposit rates is not efficient and therefore, since deposit rates are not decreasing below zero, lending rates are not either decreasing much. They explain that lending rates and the policy rate are not in connection with each other which can be a consequence of high deposit dependence of the banks. Therefore, they state that the credit growth of high-deposit banks is lower when deposit rate is not responding well to the circumstances.

As can be noticed from the introduced literature, the results of these studies differ a lot with each other. Some studies consider that negative interest rates have affected bank

lending in a positive way and other studies find that lending has decreased after the negative interest rates were introduced as a part of unconventional monetary policy actions. Thus, the results vary and there cannot be drawn any simple conclusion of whether the negative interest rates did boost lending or not since the research settings are varying. However, it can be noticed that the negative interest rates are affecting bank lending.

## 5 Data and methodology

In this chapter the main data and methodology is described. Furthermore, the panel data method is introduced to further understand the results of the study. The main purpose of this study is to find if loan growth, which is the dependent variable also in the model, has increased as the result of introducing negative interest rates in Sweden.

### 5.1 Data description

The data is retrieved from the years 2011-2019 and is restricted to Sweden. The data is not extended further because of the COVID-19 crisis that began in early 2020 in Europe and which is expected to impact the balance sheet ratios as well as the (central) banking sector. Also, the interest rates are not on a low or negative level anymore in 2023 and therefore the data sample is restricted between the years 2011-2019, otherwise incorrect results would have received from the tests.

The European Central bank started using negative interest rates in 2014. After that, the Riksbank, the central bank of Sweden, started using negative policy rate in early 2015 as a part of the unconventional monetary policy tools. Therefore, the period that is considered in this study as a negative interest rate period is from 2015 to 2019.

The annual bank-level data variables used in this study are retrieved from the Fitch Connect database (2021) where the financial statements of the chosen banks are presented. Swedish krona is used as the currency and the results are scaled in millions. The ratios on the other hand are presented in percentages. The banks considered in this study are commercial and retail banks. There are a total of 36 banks observed in this study after removing banks that did not have enough observations from the beginning of the sample period. The data of the macroeconomic variables is provided by the University of Vaasa and the interest rate data is retrieved from the Riksbank's (2022) database.

### **5.1.1 Bank-level data variables**

There is one dependent variable that is used to measure the impact of negative interest rates on bank lending. The dependent variable used in this study is the loan growth in Sweden. The loan growth used as the dependent variable is a yearly measurement of the variable.

There are several bank-level data variables used in this study as control variables. The first of the control variables is the size variable, following Boungou (2021) and Molyneux et al. (2020) who also use the size variable in their studies as the bank-level control variable. The size variable refers to the total assets of the banks in the sample. Therefore, it is the size of the bank. This variable is used in the empirical model as the logarithm of the size variable so the variation in the total assets is taken into consideration.

Also, following Boungou (2021), variables deposit ratio and liquidity are used in this study as well. The deposit ratio is used in this study to measure the ratio of deposits to assets to find out how it affects banks' reaction to negative interest rates. Liquidity refers to the ratio of liquid assets to total assets which also Molyneux et al. (2020) use in their research as a variable. It can be considered as a part of the risk appetite of the banks, and it is a prerequisite for the operation of the banks. Additionally, return on average assets (ROAA) ratio is used in this study to measure the profitability of the banks.

### **5.1.2 Macroeconomic data variables**

Following Boungou (2021) and Molyneux et al. (2020), gross domestic product (GDP) and consumer price index (CPI) are also used in this study as macroeconomic data variables. In this study, the yearly change of the real GDP growth rate is used as a macroeconomic data variable.

Also, the growth rate of the yearly consumer price index (CPI) is considered in this study as another macroeconomic data variable. Unemployment rate was originally included to the sample as well but due to the high correlation with other variables, it was excluded from this study.

## 5.2 Methodology

The method used in this study is the linear panel data model. The linear panel data model is a suitable method to use when there are several variables that are observed over many years. Therefore, every variable can be traced over the years, and it is possible to observe the development of the variables during that time. Panel data also enables to study multiple economic subjects that some other methodologies are not able to do. (Hsiao et al., 2003, p. 1, 3). The panel data method is used in this study since Sweden is the only country of which data is observed in this study over the period from 2011 to 2019 and therefore the panel data is suitable method to observe how lending growth develops during the observation period.

After defining the dataset, it is important to know if the panel data should be estimated as fixed-effects model or random-effects model. It is possible to know by using a Hausman test which indicates on which of the models should be chosen to use in the further tests. The Hausman test assumes that the null hypothesis means that the random-effects model is to be chosen. Therefore, if the test rejects the null hypothesis, then fixed-effects model should be used in the further test. If on the other hand the results from the Hausman test shows that the null hypothesis is accepted, then random-effects model is the model that should be used in further tests. (Guggenberger, 2010; Hausman, 1978).

To find out if there is any impact of the negative interest rates on the lending of high-deposit banks it is done by adding a dummy variable that demonstrates this to the regression. So, the treatment group considers high-deposit banks and the control group low-deposit banks. High-deposit banks consider banks from Sweden that have deposit

ratios above the median during the period of negative interest rates, 2015-2019, and in contrast low-deposit banks are banks with deposit ratios below the median during that time.

### 5.2.1 The panel data analysis framework

To have information about the effects of negative interest rates on loan growth, the panel data method is used. The equation of the basic linear panel data model is formed as follows for this study:

$$\text{Loan Growth}_{i,t+1} = \alpha + \beta_1 \text{Interest rate}_t + \beta_2 \text{Deposit ratio}_{i,t} + \beta_3 \text{Size}_{i,t} + \beta_4 \text{Liquidity}_{i,t} + \beta_5 \text{ROAA}_{i,t} + \beta_6 \text{CPI}_t + \beta_7 \text{GDP}_t + \varepsilon_{i,t}, \quad (1)$$

where

$\text{Loan Growth}_{i,t+1}$  is the dependent variable in every regression model that are going to be reviewed later in this study. It refers to the percentage change in consecutive accounting periods and the variable is lead by one in every regression;

$\alpha$  is the intercept term;

$\text{Interest rate}_t$  refers to the Riksbank's yearly average policy rate;

$\text{Deposit ratio}_{i,t}$  explains the ratio that deposits and assets have;

$\text{Size}_{i,t}$  refers to the logarithm of total assets;

$\text{Liquidity}_{i,t}$  is the ratio of liquid assets divided by total assets;

$\text{ROAA}_{i,t}$  refers to the return on average assets;

$\text{CPI}_t$  is a macroeconomic variable referring to yearly measure of consumer price index;

$\beta_7 \text{GDP}_t$  is a macroeconomic variable referring to yearly measure of gross domestic product;

$\varepsilon_{i,t}$  is the error term;

$i$  stands for a bank and  $t$  refers to time.

Besides the equation 1, two additional equations are formed with dummy variables. Dummy variables are added to the equation 1 on separate regressions to know the effect that they are going to add to the regression results. First regression has a dummy variable that considers the period, years between 2015 and 2019, after negative interest rates. The second regression is only for the period after negative interest rates and the dummy variable explains if the high-deposit banks have a greater loan growth than the low-deposit banks, and years from 2015 to 2019 are forming the sample in this regression.



## 6 Empirical results and analysis

In this part of the study the focus is on the results that are drawn from the researched data. Also, the results are analyzed thoroughly in this chapter to know if negative interest rates have had any impact on bank lending.

**Table 1.** Summary statistics.

Variable	Banks	Obs	Mean	Std. Dev.	Min	Max
Loan Growth	36	324	6.298	5.762	-13.660	24.430
Interest rate	36	324	0.298	0.850	-0.500	1.760
Size	36	324	8.772	2.124	6.420	14.937
Liquidity	36	324	11.816	6.730	0.170	31.610
ROAA	36	324	1.012	0.419	0.100	2.910
Deposits	36	324	75.855	17.289	2.580	91.200
CPI	36	324	1.084	0.963	-0.182	2.626
GDP	36	324	2.137	1.242	-0.270	4.220

Table 1 above represents the summary statistic of the whole dataset from year 2011 to 2019. It can be observed that the interest rates have been changing quite a lot during the sample period. When being on the most negative level the interest rates remained at -0.5 percent and the highest it remained during the sample period is at 1.76 percent. Thus, it certainly did go below zero significantly during the sample period. Also, it can be noticed that the loan growth during the sample period has been both increasing and decreasing and therefore not only growth has been occurring during the observed period.

**Table 2.** Pearson's correlation matrix.

	Loan Growth	Interest rate	Size	Liquidity	ROAA	Deposit ratio	CPI	GDP
Loan Growth	1							
Interest rate	-0.3371	1						
Size	-0.0630	-0.0723	1					
Liquidity	-0.2742	0.2885	0.2276	1				
ROAA	0.1334	0.0074	-0.1526	-0.2725	1			
Deposit ratio	0.0626	-0.0004	-0.8871	-0.2442	0.1860	1		
CPI	-0.1861	0.0119	0.0172	-0.0873	-0.1105	0.0368	1	
GDP	0.1062	-0.2928	0.0043	-0.1142	-0.0044	-0.0043	0.0123	1

On the above, Table 2 shows Pearson's correlation matrix. This table indicates how much correlation there are between the observed variables and how the variables are correlating with each other. The results are taking the value between 1 and -1. It can be, for example, seen that loan growth and interest rate has a negative correlation. This means that when loan growth increases, the interest rate decreases and when on the other hand loan growth decreases, the interest rate increases.

**Table 3.** Variance Inflation Factor (VIF).

Variable	VIF	1/VIF
Size	4.95	0.202
Deposit ratio	4.94	0.202
Liquidity	1.28	0.782
Interest Rate	1.24	0.807
ROAA	1.14	0.880
GDP	1.10	0.911
CPI	1.05	0.953
Mean VIF	2.24	

Variance inflation factor (VIF) test is also made besides other tests to know if there is multicollinearity between the variables on the sample. The results, that can be seen from Table 3, of the VIF test indicates that VIF is not on a too high level for any variables observed on this test after excluding unemployment rate which increased VIF levels remarkably. Therefore, multicollinearity, that would be on a too high level, does not exist on the sample.

Hausman test is also done to be able to recognize which one of the two models fixed-effects model or random-effects model should be used on the second stage of the tests after resolving the previous question. Based on the executed Hausman test, fixed-effects model is used in panel data regression in this study for every regression since the p-value is at a significant level.

**Table 4.** Regression results for finding out if interest rates are affecting loan growth (column 1), if negative interest rates affect loan growth (column 2) and if high-deposit banks have greater loan growth during negative interest rates than low-deposit banks (column 3).

VARIABLES	(1) Loan Growth	(2) Loan Growth	(3) Loan Growth
Interest Rate	-3.731*** (0.893)	-2.409* (1.457)	31.99 (23.77)
Size	-12.99*** (4.543)	-11.86** (4.645)	-21.84 (14.63)
Liquidity	0.243*** (0.0696)	0.238*** (0.0697)	0.215* (0.128)
ROAA	0.571 (1.142)	0.811 (1.160)	2.164 (3.192)
Deposit Ratio	0.0603 (0.136)	0.0583 (0.136)	1.097** (0.428)
CPI	-1.189*** (0.343)	-1.472*** (0.422)	1.971 (2.926)
GDP	0.0437 (0.257)	0.0198 (0.257)	-1.500 (1.485)
Negative Rates Dummy		2.135 (1.860)	
High-Low-Deposit Bank Dummy			-6.316 (4.046)
Observations	288	288	144
Number of Banks	36	36	36
R-squared	0.223	0.227	0.313
Adjusted R-squared	0.090	0.091	0.018

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results of three different regressions are presented in Table 4. Fixed-effects model is used for all three regressions. Results in column 1 represents the whole sample between years 2015 and 2019 and do not include any dummy variables. The results of the column 2 include a dummy variable *Negative Rates Dummy* which indicates to the time after the

negative interest rates were implemented in Sweden, taking the value 1 if the observation is in 2015 or later, otherwise it is taking the value 0.

In the column 3, the results are gathered from the period after Sweden introduced the negative rate policy so the observation period in this regression includes years from 2015 to 2019. Also, a dummy variable is used in this regression to show if high-deposit banks are issuing more loans than low-deposit banks. The dummy variable called *High-Low-Deposit Bank Dummy* is taking the value 1 if the bank is over the median in deposit ratio during that time and value 0 if the banks' deposit ratio is below the median.

When interpreting the results of the different regressions, it can be observed that in column 1 and column 2 the interest rate is statistically significant in both models. In this case the relationship with loan growth and interest rates is negative meaning that interest rate is decreasing when loan growth increases. For example, when analyzing the relationship between interest rate and loan growth in column 1, it can be noticed that when interest rate would increase by 1 percent, the loan growth would decrease by 3.73 percent. With column 2 the relationship is similar but now the loan growth would decrease by 2.41 percent. Therefore, it can be said that the interest rates do have an impact on bank lending by increasing it when the interest rates decrease or go to a negative territory. Furthermore, when observing the column 3 the interest rate variable is not statistically significant anymore in this model and therefore no significant further assumptions can be made from it.

The results of both columns 1 and 2 are rather similar with each other. The variables that are significant on both columns are the *Size*, *Liquidity* and *CPI*. It seems that the size of the bank is negatively related to the loan growth. Therefore, when the bank is lending more, the size of the bank gets smaller regarding their total assets. Unlike other variables, that have a negative relationship with the loan growth, the liquidity of the banks does have a positive and strongly statistically significant relationship with the loan growth. Therefore, it can be summarized that banks that increase their lending are also

increasing their liquidity. In line with the variables interest rate and size, the consumer price index (CPI) variable does have a negative relationship with the loan growth. Therefore, it can be stated that when the overall inflation increases in Sweden, the lending growth decreases at the same time.

When observing only the regression results in column 3 it can be noticed that only two variables are statistically significant. The variables that are significant in this column are deposit ratio and liquidity. Liquidity has a positive relationship with loan growth as in other regressions as well. It can be noticed that during the period of negative interest rates, banks that increase their deposit ratio also issue more loans. Therefore, the deposit ratio is impacting the loan growth during the negative interest rates by having a positive relationship with the dependent variable meaning that it increases when loan growth increases.

It can be noticed that some of the variables are not significant in any of the regression results. One of them being the return on average assets (ROAA) and the other being the gross domestic product (GDP). Also, either of the dummy variables are not statistically significant. Regarding other variables that are considered in every regression model, there are always at least one statistically significant result amongst the three regressions results with those variables.

It is rather difficult to compare the results of this study to the existing literature regarding the impact that negative interest rates have on bank lending since the other studies are not conducted on the exact same manners as this study is, and most of them are not solely studying the overall lending growth of one country or multiple countries. Previous studies use mostly the difference-in-differences method, and this study uses the panel data method. Also, in other studies the research design is not exactly the same. However, it is possible to compare if the results are similar with some of the other studies and point out if the end result is as in this study or not.

Therefore, to conclude, the interest rates do have an impact on bank lending, and the rates do have a negative relationship with the lending growth. Hence, the results differ, for instance, from the results of Molyneux et al. (2020) who found that the countries that have implemented the negative interest rate policy are issuing less loans during the time when interest rates went negative than countries that did not adopt negative interest rate policy. When looking closer to the results of Molyneux et al. (2020) it can be seen that one of their tables show individual results for lending, and it seems that Sweden would have decreased their lending after the adoption of negative interest rate policy. Therefore, the results of Molyneux et al. (2020) differ from this study where there is negative relationship between loan growth and interest rate and it can be assumed that when interest rate decreases, the loan growth increases. However, the observation period of Molyneux et al. (2020) is shorter than in this study so that can also explain the difference.

However, the results of Boungou (2021) are similar than the results of this study. He shows that the loan issuance has increased under the negative interest rate period. Therefore, the results are matching with the results of this study in that manner. Nevertheless, the results of this study are difficult to compare with the other study from Sweden that Eggertsson et al. (2019) have conducted since they are examining more the lending rates rather than lending growth of the banks. However, they found out that credit growth of the high-deposit banks is on a lower level during the negative interest rate period so therefore the overall result of this study is not quite in line with the findings of Eggertsson et al. (2019).

Therefore, it can be noticed that the results of this study are rather unique at this point in time since there are no other studies, according to the current knowledge, about researching solely the relationship that negative interest rates have on lending growth in Sweden. The limitations of this study may be the rather low r-squared and adjusted r-squared but despite of that, most of the control variables are statistically significant when observing the regression results.

## 7 Conclusions

The European Central Bank has introduced negative interest rates as a part of the unconventional monetary policy actions in 2014 and the Riksbank introduced negative interest rates a year later in 2015. The reason behind decreasing the interest rates to a negative level was that the banks would not want to store their deposits anymore and that they would issue more loans to households and to corporates. This should influence the whole economy since households could get loans more easily since the interest rates are at a lower level. As a consequence, more money would circulate in the economy since consumers are spending more money and not just saving it for the future.

Previous literature about negative interest rates and bank lending shows that there is not a unanimous answer if the negative interest rates have had an impact on bank lending or not. Some say that it has had an effect and some say that it has not. However, it should be noticed that the research settings are different and therefore it is difficult to generalize the results. Nonetheless, it can be concluded that there is not a single expected outcome when examining the relationship between bank lending and negative interest rates.

This study shows that there is a negative relationship between lending growth and interest rates in Sweden. Therefore, when lending growth increases, interest rates are simultaneously decreasing. Unfortunately, there is not strong or statistically significant evidence about the impact that negative interest rates have on lending growth or to the high-deposit banks and low-deposit banks. The results only imply that there is a positive relationship between loan growth and deposit ratio so when bank lending increases, then also the deposit ratio of the banks increase as well. To conclude, interest rates do have an impact on bank lending in Sweden. When interest rates are decreasing, lending growth of the banks is increasing.

Suggestions for further research could be that the country selection would be expanded to Nordic countries, excluding Iceland which has not implemented low or negative rate

policy. With this selection it would be interesting to see if the negative or low interest rates are passing through to the lending growth of these countries and if the results would be similar compared to the results of this study where Sweden was only researched. It would also be interesting to research if banks that have hedged against interest rate risk are more likely to grow their lending or not compared to banks that have not hedged against the interest rate risk.



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