

Negative Deposit Rates as a Central Bank's Policy Tool
Theory Overview and Experiences from Europe

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Abstract

This paper uses the theoretical framework of zero lower bound and the transmission channels of monetary policy to inspect why the interest rates cannot go negative and how the adjustments of central banks deposit rate transmit to the real economy. I review these presented theories by comparing them to the empirical results obtained from the banking sector of Europe to determine why the central banks deposit rates have been able to go negative and if there are any adverse effects related to this crossing of zero lower bound.

For the theoretical framework I mainly use the transmission channels presented by Mishkin (1996), mathematical presentation of zero lower bound by McCallum (2000) and empirical results from several authors. I find that the deposit rate mainly operates through the bank lending channel, but this specific channel has not been operating according to the theory especially after the financial crisis. I also find that of all the different interest rates, the zero lower bound concerns most specifically the deposit rate, as it determines whether it is profitable to hold assets as deposits or as cash and that it has to be always lower than lending rate, therefore possibly breaking the zero lower bound always first. The absoluteness of the zero bound however has not been tested yet empirically, as no commercial bank has introduced a negative deposit rate that would concern all their clients, even though central banks have implemented negative deposit rates. I also find that the banking sector has been able to absorb the costs of narrowed margins by increasing other forms of income, such as fees, and no notable risks has arisen during the period of negative interest rates.

Keywords negative interest rate, deposit rate, zero lower bound, transmission channel

Contents

Abstract.....	2
1. Introduction.....	4
2. Deposit Rate as Part of Unconventional Measures.....	5
2.1 Overview of Unconventional Measures Taken.....	5
2.2 Policy Rates and Lending Rates.....	5
2.3 Deposit Rate.....	6
2.4 Motives for Setting Negative Deposit Rates.....	7
3. Theory of Transmission and Constraints of the Deposit Rate.....	8
3.1 Origin of Zero Lower Bound and Liquidity Trap.....	8
3.1.1 Theory of Zero Lower Bound.....	8
3.1.2 Liquidity Trap.....	11
3.2 Transmission Channels of Monetary Policy.....	12
3.2.1 Traditional Interest Rate Channel.....	13
3.2.2 Credit Channel.....	13
3.2.2.1 Bank Lending Channel.....	14
3.2.2.2 Balance Sheet Channel.....	14
4. Empirical Findings.....	15
4.1 Bank Behavior and Profitability.....	15
4.2 Bank Lending and Transmission of Monetary Policy	16
5. Discussion.....	18
5.1 Was Zero Lower Bound Actually Broken?	18
5.2 Helicopter Money – Solution for Zero Lower Bound?.....	19
5.3 Transmission Channels Under NIRP.....	21
5.4 Are We in a Liquidity Trap?.....	21
5.5 Conclusion and Limitations of the Study	22
6. References.....	24

1 INTRODUCTION

June 2014 marked another addition to the list of unconventional measures taken by the European Central Bank (ECB) after the financial crisis, when as the first major central bank it lowered its deposit facility rate to negative territory. The decision to use negative rates was partly in conflict with already established economic theory, e.g. theory of zero lower bound and promoted a lot of discussion and research on the revision of assumptions of these theories and on the effectiveness of this policy tool.

As of now the ECB's deposit rate has sunk into negative 40 basis points and the period of Negative Interest Rate Policy (NIRP) has lasted for 5 years in the countries under ECB's governance and even longer in some other European countries with sluggish growth driving the economy forward for now. But what have been the effects of this policy and how exactly have these effects transmitted to the real economy? To answer this question, I review in this paper the channels that deposit rate uses to transmit monetary policy through commercial banks to the real economy, presented by Mishkin (1996) and other main theories most relevant to this policy tool, such as the zero lower bound for which I mainly use the mathematical presentation of McCallum(2000).

The goal of this paper is to deconstruct the established chain of effects started by adjustments in central banks deposit rate by examining literature on the theories and previous assumptions related to the subject and reviewing them with recent empirical research from the NIRP-period to see the reasons behind the decision to apply negative rates and whether the results of this policy have been as expected. I will leave outside of our scope the other unconventional measures taken by European central banks or the total effects to the real economy as I specifically focus only on the deposit rate and the channels which it uses to transmit policy changes to real economy through bank lending. I will also limit the geographical scope to Europe and use empirical results from European Monetary Union area and some members of European Union with their own currency and negative deposit rates. These countries include Switzerland, Denmark and Sweden. The paper is structured as follows:

First, I take a short general view on the variety of unconventional measures and make the difference between the deposit rates and other policy rates used by central banks to clarify the definition of this policy tool and separate it from other similar tools. I finish the introduction of the subject by peeking into the motives behind decision of lowering the rate to negative territory from the viewpoint of different European central banks.

Next, I introduce the theoretical framework for zero lower bound and two transmission mechanisms of monetary policy also known as the interest rate channel and credit channel, the latter dividing further into balance sheet channel and bank lending channel. I exclude from our scope of the study the portfolio channel and exchange rate channel.

In the empirical literature review section, I review empirical findings from several authors in contrast with established theoretical framework to find out, whether the implications of binding zero lower bound are correct when inspecting from deposit rates point of view and what are the effects on the transmission channels. In the end of this paper I identify that the bank lending channel is the main transmission channel for the central banks deposit rate and I conclude that the introduction of negative interest rates itself has not brought changes to the transmission mechanisms of monetary policy, but the negative deposit rate might actually be a measure to fix a broken bank lending channel. I also conclude that the zero lower bound cannot be absolutely said to have been crossed, as not a single commercial bank has introduced negative deposit rates that would concern all their clients. I also present an extremely simplified scenario analysis how helicopter money could be a better way to introduce further monetary expansion than negative lending rates and use this scenario also to review how come Jyskebank has been able to offer mortgages with negative rates. I start with the overview of unconventional measures taken during the last decade.

2 DEPOSIT RATE AS A PART OF UNCONVENTIONAL MEASURES

2.1 Overview of Unconventional Measures Taken

As a reaction to the sudden lack of trust between commercial banks, central banks all over the world implemented different measures to prevent the effects of financial crisis from spiraling out of control. Central banks had responded by easing the monetary conditions with conventional measures, but new methods were needed as the results from these measures didn't have enough impact. Most sovereigns resorted to quantitative easing with programs such as large-scale asset purchase programs (LSAPs) in United States or Securities Market Programme (SMP) in Europe (Eser & Schwaab (2016)), but to further signal the continuity of eased monetary policy new tools, such as forward guidance, were brought along. The decision to lower deposit rates to negative territory was a part of this set of tools and since each tool had different objectives, identifying the characteristics of the deposit rate is necessary to see its role in the big picture of unconventional measures, as well is describing the reasons why different sovereigns decided to implement it.

2.2 Policy rates and Lending Rates

Central banks in Europe and elsewhere adjust their policy rates depending on the economic situation and even though the general term of "policy rate" is often used when describing central banks actions, there might be confusion to which policy rate they refer, as the features vary across the central banks.

For this reason, I separate the properties of different policy rates and specify different rates used in selected economies.

Policy rates can be generally divided based on whether the rate is used for deposits or lending and whether they are for short-term or long-term operations. Sometimes the deposit rate and lending rate are even combined – as in case of Riksbank’s main policy rate, the repo rate, which is a rate of interest at which banks can either deposit or lend for a period of 7 days, whereas the term deposit rate is used only for overnight deposits in Riksbank. In comparison, Federal Reserve’s main policy rate, the Federal Funds Rate describes the average interest rate at which commercial banks lend overnight their surplus balances in the federal reserve accounts to other banks, a so-called interbank rate. Compared to Sweden’s main policy rate, it is not used for deposits at all and is a much more short-term rate which makes these two policy rates almost incomparable.

As the properties of the central bank’s main policy rates differ sometimes greatly, authors usually do not specify the rate that they are referring to but use general terms such as policy rate or nominal interest rates, when describing general changes in the interest rate level in academic papers. For example, Jobst and Lin (2016) use the term “marginal policy rate” when presenting ECB’s negative interest rate policy, but there is no specification what rate this marginal policy rate is referring to. This might be easily confused with ECBs marginal lending rate which actually has not been negative, like the deposit facility rate. Examples like this call for clarification as especially in case of the theory of zero lower bound it is critical to know whether we are referring to the deposit rate or lending rate when discussing the implications of going negative. However, when describing directional changes in monetary policy, the more-vague references can be accepted as deposit and lending rates usually move in the same direction within a certain margin. In ECB’s case the margin between main refinancing operations rate and deposit facility rate has varied but stayed within one percent margin whereas Riksbank has more strictly declared the deposit rate to be normally fixed at 0.75 percent lower than the repo rate.

2.3 Deposit rate

As seen, the different policy rates used for lending differ sometimes greatly, but even though the deposit rate is a much simpler rate, it also has differing characteristics. Next, I cover the general properties of the deposit rate and review how they were lowered below zero in the economies included in our study.

A deposit rate usually does not have similar short-term and long-term versions as lending rates and although commercial banks offer possibility to deposit for a fixed term, central banks generally have

one deposit rate for overnight deposits. The differences might arise from how the bank treats the deposits that are required to deposit in the bank and excess reserves in addition to these required reserves. In ECB's case they use their main lending rate, the MRO-rate, for all required reserves and the deposit facility rate for all excess reserves. Therefore, the deposit rates can be divided to interest on required reserves, i.e. IORR, and interest on excess reserves, an IOER-rate, from which the former in ECB's case is positive, encouraging to meet the reserve requirements, and the latter negative, penalizing for excess reserves. In this paper when I refer to the deposit rate, I use the ECB's deposit facility rate or IOER-rate as the basis for discussion from now on. Further effects of negative deposit rates are discussed later in this paper, but some preliminary motives have been identified for ECB and other central banks that decided to go negative.

2.4 Motives for Setting Negative IOER-Rates

Several central banks in addition to the ECB also decided to go negative during the period of 2011 to 2015, but as every economy has its own features, I inspect the variety of motives between central banks in Europe.

Denmark was the first country to go negative in 2012 and according to Turk (2016) Denmark, which pegs its currency to Euro, had incentives to penalize capital inflows and to prevent currency speculation. The next one to go negative was the European Central Bank in 2014 and there has been some discussion whether the decision was a truly a new and separate measure to induce monetary easing when other unconventional measures had reached their limit, as Demiralp et al. (2017) suggest, or whether it was only part of forward guidance, strengthening the expected future level of low interests as Jobst and Lin (2016) present. Switzerland followed shortly ECB and Demiralp et al. (2017) see that the motives were similar to Denmark's, as the Swiss currency was under a lot of speculation during the previous years, making Switzerland to introduce an upper bound for currency appreciation in 2011. The introduction of negative rates in Switzerland coincided with the removal of the appreciation cap from Swiss franc. The last of the central banks reviewed here, Sweden's Riksbank, lowered its policy rate negative in 2015, using it to strengthen the credibility of its inflation target (Turk (2016)).

Several economies, especially the smaller ones, seem to have had some incentives related to their currency but ECB had different challenges. According to Arteta et al. (2016) the ECBs purchase program was beginning to be constrained by decline of the net supply of eligible assets and the commercial banks were also hoarding excess reserves, preventing the transmission of lending to households. Arteta et al. (2016) also provide a more overall view of the common reasons behind negative rates in Europe, by suggesting that spare capacity was still present in many advanced

economies and inflation level was under targets, all which enabled for another policy tool to be added to combat the possible deflation.

3 THEORY OF TRANSMISSION AND CONSTRAINTS OF THE DEPOSIT RATE

Economic theory has an established set of monetary policy transmission channels and although some of them have been under debate (see Bernanke (1995)), whether they can be described as real channels or merely amplifying factors, the original theories presented in this section still hold firm ground when monetary policy transmission mechanisms are discussed. The channels presented in this section are the ones most relevant to the deposit rate and if the deposit rates were positive, these channels would be the only theoretical framework needed for this paper. However, as the rates have gone negative, presenting the theories of zero lower bound and liquidity trap is also necessary as they affect how these channels operate during the NIRP-period. Therefore, I start by presenting the origin of zero lower bound and liquidity trap.

3.1 Origin of Zero Lower Bound and Liquidity Trap

The definition of liquidity trap and zero lower bound has varied over time and sometimes these two terms can be mixed to describe the same phenomena. According to Boianovsky (2004) the term liquidity trap connects more strongly to the original definitions used by Keynes and Hicks where the interest rate floor was seen positive, whereas more recent approach sees the interest rate floor being at the level of zero, therefore favoring the term zero lower bound. Eggertson and Woodfords (2003) notable paper also contributed to both the theory of zero lower bound and liquidity trap, but their ideas in the end did as well derive from the original definitions of Keynes. In this paper I separate these two phenomena and use the zero lower bound as the base for our inspection of negative deposit rates.

3.1.1 Theory of Zero Lower Bound

John Hicks (1937) presented that if the rate of interest is not greater than zero, then it would always be profitable to hold money rather than lend it out, from which he concluded that the rate of interest must always be positive. Krugman (1998) also sees that negative rates would be impossible, because then money would dominate bonds as an asset. And for the deposit rate it is obvious that withdrawing your money would be reasonable if it would otherwise be taxed with negative rates. For these reasons introducing negative deposit rates has been an unorthodox move and to further understand the restrictions imposed by zero lower bound I use McCallum's (2000) breakdown of zero lower bound to prove that, in addition to the logical assumption of consumers withdrawing their deposits in case of

penalizing negative deposit rates, the lower limit to interest rates derives from a constraint of an utility function. McCallum presents the equation followingly:

Households seek to maximize the following utility function:

$$u(c_1) + \beta u(c_2) + \beta^2 u(c_3) \dots$$

Constrained by the following sequence for $t = 1, 2, \dots$

$$f(n_t, k_t) - tx_t = c_t + k_{t+1} - (1 - \delta)k_t + (1 + \pi_t)m_{t+1} - m_t + (1 + \pi_t)(1 + R)^{-1}b_{t+1} - b_t + w_t(n_t - 1) + \psi(c_t, m_t)$$

Where:

c = consumption during period t

$f(n_t, k_t)$ = output from labor (n_t) and capital (k_t)

δ = capital expenditure

π_t = inflation $\left(\frac{P_{t+1} - P_t}{P_t}\right)$

m_t = real money balance at the start of period t

tx_t = lump – sum of taxes net of transfers from the government

b_{t+1} = number of bonds purchased at period t for the price of $(1 + R)^{-1}$

$\psi(c_t, m_t)$ = Reflects transaction

– facilitating properties of money (transaction costs)

Following the notation of McCallum and abridging some of the steps I focus on the last term of the constraint, $\psi(c_t, m_t)$, which represents the transaction costs and I inspect the dynamics of this specific term. It can be assumed that increase in consumption increases the need of resources for the transaction services of money i.e. $\left(\frac{\partial(\psi(c_t, m_t))}{\partial(c_t)} > 0\right)$ and on the other hand an increase in the real money balance decreases the need and the cost for these transaction services due to availability of cash on hand $\left(\frac{\partial\psi(c_t, m_t)}{\partial m_t} < 0\right)$. The author points out that these transaction costs can be thought to be either direct costs of acquiring financing, “shoe leather costs” or lost time caused by not having the cash available. This specific change in costs is called marginal service cost and I use it when referring to this second partial derivative.

Next he combines first-order conditions for optimality producing the following equality

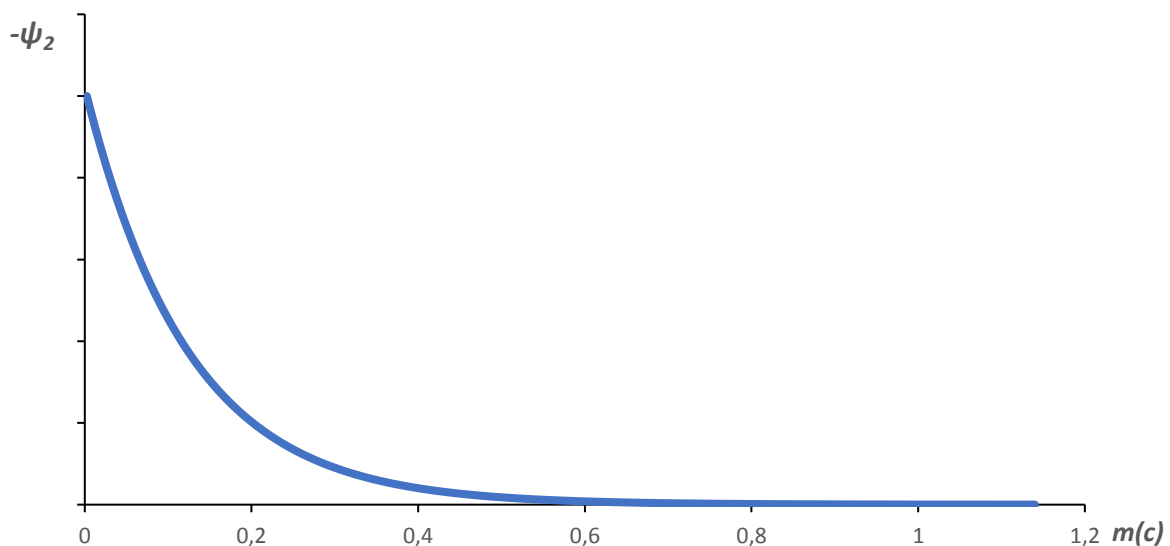
$$1 + R_t = 1 - \psi_2(c_{t+1}, m_{t+1})$$

Which according to McCallum can be written with a market-clearing condition $m_t = M_t/P_t$ similarly as presented also by Friedman (1969),

$$R_t = -P_{t+1} \frac{\partial \psi(c_{t+1}, m_{t+1})}{\partial M_{t+1}}$$

both which imply that interest rate R_t would be always positive, if the condition $\psi_2 < 0$ would hold strictly. McCallum finds this implausible and in order to present that the interest rate can also be zero, he introduces the marginal service yield, which can be also described as the inverse of marginal service cost, $-\psi_2$. He presents that this service yield from holding money decreases as the amount of money increases compared to consumption, therefore making the $\psi_{22} > 0$ over an extended range. After a certain point the marginal service yield drops to zero when no additional benefit is gained from holding extra money producing an upwards concave curve for the utility gained from holding real money similar to Figure 1.

Figure 1: Marginal Service Yield Lost by Increasing Real Money Balance (Without Holding Costs)

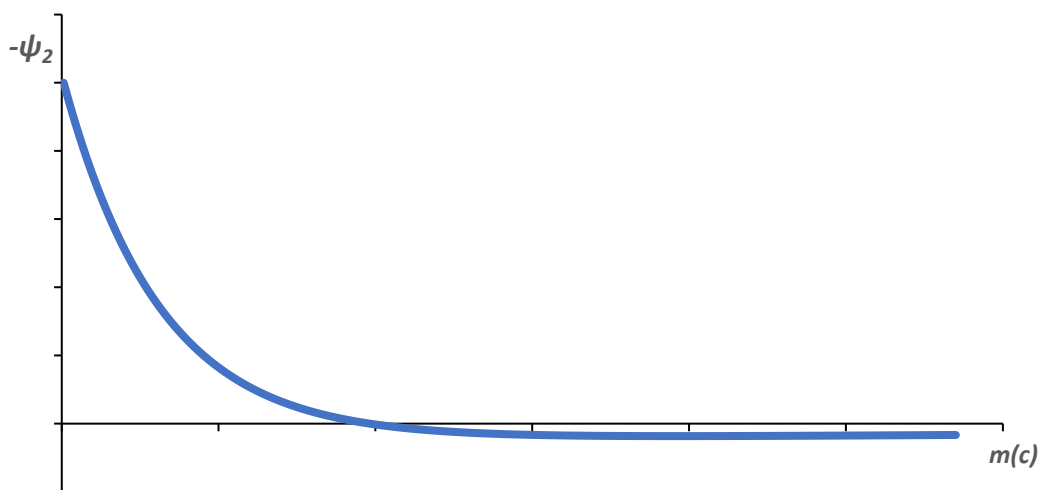


So, what does this result mean when described in layman's terms is that the rate of interest is determined by the additional utility you gain when your money balance increases to meet your total consumption. In a situation where you already have exactly the amount of money to finance your consumption, $m(c) = 1$, you would not gain any utility by taking an additional loan and you don't have to liquidize any assets or barter to make your ends meet. Then your marginal service yield is zero

and you would only take a loan with zero interest as extra money at hand does not bring you any extra utility. The Y-axis of this graph could as well be R_t and as seen it is limited by the zero lower bound.

This provides a theoretical yet elementary example of how due to decreasing marginal service yields the amount of money held by household determines $R_t \geq 0$ creating an effective ZLB for the one-period interest rate R_t . However, the author recognizes that due to storage costs related to large amounts of money, the marginal service yield curve could break the zero lower bound but would remain only a few basis points in the negative territory in then-conceivable circumstances as shown in Figure 2. This negative service yield means that when your money balance reaches a certain level, you are willing to take extra money only if you are compensated for that, for example with a negative interest rate, due to increased storage costs.

Figure 2: Marginal Service Yield Lost by Increasing Real Money Balance (With Holding Costs)

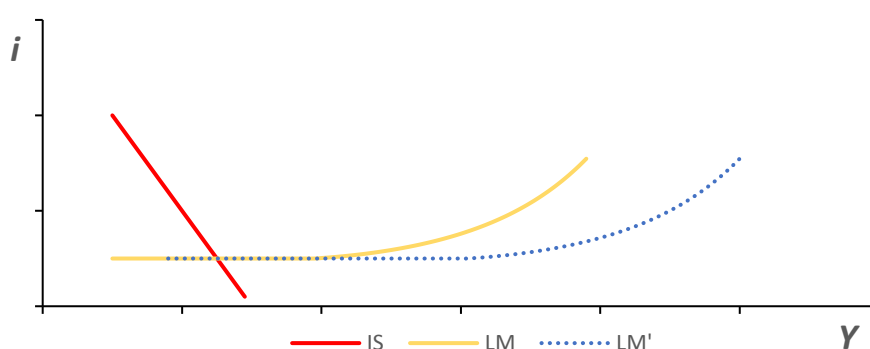


From this presentation of how the zero lower bound derives from the constraints of utility maximizing consumers, it can be seen that it is not without theoretical evidence, but in addition to this constraint economists have also warned that other consequences, such as liquidity trap, might await economies that get too close to this zero bound.

3.1.2 Liquidity Trap

Liquidity trap is a phenomenon sometimes mistaken with zero lower bound, but the difference comes from the viewpoint. Zero lower bound sets the limit, whereas liquidity trap tries to explain why economy cannot easily return to normal state if interest rates fall too low. One way to present the liquidity trap is in IS-LM framework by John Hicks, where exogenous shock of increasing money supply causes the LM-curve to shift right (Figure 3), but no real change in real interest rate level or GDP is achieved due to the real interest rate level being already too low.

Figure 3: Monetary Expansion in IS-LM Framework at Low Interest Rate Level



Several authors have also addressed the liquidity trap. Krugman (1998) defines the liquidity trap as a situation in which nominal interest rates are at or near zero therefore making conventional monetary policy ineffective by making bonds and currency to be viewed as perfect substitutes. Buiter (2003) also sees that additional monetary easing by increasing real money balances would be pointless in the environment of zero interest rates, as the private agents would not change their investment or saving behavior as depicted in Figure 3 due to the opportunity cost of holding currency being zero.

The ways to get out of this liquidity trap are not numerous, as conventional measures don't seem to have any effect, but as a resolution for economies caught in a liquidity trap and unable to lower the nominal rates furthermore, Krugman (1998) recommends creating expectations of inflation, which leads to a decrease in real interest rate and possible increase in real activity. Eggertsson and Woodford (2003) mainly agree with Krugman's definition of liquidity trap, but criticize that the prices in his model are fixed and they improved it by introducing an intertemporal equilibrium model which takes into account the whole path of expected real interest rates therefore lessening the weighing on short-term real interest rates. With this model they agree with Krugman's recommendation of increasing expectations of inflation as it shapes the path of expected real interest rates.

As the definition of liquidity trap is part of a larger IS-LM framework, more thorough analysis how to derive it would be too inconvenient for the purpose of this paper, so I leave it to the definitions presented above and use the zero lower bound as the main framework in this paper. Liquidity trap is either way relevant in tandem with zero lower bound when inspecting the empirical results to see whether negative deposit rates are one of these unconventional measures that could be credited for breaking out of the trap. But for this purpose, I need to also define the transmission channels of monetary policy.

3.2 Transmission Channels of Monetary Policy

I present three different mechanisms through which the adjustments in policy rates transfer to the real economy. These channels are not the only ones presented in economic theory nor are they equally

important when comparing them from deposit rates point of view but all of them play their roles in the process and are worth addressing. I also limit our scope by excluding some transmission channels, which transfer the policy changes to asset prices and exchange rates, as they are not that relevant to bank lending but describe more broader effects in the economy. For the presentation of traditional interest rate channel and credit channel I use the definitions established by Mishkin (1996) and these definitions have been under a debate but still hold their place in the basic economic theory. These channels give a reference point which I can use to compare the empirical results to see whether they have operated as intended or if the negative rates have somehow affected these mechanisms.

3.2.1 Traditional Interest Rate Channel

Similarly, as the liquidity trap, traditional interest rate channel also bases on the Keynesian IS-LM view of how monetary policy transmits to real economy through the changes in interest rates, savings and investments and the basic mechanism of IS-LM model should be self-explanatory. When comparing this channel to the credit channel presented later, the greatest difference between them is that this traditional interest rate channel takes into account the real interest rates in addition to nominal rates. Since this model puts more emphasis on the real and long-term rates rather than short-term nominal rates, it gives more room for the short-term nominal rate to move, even below the zero. The nominal interest rates are not entirely ineffective though, since in this channel an impact in short-term nominal rates causes also an impact to real rates through sticky prices. This move in real rates is assumed to affect directly spending and investments therefore transmitting to the real economy. The core assumption is that low interest rate environment encourages companies to invest but as the model is used to describe the short run, empiric results of long-term investments caused controversy and brought the need for further explanation.

3.2.2 Credit Channel

One of the most notable papers regarding the idea of credit channel was first published by Bernanke and Blinder (1988) as they raised some discrepancies in the IS-LM-model, but it wasn't until later, when Bernanke (1995) properly defined this channel. One of the discrepancies in the traditional model was that according to the IS-LM-model monetary policy shocks should have more effect on the short-term interest rates than long-term rates but on the contrary the empirical results say that these shocks mainly affect the purchases of long-term assets. This among few other discrepancies led to the presentation of two extensions to the traditional interest rate channel - bank lending channel and balance sheet channel. Although they are named as channels, both are considered by Bernanke to be merely amplifying factors to the traditional interest rate channel, rather than completely separate or substitutive channels. In addition to this discussion of how independent these channels are, different

alternatives to the primary definitions have also been presented, one of them being the division to the broad and narrow credit channel, as presented by Oliner & Rudebusch (1996), who see empirical evidence for the existence of broad credit channel which acknowledges other sources of external financing as part of the theory, not just the loans extended by banks, as would be in the narrow bank lending channel. Whether the credit channel is an independent channel or an amplifying factor, it is nevertheless relevant to inspect them parallel with the traditional interest rate channel as they together explain the possible routes of monetary transmission.

3.2.2.1 Bank Lending Channel

The mechanisms of bank lending channel and balance sheet channel both originate from the bank's special role as a solver of asymmetric information in the markets, but the chain of events triggered by monetary policy adjustments are different.

Bank lending channel explains the increase of investment and spending caused by expansionary monetary policy to be due to the assumption that increasing bank reserves also automatically increases the quantity of bank loans available and that these loans transfer to investments and spending. This assumption is more relevant when there are no substitutive fund sources for bank lending, so the effect should be less potent in economies with market-based financial systems and larger share of big businesses that gain funding from stock and bond markets instead of banks. This channel can be described as the narrow credit channel, which puts more emphasis on the banks as the generator of loans even though other external sources of funding are available. Oliner & Rudebusch (1996) speak for the broad credit channel, which takes into account also the external finance premium caused by balance sheet changes.

3.2.2.2 Balance Sheet Channel

The transfer mechanism of balance-sheet channel can be seen inverted compared to bank lending channel. The adjustment of interest rate is assumed to effect bank lending indirectly by making the businesses appear more or less risky to lend to. First, the interest rate adjustments affect the profitability of businesses by lowering or increasing the total interest costs and then it affects also the calculated present value of assets due to the adjustment of the discount factor used in the present value calculations. These two effects overall affect the net worth of the company and in case of expansionary monetary policy this net worth increases, which in turn decreases the agency costs related to the information asymmetry in bank lending therefore increasing the quantity of loans and investments made. This decrease in the external finance premium, the cost of acquiring financing,

causes the companies to seek more loan from external sources, such as banks, which in turn boosts economy in form of investments.

These three different channels all operate from the same starting point, the adjustment of nominal interest rate, but together they explain the same phenomenon from different points of views and how the monetary policy transmits to the economy. As I have covered the properties of the deposit rate, possible transmission mechanisms and the restriction suggested by theory, I can start inspecting the empirical results to see what might have been the effects of these negative rates.

4 EMPIRICAL FINDINGS

For this section I review the results of empirical studies conducted in the area of European Monetary Union during the period of negative interest rates to see what the effects of negative deposit rates have been when inspecting them from the point of view of transmission channels and zero lower bound. I also present possible changes in the behavior and risks related to banking sector to see if there are any adverse effects that could be resulting from breaking the zero lower bound on central banks deposit rate. Purpose of the examination of these empirical results is not to draw exhaustive conclusions of the success of monetary policy during the period of NIRP, but to offer a basis for a more thorough discussion of the theories presented in section three.

4.1 Bank Behavior and Profitability

After the introduction of negative deposit rates in central banks, adjustments to the same direction have been identified similarly in the deposit rates of commercial banks, but there has been reluctance to transfer these rates completely to negative territory for different reasons. Demiralp et al. (2017) present that in addition to the possible mass withdrawal of deposits in case of negative deposit rates, banks also have other cost inducing factors that could prevent them from lowering the rates negative. One of them could be institutional legal barriers and taxation issues in some jurisdictions when applying negative rates, but also company specific issues could be an obstacle, such as the IT-systems not recognizing negative rates. This reluctance to lower the rates squeezes the margins of the banks and affects their profitability and some researchers did present possible threats to the economy. Jobst (2016) for example raised concern of the effects to the bank profitability deriving from a general low interest rate environment and presents that the higher asset values and increased aggregate demand might not in the long run be enough to compensate for the profit losses of banks. In addition to this profit erosion, Arteta et al. (2016) present that aggressive risk taking might increase in the search for yield.

The actual results from cross-country studies paint a less intimidating picture. When examining the effect on bank profitability, Turk (2016) presents that based on financial statements from Swedish and Danish banks there has not been significant weakening of profitability during the era of negative interest rates. The interest income has expectedly declined, but it has been offset by cost-cutting and increased fees. The cross-country analysis results of Lopez et al. (2018) from European and Japanese banks comply with Turk's view of steady profits and Arteta et al. (2016) also find no signs of financial instability, although they raise concern for the potential consequences on the long run. Heider, Saidi and Schepends (2017) claim that these potential consequences could be more imminent with high-deposit banks, as they take more losses from the narrowing of interest margins than low-deposit banks, but there has been also countering results from Lopez et al. (2018), who see that high-deposit banks are not any vulnerable to negative rates than low-deposit ones, even though the low-deposit ones have reported larger increases in non-interest income. As for now, in a recent bank lending survey by ECB (2018) a majority of the partaking commercial banks agreed that the negative deposit facility rate has affected considerably their net interest income but had a slight positive effect to the volume of loans.

Based on these results, the crossing of zero lower bound does not seem to have had any extreme effects that might put the economy under too much stress, but the reluctance to transfer these rates to customers might imply of the existence of zero lower bound. I leave this thought for the discussion section and next I inspect the effects on bank lending to see if the transmission channels operate as predicted.

4.2 Bank Lending and Transmission of Monetary Policy

Even though the low interest rate environment should generally encourage loan taking there have been mixed results from different economies. Turk (2016) finds that lending in Danish and Swedish mortgage banks continued to grow at steady pace before and during the whole period of NIRP, whereas commercial banks experienced a decline after the financial crisis, but the amount of lending either leveled or increased after introduction of negative rates. Demiralp et al. (2017) similarly received results of increased lending throughout the euro area. The amount of lending can also vary depending on the nature of the bank. For example, Heider, Saidi and Schepends (2017) found that high-deposit banks lend less during the period compared to low deposit banks and according to Demiralp et al. (2017) banks in more "vulnerable" countries such as Greece, Ireland or Spain had higher increase in loan extension compared to banks in less-vulnerable countries. Bräuning & Wu (2017) has similar results as Demiralp et al. of increased loan origination, but Jobst and Lin (2016) describe the expansion

of credit caused by negative rates in the Euro area to be “modest” at best but see more improvements in the overall financial conditions.

Most of the studies addressed the transmission channels as basis for the study but Arteta et al. (2016) specifically see possible adjustments in the transmission channels of monetary policy, partly to positive but also some possible negative aspects. For example, in the traditional interest rate channel framework by penalizing cash hoarding with negative deposit rate the central bank might encourage the commercial banks to weigh more on long dated bonds therefore lowering the real interest rate more effectively and causing more activity in the real economy. On the other hand, they see that if consumers take precautionary action to increase savings due to negative interest rates, this would cause a setback in monetary expansion according to the IS-LM model. For the bank lending channel Arteta et al. (2016) fear that although cash hoarding penalty should encourage lending, the lower profitability and diminished capital base of the banks might cause reluctance to lend more and increase the lending rates to cover possible losses caused by negative rates.

Research has been also made on the responsiveness of different interest rates to monetary policy adjustments when deposit rates are below zero. One of these studies is made by Eggertson and Juelsrud (2017), who find that both deposit and lending rates to corporates and households seem to disconnect from the policy rate changes after policy rates go negative, even though they would still have room for movement. This might mean that further reductions to more negative territory don't have effect to the rates in economy, making other rates unresponsive to adjustments. Bräuning & Wu (2017) oppose this view as their study concludes that in all countries in the Euro area the introduction of negative rates has increased the transmission of policy rate cuts to loan origination and rates, especially in loans with longer maturities. Turk (2016) finds a parallel relationship with the declining lending rate and interest rate in Sweden, whereas in Denmark the lending rate was mostly unchanged during the time of substantial rate cuts but in the end also declined.

The results of these empirical studies give no clear-cut answer to whether the negative deposit rate of a central bank has been a successful monetary policy move. Partly this is because a variety of unconventional measures has affected the end results of current economic situation, but even if I were to inspect only how the directional adjustments of policy rates have transferred to lending rates as a measure for successful monetary policy, the results differ. However, we can use the results of this section to discuss our theoretical framework of zero lower bound and the transmission channels of Mishkin (1996) as most of the studies use these two theories also as the base of their research.

5. DISCUSSION

After reviewing the theory of zero lower bound, liquidity trap and the theoretical transmission mechanisms related to deposit rate, I address these three topics in this discussion section by comparing them with the empirical studies in section four to see if there is empiric evidence of the theories presented above and also the other way around, if the theory could give some explanations for the empiric results. I start with more theoretic discussion about whether the zero lower bound was actually broken when central banks lowered their deposit rates to negative territory and what would be the consequences if the rates were to go more negative. Then I focus more to the overall effects of negative interest rate policy to the transmission mechanism of monetary policy and finish by addressing the future and the possibility of the economy being in a liquidity trap.

5.1 Was Zero Lower Bound Actually Broken?

The theoretical and empirical literature covered in this paper addressed the negative interest rates at least from some perspective, but a considerable amount of them failed to specify the exact interest rate they were referring to in the texts. I reviewed the main policy rates of different central banks and almost all of them had different properties, therefore making it harder to compare what would be the effects of going through the zero lower bound as the outcomes might vary between loan rates and deposit rates. In case of deposit rates, the zero lower bound in theory presents a genuine restriction if utility maximizing consumers withdraw all their deposits to counter the penalty of negative deposit rate as suggested by Heider, Saidi and Schepens (2017). I suggest that the zero lower bound has not been broken as the proposition above was not completely tested empirically, since banks did not transfer these negative deposit rates all the way to consumers. Yet, according to Bech and Malkhozov (2016) the central banks negative rates transferred smoothly to interbank rates, which shows that banks are willing to use negative rates within the banking sector. Instead of asking why commercial banks haven't charged the consumers with negative rates, a more relevant question is what makes it possible for the central banks to do so to commercial banks? One main reason is that the commercial banks do not have a similar option of withdrawing their deposits mainly due to the sheer amount of cash and the storage costs related to them and the option to "switch" central banks is not as easily done as consumers can switch between banks. This might not be the case in long-term, according to McAndrews (2015) who sees that prolonged period of negative interest rates might force the investors to innovate new means of lowering the holding costs associated with storing physical money, therefore moving the effective lower bound up closer to zero.

The different positions banks and consumers are currently when comparing the ability to withdraw their deposits raises a question if there are possible solutions to transfer the negative rates all the way

to consumers, encouraging spending or investments and effectively eliminating the zero lower bound. One of the most radical ideas would be the solution presented by Buiter (2009) – removing cash from the society and therefore forcing the consumers to the same position the banks are currently. Buiter also presented other less radical ideas, such as placing a tax on currency or introducing a second currency and discounting them by manipulating the exchange rate but implementing these solutions would be problematic due to the administrative costs related to them. At the time, even though electronic currency dominates physical currency, these ideas still seem a bit far-fetched.

5.2 Helicopter Money – Solution for Zero Lower Bound?

As the options to eliminate zero lower bound seem distant I present next an extremely simplified scenario analysis of what would be the consequences of lowering both the lending and deposit rate negative or whether issuing “helicopter money” would be more preferable when cash is available in the society. I suggest that the interest rate for loans from commercial and central banks itself is not restricted by the zero lower bound, but the conditionality that it must be always higher than the deposit rate restricts it. I then use the scenario analysis to review how come a Danish bank Jyskebank has been able to introduce both negative lending and deposit rates. A simple starting point is when we think of the concept of helicopter money – transferring money straight to the economy and bypassing the banking sector.

Helicopter money can be thought also as a fixed amount bullet loan with a negative interest rate of 100 percent that is issued only once with the central bank and the consumers as counterparts. As the issuer of currency, the central bank would be free of the responsibility to chase profits unlike commercial banks and therefore can issue quite freely the needed amount of money for the stimulus if it chooses so. Consumers also would most likely welcome free money and use it for consumption, investments or savings. With this example I want to show that due to the amount of helicopter money being fixed, the zero lower bound and cash would not seem to play any role in the incentives of the participants even though issuing free money could be comparable to loans with negative interest rates. In the next scenario I show how lifting the restriction on the amount of money injected creates a more complex chain of events. But as a side note, even if the zero lower bound would not seem to restrict this kind of monetary policy, the effects to the economy could be unpredictable and risks high.

If instead of a fixed amount of monetary injection to the consumers, the commercial banks were given loans with negative rates that exceed the holding cost of cash, then the most probable outcome would be that it would be profitable for banks just to take infinite amount of loans and convert them to cash. Even the negative deposit rate would not help the situation as it must be always lower than the lending rate, or otherwise an opportunity for arbitrage of lending and depositing would arise. The lower

deposit rate would only further encourage converting of reserves and deposits to cash. And if somehow the banks were denied the possibility to convert deposits to cash and the central banks rates would transmit completely to the rates of the commercial banks, then the similar strategy of taking a loan and storing it as a cash until maturity would be the most profitable strategy for consumers as well.

I leave the more detailed inspection of this scenario analysis for further studies but from this simple comparison of helicopter money and negative lending rates can be drawn some conclusions. It seems that the main characteristics which makes it possible for the helicopter money to avoid these “doom loops of arbitrage”, is that the amount is fixed, which makes it possible for the deposit rate to stay above zero even if the “lending rate” would be negative, therefore preventing the bank run. As for the arbitrage of lending and depositing, the helicopter money would itself be arbitrage, but at least its effects would be limited due to the amount being fixed and the increase of economic activity might surpass the risks.

At the time of writing this paper several signs of daring attempts to cross these bounds have appeared. Danish commercial bank Jyskebank is already offering mortgages with negative interest rates (see Martin (2019)) and will also introduce lower negative deposit rates in December for deposits of over 7.5 million Danish kronor (Schwartzkopff (2019)). This would seem like an intuitive way to prevent the bank run by not lowering the deposit rate for everyone and at the same time prevent the arbitrage of depositing large loans back to the bank. Also, the bank probably can limit the amount of loan taken as in most cases of mortgages so when reviewing Jyskebank’s decision in light of the scenario analysis above, can be seen that they have taken into consideration the consequences well. In Sweden the central bank Riksbank has also kept its seven-day repo rate negative, which accounts for both deposit and loans, but as yet no Swedish bank has yet dared to break the zero-floor, the status quo remains.

These previous examples shows the point emphasized already many times in this paper, that if the effect of zero lower bound is this different depending on the type of interest rate, then it should be clarified in the economic theory how zero lower bound primarily takes effect with deposit rates, but other rates are as well restricted as the deposit rate has to be lower than them. As for the interest rate of bonds, the McCallums (2000) presentation of zero lower bound used the price of bonds as the R_t in the model, as well did the early descriptions by Keynes and John Hicks. Due to the price of bonds being widely used in different models as a measure of interest rate level it would be worth studying if a similar model of zero lower bound can be developed which takes into account the different types of interest levels separately. In the scenario analysis above I excluded the possibility to invest in bonds to simplify the scenario, but I focus more on the negative bond yields in the following sections.

5.3 Transmission Channels Under NIRP

The monetary transmission channels presented by Mishkin (1996) in this paper showed that there are different ways the deposit rate adjustments can transmit to the real economy and I suggest that the uncertainty, cash hoarding and the expansion of balance sheets of the commercial banks caused by the financial crisis have brought changes to the rules of law of these channels – not the introduction of negative rates itself. Another point to be made out is that in certain sense the thought of traditional interest rate channel being the main transfer mechanism and the credit channel merely an amplifying factor would normally be correct, but during the last decade the importance of bank lending channel seems to have increased greatly and this is partly due to the bank lending channel being “broken”.

The bank lending channel had one critical assumption and it is that increasing banks reserves automatically transmits to lending. So, when according to Arteta et al. (2016) the banks refused to transmit their reserves to real economy, it seems that the bank lending channel was broken even before the introduction of negative rates, and the penalizing effect of negative rates was used specifically to unclog this transmission route. A review of the theory regarding bank lending channel would probably be needed, since the channel seems to operate entirely differently when banks face great uncertainty and reduce lending - even if their reserves grow. It could be argued that negative deposit rates should be therefore used only if there is an accumulation of excess reserves in commercial banks or in the economy.

5.4 Are We in a Liquidity Trap?

The last question to be discussed shortly is related to the liquidity trap and the future of European economies. As seen, the negative deposit rate has been only a part of the measures taken to get economy back on its track and European economies have indeed grown for almost a decade but worrying is that signs of another downturn, such as the inverted yield curve of US government bonds, have already appeared with the monetary policy being still lax. The question is how can the economy be helped if majority of the measures taken are still being used – have we fallen into a liquidity trap as described in this study?

Krugman’s (1998) definition of liquidity trap has been correct in sense that the conventional measures are not sufficient when nominal interest rates are close to zero, but the notion that negative interest rates are not possible because money would dominate bonds as an asset, has been incorrect. Both in 2016 and now 2019 a record high number of bonds according to Financial Times (Wigglesworth (2019)) have had negative yields and investors are prepared to pay a price for the safety of their assets. This leads to the same question as with the lending rate, whether the zero lower bound concerns it at all

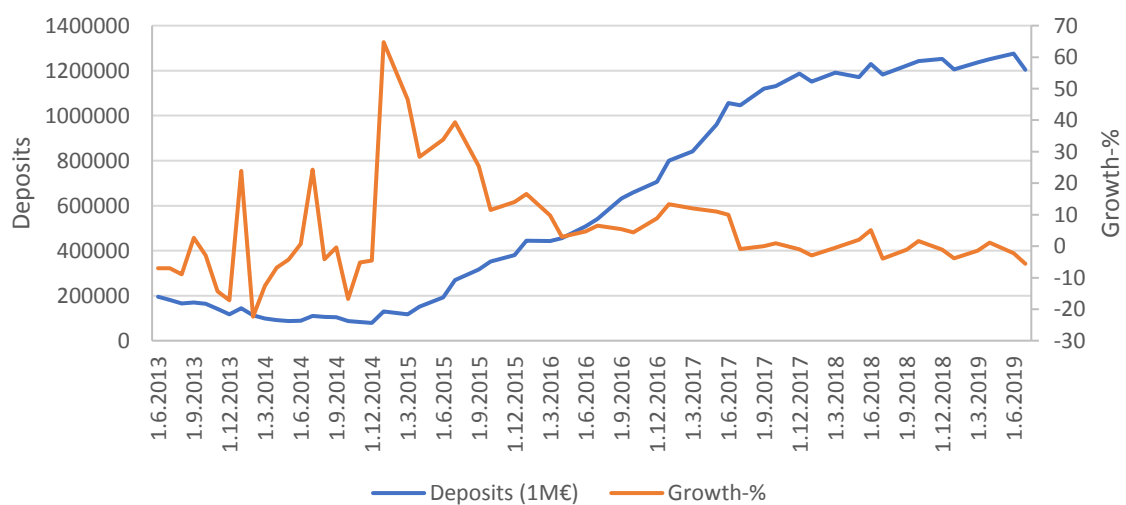
or whether it is only for the negative deposit rates between commercial banks and customers. One point to consider is that bonds might have been thought in the past to be a similar alternative for cash as deposit accounts are nowadays, whereas currently government bonds have more liquid aftermarkets and possibilities to speculate with them gives opportunity to gain profit even if the underlying bond is providing negative yield, therefore also providing demand for such bonds.

The theory of liquidity trap also states that further monetary policy expansion has no effect as shown by the IS-LM model, and even though I left the asset purchase programs outside the scope of this study, a careful conclusion of weakened effectivity could be argued, as the ECB program has currently reached the amount of 2,646 billion as of end of July 2019 yet the economy has not recovered completely.

5.5 Conclusion and Limitations of the Study

In this paper I don't try to conclude whether the monetary policy as a whole or only the negative deposit rates have been successful monetary policy moves, but some key points can be identified from the empirical results presented in section four. First of all, after the introduction of negative rates researchers seem to have acquired results of increased lending and although this varies between different types of banks, at least no clear results of decreased lending can be found. However, increased lending does not automatically mean that it would be greater than the amount of cash hoarding performed by the banks and actually when inspecting the development of the excess reserves deposited in ECB (Figure 4) one might not see any improvement in the cash hoarding.

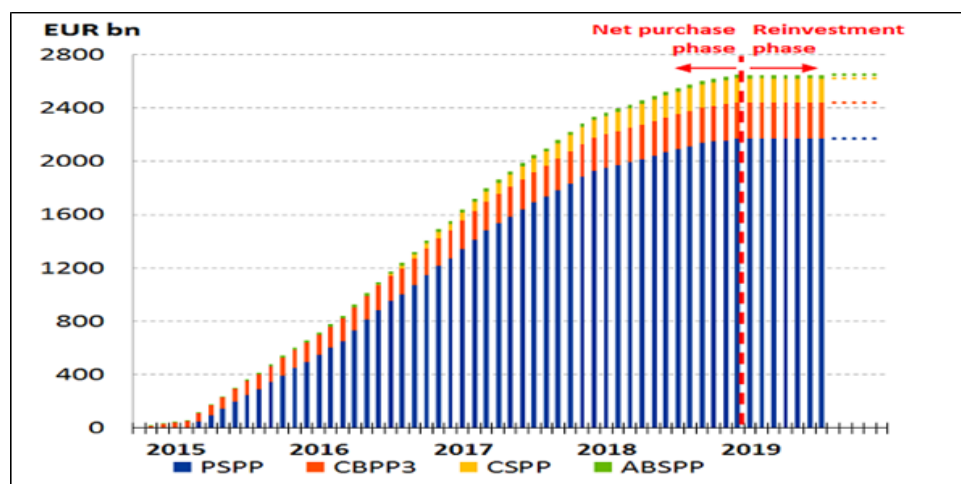
Figure 4: Excess Reserves Deposited in ECB



[Source: European Central Bank – Statistical Data Warehouse](#)

The excess reserves seem to increase right after the introduction of negative deposit rates in 2014, but partly the Asset Purchase Program can be blamed for this cumulation reserves. In figure 5 can be seen that the growth of assets purchased continued to grow until the end of year 2018, whereas the growth of excess reserves reached zero percent already in the middle of 2017. It is hard to say whether the negative deposit rate had real effect on cash hoarding. This describes well the restriction of this study as it does not cover the effects other measures have on the excess reserves and especially the Asset Purchase Program would seem to be relevant to inspect together with the deposit rate as it has increased the excess reserves.

Figure 5: APP Cumulative Net Purchases by Program



Source: European Central Bank

The effect that negative deposit rate has had on the results of the studies covered cannot clearly be separated and I also recognize that in this study I have not covered other factors that affect how much debt is taken in an economy. In a certain sense our scope includes only the supply side of lending, whereas demand side was ignored. The exclusion of portfolio channel and exchange rate channel also limit the means to make more exhaustive conclusions, since the smaller economies that have their own currency clearly had motives related to their exchange rate when they decided to lower deposit rates to negative territory. In their case other monetary policy transmission channels might've helped to understand their policy and outcomes better.

The effects to the banking sector have been a concern in many papers used for this study and some preliminary studies reviewed here raised concern for the increased risk-taking and effects to the profitability of banking sector. However, more recent studies show that even though the interest rates used for new loans have somewhat disconnected from further adjustments in the central bank's policy rate, these narrowed profit margins have been compensated in form of other fees and the banking

sector does not seem to be in distress. One of the few concrete issues raised by Bräuning & Wu (2017) is that the price changes in riskier assets became more volatile during NIRP-period.

Even though the banking sector in Europe seems to be on a firm base, there might be risks in the financial system such as inflated asset prices that might be deriving from these unconventional measures and most of the authors reviewed here agree that if prolonged, the era of negative interest rates could pose a threat to the economy.

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