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The impact of negative interest rate policies on investments and liquidity-constrained households and firms

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Abstract

In this thesis, we have investigated the main concerns and hypotheses related to investments and liquidity-constrained households and firms following the Negative Interest Rate Policy (NIRP) implementation in Denmark, Sweden, Switzerland and the Euro Area. The unconventional expansionary monetary policies were implemented to meet economic challenges following the Great Financial Crisis of 2007-2008.

The main goal of the thesis is to uncover how implementation of the negative policy rates transmitted to the commercial banking market and further affected households and firms. Furthermore, we also investigate some of the consequences for the aggregate economy. The research is based on an empirical analysis of macroeconomic variables, and the approach is abductive. The data available is an incomplete set of observations, as NIRP is a relatively new, and current, economic phenomenon. Consequently, our findings and conclusions will only uncover information related to the short-term effect of NIRP implementation.

The analysis uncovered limited materialization of concerns related to NIRP implementation, and there are only a few cases where we could fully isolate a NIRP effect. This indicates that the response to NIRP implementation either is more economy-specific than general or that it, to a limited extent, differs from implementing a conventional expansionary monetary policy with low interest rates, as controlled for in this thesis.

Focusing on policy rate transmission to the commercial banking market, we concluded that transmission to a large degree had taken place following NIRP implementation. With respect to the investment analyses, we could not conclude that NIRP caused a preference shift. Moreover, we could not isolate a causality relation between NIRP implementation and corporate or aggregate investment growth. We also had to reject the hypothesis that NIRP implementation had facilitated an overinvestment bubble. In the analyses related to liquidity-constrained households and firms, we were not able to prove an increase in zombie presence on the aggregate level, or that the NIRP implementation had led to the suppression of creative destruction. We also had to reject the hypothesis that NIRP implementation would lead to an increase in labour reallocation rigidity. All in all, we did not find evidence that NIRP concerns had materialized, at least not thus far.

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Table of contents

List of figures

List of tables

1. Introduction

In 2007, the Great Financial Crisis erupted in the United States, when several households defaulted on their mortgages. The mortgage defaults soon generated larger global consequences than anyone could have foreseen: The crisis developed from household insolvency issues to a subprime mortgage crisis in the banking sector, and finally, it had spread globally and become a sovereign debt crisis. The implications of what seemed to be less significant insolvency issues for households in the US now turned into one of the largest financial crises the world had seen in modern time.

In the years that followed the 2007-2008 financial crisis recession was dominating the global economy. To try and stimulate the economy, many central banks initiated expansionary policy measures, some even took it to the level where they broke through the Zero Lower Bound. The Central Banks that implemented negative interest rate policies believed that the Effective Lower Bound was sub-zero, due to cash' cost of carry.

In general, Dynamic Stochastic General Equilibrium models (DSGE) are the key models for analysing and evaluating monetary and fiscal policy today. However, we have chosen to go in another direction, and take on an empirical approach to our research, investigating some of the real economic consequences of implementation of Negative Interest Rate Policies (NIRP).

The aim of this master thesis is to provide an alternative approach and view of the effect of unconventional monetary policy. More precisely, we aim to investigate some of the hypotheses and concerns related to the economy from implementation of negative key policy rates. Of course, the effects are many and we do not have room to research them all in this thesis. Therefore, we have chosen to limit the scope into two real economic areas: Investments; and effect on liquidity-constrained households and firms.

We will, to our best efforts, provide an in-depth current-state analysis to our four chosen European economies; Denmark, Sweden, Switzerland and the Eurozone. These are all economies that have implemented negative key policy rates in the wake of the Great Financial Crisis. In addition, we will try to isolate the effect of the NIRP implementation by

comparing our findings to the development of an economy that has not entered the negative territory, the United Kingdom. To our knowledge, this type of analysis, on the chosen topics of interest, has never been conducted and published before. The Euro Area is per definition a monetary union consisting of several economies with varying characteristics and challenges. However, for the simplicity of this paper we will address the Euro Area as an economy, and use the aggregate economy variables in our analyses.

1.1 Research Question

By investigating empirical data of households and firms in economies with negative key policy rates in Europe, we are looking to answer the following question:

"Following NIRP implementation, what are the main hypotheses and concerns related to investments and liquidity-constrained households and firms, and have these materialized?"

To answer the main question, we focus our research towards the Danish, Swedish, Swiss and Euro Area economies from the years the economies entered negative territory; 2012 for Denmark and the Euro Area, and 2014 for Sweden and Switzerland, to the end of 2016. The control economy analysis will be performed in the corresponding timeframes as outlined above. The further focus and delineation of our problem statement and analysis will be guided by two sets of sub-questions:

Sub-question set 1: Could the NIRP implementation facilitate a preference shift from savings to investments? Could NIRP through the transmission to the discount rates influence the level of corporate investments? Focusing on the aggregate economy, how has the investment level developed, and is this development driven by NIRP? Could NIRP be a facilitator of a potential overinvestment bubble?

Sub-question set 2: Could the NIRP facilitate an increase in the survival of non-viable (zombie) firms? Is market restructuring affected by NIRP? How is allocation and utilization of labour resources influenced by the new interest rate regime?

1.2 Basic Assumptions and Limitations for the Thesis

Focus on households and firms: In this thesis, we have chosen mainly to focus on the effects for households and firms, rather than the aggregate economy. In other words, we will not

comment on the effects for governments. However, in some analyses, the aggregate economy variables will be considered.

Economies of interest: We have chosen to focus our analysis towards four European NIRP economies; Denmark, Sweden, Switzerland and the Euro Area. The Euro Area is a monetary union consisting of several economies, but in this paper, we will refer to the Eurozone as one economy. The reasoning behind the choice of economies was first and foremost because they all have implemented negative interest rate policies. We also wanted to focus on European economies, as they are all interlinked by geographical location, but at the same time, the economies differ with respect to economic development, monetary policy targets and implementation of the monetary policy. We believe that the choice of the four will contribute to provide a more nuanced picture of the consequences of negative key policy rates.

Isolating the effect of the NIRP: While the visual interpretation of our empirical analysis might give an indication of the effect of the NIRP, it will never be fully conclusive, as we are not able to fully separate the specific effect of the NIRP from other events that influence the variables of interest. However, to try to isolate the NIRP effect, we have chosen to perform a comparable analysis with a control economy that has not implemented negative interest rates. The control economy of choice is the United Kingdom (UK), since the Bank of England, despite facing similar economic challenges, has not implemented NIRP. Further, the close geographical location and shared history to the other economies support the choice of the UK as a suitable control economy.

Definition of the key policy rates: When we refer to the economies' key policy rates in this thesis, we refer to the following rates: Denmark the Certificate of Deposit Rate; Sweden the Repo Rate (interest rate on Riksbank certificates); Switzerland the Sight Deposit Rate (midpoint of target range for 3-month CHF Libor); Euro Area the Deposit Facility Rate; and the United Kingdom the Official Bank Rate.

Timeframe for the analysis: We have chosen to focus our analysis from the year of NIRP implementation for the different economies, 2012 for Denmark and the Euro Area and 2014 for Sweden and Switzerland, to the end of 2016. The ending point was chosen as most data

do not stretch further. Some data is not available further than 2015. In the discussion, we will implement information related to the historical development of the variable of interest when needed, so we are able to uncover underlying economic tendencies that may influence our results. The data will then, most commonly, stretch back to 2004, and the relevant historical development plots will be attached in the appendix. It is also worth mentioning that there have not been any significant economic events that should influence any of the economies of interest since the end of 2016.

The thesis scope: When analysing the effects of the unconventional monetary policy, we will focus the period from when the key policy rates of the four chosen economies were set to zero or negative levels. It could be argued that it is the abnormally low interest rates implemented post the Great Financial Crisis that cause deviations from conventional monetary policy, this also includes low, but still positive, interest rates. However, we need to make a clear separation in our analysis and has therefore chosen to set the upper limit to the zero level of key policy rates. Zero rates are not negative, but we have still chosen to implement these in our NIRP analyses. This will affect the analysis of Sweden and the Euro area, which both had a period with the key policy rate equal to zero before they were lowered into negative territory. Denmark and Switzerland made key policy rate cuts directly from positive to negative territory.

1.3 Monetary Policy

This section will provide a description of the monetary policy targets for the chosen economies. Monetary policy is executed by the economies' central banks.

1.3.1 Denmark

The objective of Danmarks Nationalbank (DN) is to "maintain stable prices, i.e. low inflation" (Danmarks Nationalbank, 2017b). The monetary policy aims at keeping a nominal exchange rate peg towards the Euro whilst the fixed-exchange-rate target is to keep the central rate of 746,083 Danish Kroner per 100 euros with fluctuation limits of plus/minus 2,25% (Danmarks Nationalbank, 2017c). This is achieved as DN changes its policy rates relative to those of the European Central Bank (ECB). Through the nominal exchange rate peg, the Danish national bank is also able to ensure that inflation in Denmark is kept at a low level.

1.3.2 Sweden

The objective of Sweden's monetary policy is to "maintain price stability" (Sveriges Riksbank, 2017b). In practice, this means that the Riksbank aims at keeping the inflation rate low and stable, close to 2% annually. To keep the inflation at its target level, the Executive Board of the Riksbank makes policy rate decisions and adjustments related to three key policy rates; the Repo rate, the Deposit rate, and the Lending rate.

1.3.3 Switzerland

The Swiss National Bank's (SNB) main objective is to provide price stability in the medium term (Swiss National Bank, 2017c). In percentage terms, the price stability target of the SNB is to keep annual inflation below 2% (Swiss National Bank, 2017b). The monetary policy of the Swiss National Bank is conducted by governing the interest rate level in the Swiss franc money market. The central bank fixes and publishes a target range for the three-month Swiss franc Libor rate regularly, and in its daily operations the SNB aims to keep the Libor rate in the middle of the operational target range by conducting market operations (Swiss National Bank, 2017d).

The main instrument the SNB applies to manage the money supply and the Libor rate, are repurchase agreement transactions (repo transactions). In addition to repurchase agreements, the SNB can also utilize other supplementary monetary policy instruments, such as swaps, purchase of Swiss Franc bonds and so forth. However, the repo transactions are the most commonly used instrument (Swiss National Bank, 2017e).

1.3.4 Euro Area

The primary target of ECB's monetary policy is to "maintain price stability" (European Central Bank, 2017b). Subject to this, the ECB aims to keep inflation close to, but below, 2% over the medium term. By aiming at a two percent rise in the Harmonised Index of Consumer Prices, ECB provides a security margin against deflation.

In addition to the price stability objective, the Eurosystem shall also "support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union" (European Central Bank, 2017d). These objectives include full employment and balanced economic growth.

1.3.5 United Kingdom

The Bank of England's main objective is to maintain price stability, low inflation, and hereunder the central bank aims to meet the Government's 2% inflation target (Bank of England, 2017b). The Monetary Policy Committee primarily use adjustment of the key policy rate to achieve the objectives, but they also have a range of other tools available, including quantitative easing which was implemented in 2009 (Bank of England, 2017a).

1.4 Thesis Structure

The thesis will take the following structure: In chapter two, we will provide a general historical overview of the Great Financial Crisis. Further, we will present economy specific sections describing the policy rate developments into the current state before the chapter is rounded off with a short overview of the timing and reasons for significant interest rate cuts.

Further, in chapter three, we will describe the general theory associated with both conventional and unconventional monetary policy, as well as the zero and effective lower bound. The description of unconventional monetary policy will be focused towards the negative interest rate policy, and include both the intentions behind such a policy and the concerns related to the implementation. We will also include an outline of the research that has been conducted within the field to provide an overview of the existing insight related to the topic.

Then, in chapter four, the method and data section will follow. This chapter will include a specification of the research process, research approach, and the research method. Further, the data collection process, data sources and data types will be described. We will also briefly comment on the quality of data collected.

Chapter five will include the main analysis and discussion related to our problem statement and sets of sub-questions. The chapter will be split into two sub-chapters; 5.1 Investments and 5.2 Liquidity-constrained households and firms. Each section will include the analysis and discussion related to the relevant set of sub-questions in the problem formulation.

Lastly, we will present our conclusions and final remarks in chapters six and seven. These chapters aim to conclude our analysis and answer the problem statement. In addition, some insight related to the process and suggestions for further research will be presented.

2. History

Today, all our key economies have implemented negative policy rates. The control economy has not entered the negative state but has followed a strict expansionary monetary policy regime for several years. The historical event that has led to this state is, in brief, the recession that followed the Great Financial Crisis in 2007-2008. The starting point was the subprime mortgage crisis in the US, however, the situation escalated and developed into a global banking and sovereign debt crisis. Below we will provide a summary of the key events during the Great Crisis, followed by an economy by economy description of the motivation behind and the development of the key policy rates into their current levels.

2.1 The Great Financial Crisis

The Great Financial Crisis, also known as the 2008 financial crisis or the global financial crisis, is by many viewed as the "*most serious crisis to hit the global economy since the Great Depression*" (Elliot, 2011). It erupted in the United States in September 2007, following a wave of mortgage defaults by American homeowners, and spread as several banks across the globe started losing money on security holdings linked to those mortgages. Since the banks' exposure to the mortgages was unknown, uncertainty spread, banks and investors took on extreme preventive measures, and business among banks came to a hold.

Many European banks had large exposure to the American mortgage market, and the crisis hit them hard. To avoid major defaults, European governments stepped in to help the struggling banks. However, these rescue missions came at a very high price and led to some governments facing bankruptcies themselves. As the banks' problems slowly were transferred to governments, market concerns for further bankruptcies forced Europe into recession in 2009.

With the recession, the creditworthiness of governments came to focus, and huge debt-to-equity ratios were uncovered. Several governments that had become used to taking up large loans to finance their budgets, found it much harder to obtain loans in financial markets. Interest rates on government bonds escalated to levels where the governments finally had to seek financial assistance from large banks and organisations internationally, including the

ECB and the IMF. The crisis that had started out as defaulted mortgages, and turned into a bank crisis, was now, in fact, a sovereign debt crisis.

During the recession that followed the Great Financial Crisis, central banks lowered their policy interest rates to historically low levels to try to stimulate the economy, creating growth and increase inflation. However, the expansionary policies adopted did not achieve the wanted outcome; inflation and economic growth were still low. This led some central banks to break through the theoretical zero lower bound to achieve the wanted effects, by adopting negative interest rate policies.

2.2 Implementation of Negative Interest Rate Policy

2.2.1 Denmark

Danmarks Nationalbank lowered their key policy rate, the Certificates of Deposit rate, into negative territory in July 2012 (Danmarks Nationalbank, 2017a). This decision was made to discourage capital inflow to reduce the pressure on the Danish krone. The policy turned out to be effective and caused both the money market rates and the exchange rate to decrease (Jørgensen & Risbjerg, 2012). In April 2014, the key policy rate re-entered positive territory and stayed positive for five months before it was lowered back to negative state in September 2014 to continue managing the upward pressure on the Danish krone. Since then, the rate has been adjusted downwards twice, into the current level of -0,65%, as of December 2016 (Danmarks Nationalbank, 2017a).

As part of the introduction of the negative interest rate policy, the current-account deposits rate and the discount rate were also lowered, but not further than to zero. This happened in June and July 2012, respectively. Since then, the two rates have remained constant at their zero levels (Danmarks Nationalbank, 2017a).

2.2.2 Sweden

When the Swedish economy was hit by recession in 2009, the challenges were related to low exports and a deteriorating situation in the labour markets. With the downturn in the world economy and indicators of weak development going forward, Sveriges Riksbank (SR) chose to adopt an expansionary monetary policy to support the monetary policy objective of 2% inflation. The policy rates were cut, but only the deposit rate entered negative territory

(Sveriges Riksbank, 2009). In September 2010, the Swedish economy had started to recover, and all policy rates were raised (Sveriges Riksbank, 2010).

Later, towards the end of 2013, the country again faced challenges with low inflation levels and declining inflation expectations. In response, the central bank's Executive Board again endorsed a more expansionary policy by lowering the policy rates (Sveriges Riksbank, 2013). Despite the Board's response to the challenges, the inflation levels were persistently low and the inflation expectations were reduced further over the next months. By end of 2014, a sharp decline in inflation expectations led the Executive Board to lower the repo rate to zero, and later into negative territory. The key policy rates have since then been subject to two further cuts, into their current values of -0,5% for the Repo rate, -1,25% for the deposit rate and 0,25 for the lending rate, as of December 2016 (Sveriges Riksbank, 2017a).

2.2.3 Switzerland

At the time the financial crisis erupted in the US, the Swiss economy faced deflation pressures and weak growth forecasts. As a result, the Swiss National Bank (SNB) chose to adopt a conventional expansionary monetary policy, followed by several policy rate cuts (Swiss National Bank, 2017f). Later, in 2011, the Swiss economy was subject to another challenge; the Swiss Franc faced high appreciation pressure, and as a result, the Swiss National Bank made additional interest rate cuts and implemented a currency cap on the Swiss franc towards the euro. The currency cap was a minimum exchange rate of CHF 1,20 per euro (Swiss National Bank, 2011).

Despite the central bank's efforts, the pressure on the currency was consistently strong, and consequently, the operational target range and the sight deposit rate were set below zero in December 2014 (Olivei, 2002 / Swiss National Bank, 2017f). By making this decision the SNB reaffirmed its intention to keep the nominal exchange rate peg. However, in January 2015, the minimum exchange rate peg was removed. The central bank was still determined to avoid strong appreciation of the Swiss Franc and lowered the target range further to -1,25% – -0,25% resulting in a sight deposit rate of -0,75%. Since then, the target rates have been kept stable (Swiss National Bank, 2017f).

2.2.4 Euro Area

As the recession hit Europe in 2009, the Euro Area faced falling inflation and inflation expectations. In response to the weak state of the economies in the monetary union and the grave inflation outlook, the European Central Bank (ECB) also adopted an expansionary monetary policy, and the key policy rates were gradually lowered. By July 2012, the Deposit Facility Rate (DFR) was reduced to zero, and almost two years later, in June 2014 further cuts were made, and the DFR were lowered into negative territory. Since then, the deposit rate has been lowered an additional three times into the current level of -0,4% (European Central Bank, 2016). The interest rates on Main Refinancing Operations (MROs) and the Marginal Lending Facility (MLF) have not entered the negative territory. However, the fixed rate tenders of the MROs were lowered to zero in March 2016. The current levels of MROs and MLF are 0,00% and 0,25%, respectively (European Central Bank, 2016).

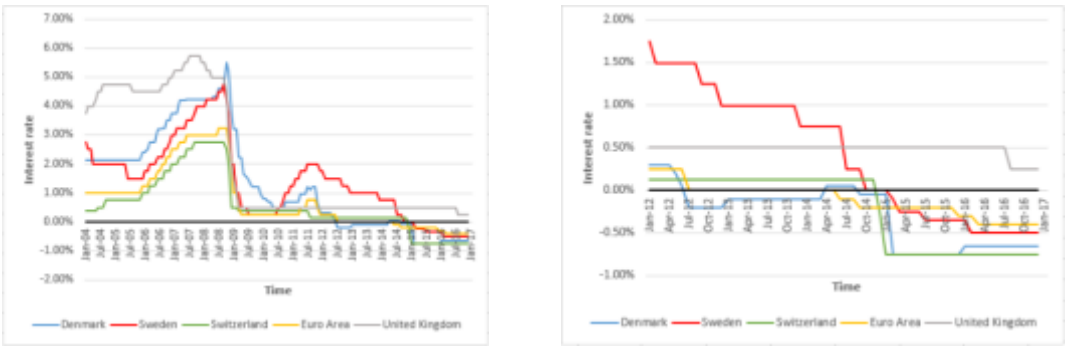
2.2.5 United Kingdom

The key policy rate of the United Kingdom has varied through the Bank of England's monetary policy history. The latest two key policy rates have been the repo rate (1997-2006) and the official bank rate (2006-) (Bank of England, 2017c). Following the financial crisis in 2007-2008, the policy rate has been lowered gradually, but has, as opposed to the NIRP economies, never entered negative territory. In 2008 and 2009, the Bank of England adopted several interest rate cuts, adjusting the policy rate to a level that was the lowest since the beginning of the 1950s (Bank of England, 2017c / Seager, Finch & Treanor, 2008). The reductions were made due to pressure from unions to lower the costs of borrowing and the recession that hit the economy in the beginning of 2009. From March 2009, the policy rate was kept stable at 0,5% for more than seven years, before the Bank of England decided on an additional interest rate reduction, cutting the rate to 0,25% in August 2016, a record low level. The latest cut was made as part of a package aiming to avoid another recession in the wake of the Brexit (Allen & Elliott, 2016).

2.3 A Graphical Presentation of Policy Rate Development

To conclude this chapter, we have made two plots showing the development of the key policy rates of the four key economies and the control economy. The plots are sequential, the first providing a more historical overview and the second uncovering more details.

Figure 2.1 Historical development of key policy rates



Note: *Denmark - Certificate of Deposit rate; Sweden - Repo rate (interest rate on Riksbank certificates); Switzerland - Sight Deposit rate (midpoint of target range for 3-month CHF Libor), first implemented in January 2000; Euro Area - Deposit Facility rate; United Kingdom – Official Bank rate.* ***Observations:*** *January 2004 to December 2016 and January 2012 to December 2016.* ***Source:*** *Danmarks Nationalbank, Sveriges Riksbank, Swiss National Bank, European Central Bank and Bank of England.*

The left plot in the figure above shows the overall development of the policy rates from 2004 to 2016. This is done to provide a general overview of interest rate fluctuations before and after the Great Financial Crisis. The right plot highlights the most recent years, January 2012 to December 2016, which is the period when the policy rates of the key economies were lowered to zero and negative values. As shown; Denmark was the first economy to enter negative territory. The European Central Bank reduced their deposit facility to zero shortly after, before they became the second economy with negative policy rates in 2014. Later, both the Swedish and the Swiss national banks also broke through the zero floor. As displayed, the United Kingdom never lowered the official interest rate into negative territory.

Finally, the reasoning and timing of the central banks' policy rate cuts are summarized in the table below.

Table 2.1 Timing and reasons behind recent policy rate cuts

Central Bank	Action	Reason
Denmark	July 2012: The Certificate of Deposit rate was set into negative territory for the first time, -0,2% 2014 onward: The rate was set slightly positive again in April, but was set equal to -0,05% already in September. Since then it	The rate was lowered to reduce and manage the pressure on the Danish Krone.

	has been cut in several steps into the current value of -0,65%	
Sweden	October 2014: The Repo rate was lowered to zero for the first time February 2015 onward: The key policy rate was lowered to -0,1%, and has since then been reduced several times. Currently, the Repo rate is equal to -0,5%	Sweden faced low exports and weak forecasts for the labour market and the economy generally. The expansionary monetary policy was intended to respond to this in addition to contributing to a rise in the inflation towards the target.
Switzerland	December 2014 onward: The Sight Deposit rate was set negative in December 2014, and was further lowered to -0,75%, its current level, in January 2015	The low Sight deposit rate was the central bank's reaction to weak forecasts and a fear of deflation.
Euro Area	July 2012: The Deposit Facility rate was set equal to zero, and was kept constant for almost two years. June 2014 onward: The Deposit Facility rate became negative for the first time. It has been lowered several times since then, into the current value of -0,4%	The Central bank responded to weak economic activity and low inflation expectations.
United Kingdom	July 2008 - March 2009: The official rate was lowered from 5% to 0,5% in several steps, some larger and more surprising than others. August 2016 onwards: A final interest rate cut was implemented, lowering the policy rate to its current value of 0,25%.	The Bank of England faced pressure from the industry, unions and other interest groups, and was responding to the recession that the nation entered in early 2009. The latest cut was an attempt to avoid another recession following the Brexit.

3. Theory and Literature Review

This chapter will include both the basic theory for our thesis, a theoretical literature review and finally a research-based literature review that will include research related to our problem statement.

We will commence this chapter by describing theories of conventional monetary policy. It will first provide an overview of general monetary policy theory, a section that includes the purpose of monetary policy, the authority of a central bank, a description of the differences between monetary policy and fiscal policy, and finally outline the monetary policy tools and the mechanisms of monetary policy implementation. Then the Taylor rule that was developed by John B. Taylor in 1992 will be thoroughly described. The description will include what it is, what it is used for, derivation of the rule, components, and critique of the rule. Finally, sub-chapter 3.1 rounds off with business cycle theory. In this section, we will describe what a business cycle is, map out the drivers behind business cycles and finally provide a brief description of business cycle research.

Further, in sub-chapter 3.2, we will consider theories related to the lower bound of interest rates. These theories address some hypotheses regarding how low the official interest rates can be set before monetary policy tools become inefficient. We will start by describing the basic Zero Lower Bound theory and the liquidity trap, before the section finishes off with theories relates to the Effective Lower Bound.

In section 3.3 we will present the theory related to unconventional monetary policy. First, the central bank's alternative course of action when the interest rates lie close to the lower bound is presented. Following, we have two sections related to the NIRP; the first regarding the goals of implementing negative interest rates, and the second concerns the transmission mechanism of the negative policy rates to economic activity. Rounding off the section, we will present a segment that provides an overview of consequences, some positive, but the major part is concerns related to the NIRP. The section combines a theory overview with a literature review.

The chapter ends with a research overview specifically related to our problem statement and sub-questions presented in chapter one. The section will provide information about three types of research papers, based on different research methodology, that are most commonly used in research related to the NIRP and consequences of the NIRP. Finally, we will provide specific research references related to the main problem statement and the two sets of sub-questions, respectively.

3.1 Conventional Monetary Policy

Governments and central banks around the world use fiscal and monetary policy tools to influence and stimulate the economy to create growth and increase wealth. The central bank is the governor of monetary policy, and by regulating cash reserves and interest rates they can affect important economic variables, and push the economy in the preferred direction. Macroeconomic theory and complex macroeconomic models are key when the central banks decide on what actions to initiate, as these theories and models provide the basis to predict how the central banks' operations will influence the country's economy. We will elaborate on the following theories and models below; the Taylor rule, a policy interest rate rule used both to evaluate historical monetary policy performance as well as a guideline to determine the correct future level of interest rates, business cycle theory, the related Real Business Cycle (RBC) as well as the Dynamic Stochastic General Equilibrium (DSGE) models.

The scope of fiscal policy and related policy tools are not subjects that will be described in detail in this thesis. We will shortly mention the difference between monetary policy and fiscal policy, but beyond that, fiscal policy will not be in focus, as the thesis is centered around the economic effects of monetary policy.

3.1.1 Monetary Policy Theory

3.1.1.1 The Purpose of Monetary Policy and the Authority of a Central Bank

Amadeo (2016a), defines monetary policy as “how central banks manage liquidity to create economic growth.” The monetary policy in modern economies is managed by independent central banks, or other types of regulatory organs such as currency boards (Investopedia, 2017c). These authorities control the economy through conducting monetary policy. The policy conducted is guided by a set of monetary policy objectives, usually defined by a

central government act. The central bank's policy operations are conducted through a set of actions such as nominal interest rate adjustments, market operations involving sale and purchase of government bonds and managing bank reserves.

The monetary policy targets vary between the different countries and economies. However, Amadeo (2016a), has defined the main objective for a central bank: "The primary objective of central banks is to manage inflation. The second is to reduce unemployment, but only after they have controlled inflation." Inflation managing could be conducted directly through inflation targeting and price-level targeting, and indirectly through a nominal exchange rate peg. Inflation targeting is a policy where the central bank sets an inflation rate as its target with the intention of keeping inflation stable over time (Amadeo, 2016b). Similarly, price level targeting is a policy where the central bank aims its policy towards meeting a pre-determined price level target, keeping prices stable over time (Investopedia, 2017e). Finally, a nominal exchange rate policy is based on the central bank fixing the exchange rate towards another currency, stabilizing the value of the nation's currency (Investopedia, 2017a).

When it comes to the role of the central banks, their main task is to control and conduct monetary policy for an economy. The central bank determines the size and growth rate of money supply, as they are the only issuers of bank reserves and notes. In that relation, the central bank may be considered as a monopolist when it comes to the domestic money supply. Managing the money supply is a powerful position as it means that they control the interest rate at which the banks place and borrow money from the central bank, which in turn will influence the interest rate in the interbank, corporate and consumer markets (ECB, 2017). A change in the nominal interest rates in the central bank will also have additional effects, these will be described in more detail below.

3.1.1.2 Monetary Policy versus Fiscal Policy

Generally, there are two sets of policies that can be applied to influence a country's economy, avoiding both recessions and overheating. These two are monetary and fiscal policy. Fiscal policy influences the market directly through tax regimes, government saving, and spending, while the monetary policy effects are more indirect and conducted by managing the money supply (Schmidt, 2017). The central banks are in theory independent

from the government and the rest of the policy makers, which illustrate the separation between fiscal and monetary policy (Blachut, 2016). However, despite this separation, the set of tools should ideally be coordinated and to the extent possible stimulate the economy in the same direction (Amadeo, 2016b). Research has also been done in the US regarding the most effective way of stimulating the economy, in the short- and long-term. The findings show that the fiscal policy was key in a long-term perspective, while the monetary policy tools were the most effective in the short run (Schmidt, 2017).

3.1.1.3 Monetary policy tools and implementation

There are several theories regarding the transmission mechanism for monetary policy; what tools the central bank can use and how their decisions result in a change in macroeconomic variables. The interest rate is an essential policy tool and can be described as a measure of liquidity; the value of tomorrow's money, today (Blachut, 2016). The central banks often have one or a set of key policy rates they use to conduct monetary policy. These rates are used in the implementation of monetary policy, as any adjustment in the key rate will influence the market's money demand (Investopedia, 2017b). Another key tool of the central bank is open market operations that directly affects money supply, and indirectly influence market interest rates (Investopedia, 2017c).

In a well-functioning market, the official key interest rate will be reflected in the interbank money market rates and further affect the rates that the banks' customers are facing. An increase (decrease) in the key interest rate will, therefore, result in an increase (decrease) in the cost of borrowing money and generate larger (reduced) benefits from savings. However, the size of these effects depends on the investment opportunities available to the investor (Jackson, 2015). Furthermore, changes in the consumer's preferences will cause a decrease (rise) in aggregate consumption and investment, as well as a tightening (increase) in the country's GDP (Steigum, 2004). This will result in an increased (decreased) output gap and thereby contribute to a decline (rise) in inflation. As the aggregate output is lowered (raised) and the output gap escalates (tightens), there is lower (higher) demand for labour and so the employment rate decreases (increases) (Jackson, 2015). The transmission mechanism described here is what we typically see following a contractionary (expansionary) monetary policy decision.

Another way interest rates affect the economy is by influencing the asset prices. More precisely, a higher (lower) interest rate will give an incentive to place more (less) money into a bank account and correspondingly less (more) into risky assets that generate high yield. A higher (lower) interest rate will also increase (reduce) the expectations of future earnings. The change in borrowing and lending will lead to a portfolio rebalancing effect that in turn, together with the earnings expectation effect, will influence the prices of the relevant asset due to a change in the demand (Jackson, 2015).

Managing the reserve requirements for banks is another way of influencing the economy. The requirement is a percentage of customers' deposits that the bank must retain, and cannot lend to other customers (Investopedia, 2017e). If it was not for the reserve requirement, banks would lend 100 % of the deposited money (Amadeo, 2016b). Meeting the reserve requirement is necessary as it secures that the bank holds enough capital to support its obligations in case of distress. Furthermore, the requirement has a direct effect on money available for lending, as it influences the bank's ability to service its borrowers. Summing up, a higher reserve requirement will result in reduced money supply, and have a contractionary effect on the economy (Jackson, 2015).

The last conventional monetary policy element used to influence the economy is through the currency channel. A rise (reduction) in the official interest rate will transmit into the market rates, and encourage (discourage) foreign capital inflow. The increased inflow will lead to increased demand for currency and cause the domestic currency to appreciate (depreciate) which, in turn, will decrease (increase) domestic demand. Externally, the effect will result in reduced (increased) competitive power, with declining (rising) external demand and reduced (increased) export (Jackson, 2015 / Ma, 2016).

3.1.2 Taylor Rule

3.1.2.1 What is it, and what is it used for?

The Taylor Rule is an interest rate rule created and perfected by John B. Taylor in 1992, and further extended and developed through his research in the 1990s. In his paper "Discretion versus Policy Rules in Practice" written in 1993, Taylor emphasise that the policy rule is developed based purely on monetary policy, while fiscal policy considerations are kept out

(Taylor, 1993). However, he says that the same approach could be used to evaluate fiscal policy.

The rule was initially developed as a tool to evaluate monetary policy in a historical context, but later research suggests that the rule could also be used as a guideline for making monetary policy decisions in the short-run. When performing historical evaluation, the model opens for comparing different economies with different monetary policy regimes, as well as evaluating policy performance within a chosen economy. In the latter, a model economy with the same properties as the economy of interest is evaluated by theoretically implementing different policies to decide which approach generates the most favourable economic outcome.

3.1.2.2 Derivation, form and components

When Taylor came up with the rule, he based his derivation upon the quantity equation of money utilized by Friedman and Schwartz (1963) in their monetary history research. The researchers concluded that a higher stock of money would lead to higher price level, keeping the other variables constant (Friedman & Schwartz, 1963).

Taylor (1999) assumed that money was growing at a fixed or constant rate. Further, he highlighted the fact that the velocity was dependent upon the interest rate and real output. By using this relation and substituting the velocity factor, Taylor could relate the interest rate, price level, and output. Further, Taylor concluded that a function relating the interest rate to prices and output could be outlined even if money did not grow at a constant rate, but rather responds systematically to a change in the interest rate or output.

Finally, Taylor established the policy rule's functional form with a linearity in the interest rate and the logarithms of price level and real output. In addition, price level and real output are made stationary by considering the deviation of real output from a trend, and the log deviation of price level or inflation rate. The linear equation was then presented as follows:

$$i_t = r^n + \phi_\pi(\pi_t - \pi^*) + \phi_y(\ln Y_t - \ln Y_t^n)$$

Where i_t is the nominal short-term interest rate and r^n is the natural real rate of interest. The parameters ϕ_π and ϕ_y represent the weight the central bank imposes on the inflation

deviation from the inflation target and the output gap (log deviation of real output from the log natural rate of output), respectively (Romer, 2012).

Looking at the policy decision response to a change in any of the factors, Taylor (1993) states that if inflation is above (below) its target level or if real GDP is above (below) trend GDP, the nominal interest rate should be increased (decreased).

When using the interest rate rule as a policy decision tool, Taylor (1993) stresses the importance of focusing on internal conditions in the economy rather than considering external. Therefore, he created the policy rule as a responsive rule to changes in the price level (inflation) and real output from a target level (output gap). Further, he claimed that weight on both price level and output gap is preferable in most economies, and his research shows that some weight on real output is better than following a pure inflation rule. The magnitude of the parameters is determined by the way monetary policy is conducted by the central banks in each economy and each period (Taylor, 1999), and the weight components make a big difference for the effects of monetary policy.

3.1.2.3 Critique

Even though the Taylor Rule has received a lot of praise from economists, his rule has also been subject to critique. Clarida, Gali and Gertler's (2000) primary criticism relates to the lack of forward-looking components. The rule in its basic form is purely backward-looking and based on lagged variables. The researchers argue that implementing a more progressive model including expected future inflation and output gap would be more relevant when a central bank applies the rule as a decision tool, as the future values are the ones that will be influenced by the policy decision.

Romer (2012), supports Clarida, Gali and Gertler's critique, and also lists some additional drawbacks related to Taylor's assumptions. While Taylor assumes that the equilibrium real interest rate is constant and known, Romer argues that the natural rate of interest varies over time, and is not constant. He, therefore, suggests replacing the constant real rate, with a corresponding time-varying component. Further, Taylor presumes that the other variables that enter the rule (inflation, output and natural rate of output) is known with certainty. Romer's response is that none of these factors are known with certainty in real time. Still,

the drawbacks associated with the distortion of inflation and output it less significant. The real problem is related to the estimation of the natural rate of output, and whether real output is above or below its natural level. This distortion makes it very difficult for the central bank to determine how to adjust the interest rate relative to the output gap.

3.1.3 Business Cycles

3.1.3.1 What is it?

The phenomenon of business cycles was first featured in Arthur Burns and Wesley Mitchell's research in 1946. They recognized that many economic variables move closely together and started to analyse these observations (Romer, 2008). The movements of output around its trend is what we know as business cycles. These fluctuations form the basis for the definition of expansions and recessions (Romer, 2008). According to David Romer (2012), one can observe that the movements are not particularly skewed, and the output growth is spread evenly around the trend. However, Christina Romer (2008) states that according to most economic research, the changes in output does not follow a predictable pattern. Further, Christina Romer provides the general explanation for the observation of fluctuations; that the economy faces shocks that vary with regards to size, timing, duration, and type.

3.1.3.2 Business cycle drivers

There is a range of theories related to the drivers behind business cycles. The predominating theory is that there exists an equilibrium state of output in the economy where resources are utilized maximally without wearing them out. In this state, full employment is in place and inflation is steady at zero growth. In a world without the presence of shocks, the economy could stay in this optimal point forever. However, if we allow for disturbances to the economy, the result of a shock would be that output will deviate from its ideal level, and this will make other factors, like employment and inflation, drift away from the equilibrium state (Romer, 2008). According to Rebelo (2005), movements in energy and oil prices as well as fiscal shocks contribute to the business cycles but are not considered to be the main source of the fluctuations. A quick change in private or government spending, for instance, because of expectations about future growth, will result in a non-optimal output level (Romer, 2008). According to Prescott (1986), another shock that is believed to be a driving

force behind business cycles is technology shocks. However, even though there is strong support of technology shocks being a key source of business cycles, Prescott's research approach has been criticised as his measurement indicator, total factor productivity (TFP), is viewed not to be a purely exogenous factor.

Monetary policy actions could also be considered a reason for change in output in the economy (Romer, 2008). When the central bank changes the official interest rate, there will be transmitting effects throughout the economy. It is, however, important to note that not all economists agree with the assumption of non-neutrality of money, a theory related to whether the nominal side can affect the real side of the economy.

There are several concrete theories that address the existence of business cycles. The New Keynesian Theory is one of them (Romer, 2008 / Romer, 2012). According to this view, nominal rigidities, and more specifically stickiness of wages and prices are the underlying cause of business cycles. When prices and wages are sticky it takes time to adjust to the new market conditions, and instead of immediately stabilizing in a new steady state, we will experience a period with sub-optimal market allocation. This is when the recessions and expansions occur (Romer, 2008). Classical Keynesian theory, on the other hand, has a different explanation: According to this theory, nominal rigidities are insignificant and will therefore not affect the demand and the output level. Rather, changes in productivity and preferences are seen as the drivers behind the fluctuations (Romer, 2008).

3.1.3.3 Business cycle research: RBC and DSGE models

There has been much research related to business cycles through the last decades, and researchers are trying to expand the knowledge within the field (Rebelo, 2005 / Romer, 2012 / Gali, 2015). Early research was purely based on using Real Business Cycle (RBC) models, where the research was based on a Walrasian model, often the basic Ramsey model, but it was subject to two assumption deviations; they allowed for a source of disturbances (real shocks) and variations in employment (Romer, 2012).

Later, during the RBC revolution, researchers started to question the RBC models' assumptions that only considered shocks to real factors as sources of the fluctuations. In this new approach, nominal rigidities were considered being crucial to explain fluctuations, and it

was stated that RBC models were not suitable for analysing variations in output level. Consequently, the basic tool of business cycle analysis shifted from RBC to Dynamic Stochastic General Equilibrium (DSGE) models (Romer, 2012 / Gali, 2015). DSGE methodology tries to explain macroeconomic phenomena, such as business cycles, by building a general equilibrium model derived from microeconomic theory and specification of underlying shocks (Romer, 2012).

In addition to the change in model preference, several other concepts were adopted in this period. One thought that prevailed was the idea that business cycles were a natural, equilibrium outcome of shocks, and therefore, the central banks' actions aiming to stabilize the economy was not necessary, but rather inefficient. Today, the policy decisions of the world's largest central banks are still based on more and less complex DSGE models (Gali, 2012). In addition, the belief of money non-neutrality, the idea that in a short-term perspective the real side of the economy will be influenced by the nominal side, is stronger. As a result, there is, to a large extent, overall agreement that the actions of a central bank or other financial institutions influence the economy (Gali, 2015).

3.2 Lower Bound Theory

The lower bound theories are theories highly related to negative interest rate policies as they contribute to explaining why the central banks are reluctant to push the interest rates below zero. The concept of the Zero Lower Bound (ZLB) is a theory related to the belief that interest rates cannot be lowered further than to zero, as monetary policy tools will become ineffective. However, some central banks have reduced interest rate levels to negative territory, and this implementation of negative interest rates has made it possible to investigate and study the ZLB hypothesis. This research has given rise and support to another theory; the Effective Lower Bound (ELB).

3.2.1 The Zero Lower Bound

"Because high-powered money earns a nominal return of zero, there is no reason for anyone to buy an asset offering a negative nominal return. Thus, the nominal rate cannot fall below zero." (Romer, 2012). This statement clearly describes the core of the theory of a zero lower bound on nominal interest rates. The theory of a lower bound has been researched in

several papers the last decades, and all these come to the same conclusion; there exists a limit to how far a country's central bank can lower the policy rates of an economy (Agarwal & Kimball, 2015 / Eggertsson & Woodford, 2003). The theory presented in research related to the Zero Lower Bound (ZLB) states that when the nominal interest rate nears or become equal to zero, the central bank cannot lower it any further (Macroeconomic Analysis, 2017). The reasoning behind the theory is, as explained by Romer (2012), that a negative nominal interest rate will lead to a large increase in cash holdings since cash generates a nominal return of zero, which in this case will be the most profitable investment choice.

Concerns are related to the event in which the rise in cash holdings will result in a so-called "liquidity trap". A liquidity trap is a situation where the monetary policy tools, and more specifically increase in money supply, does not increase the interest rate, and hence it will not stimulate growth in the economy (The Economic Times, 2017). In a situation with a binding liquidity trap, the public is set on hoarding all money supplied, as the investment alternative will generate a lower nominal return. In this case, neither open market operations or a reduction of nominal interest rates, which is already at zero percent, will have a real effect on the economy. All in all, monetary policy will be powerless (Romer, 2012).

The Zero Lower Bound was long thought of mainly being a concept of historical and theoretical relevance; "only valid in regard to the Great Depression but unlikely to be important to modern economies" (Romer, 2012). It is not until the Great Financial Crisis that one has had the chance to test whether the theory holds in practice in present-day economies. During the recent years, researchers have found evidence that the Zero Lower Bound is binding also in modern times (Rudebush, 2009 / Romer, 2012). As an example, in his research, Rudebush (2009) found that conventional interest rules implied an appropriate Federal funds rate target level of negative 4% or lower in the absence of the lower bound in 2009. Accordingly, it is believed that if the ZLB did not exist, the central banks around the world would have cut the interest rate more than what has been the case in practice following the financial crisis. Still, some central banks have chosen to break through the ZLB by implementing NIRP in the wake of the 2009 recession, which might indicate that the lower bound is somewhere in the negative territory rather than at zero. Agarwal and Kimball

state in their 2015 IMF Working Paper: “Policymakers can’t do anything about the zero lower bound: The zero lower bound is a policy choice, not a law of nature.” This theory is related to the Effective Lower Bound; a theory we will describe more in detail in the following section.

3.2.2 The Effective Lower Bound

The dominating theory of lower bounds has historically been the Zero Lower Bound theory. Still, the economic development and the policy decisions made by the Japanese and several European central banks after the Great Financial Crisis has forced researchers to look further. The zero-nominal interest level was broken, and negative key policy rates were implemented. The feared consequences related to cash hoarding and liquidity traps were absent, and the hypothesis of an Effective Lower Bound (ELB) was established. Safeguarding, holding and transacting cash is costly, and by taking these costs into account and recognizing that people are willing to pay for the convenience and safety of placing money in a bank account, cash is argued to have a lower yield than zero (Keister, 2011 / Arteta et al, 2016). This implies that the well-known Zero Lower Bound theory is wrong; the lower bound might in practice be negative. The important issue that everyone is speculating about is where this golden limit lies; how negative can the interest rates become, and for how long can they remain at that low level? (Jackson, 2015).

In 2014, the ECB implemented negative interest rates for the first time. In that context, Mario Draghi stated that the Euro Zone had reached the effective lower bound on interest rates (Blachut, 2016). A further reduction only a year later showed that the lower bound was not reached after all. Blachut (2016), claims that the effective lower bound is even lower than what Draghi’s statements imply by referring to the fact that several European countries operate with a negative interest rate close to negative one percent. Harriet Jackson’s research for the Bank of Canada (2015), compares the costs of convenience, storage, and social cost and indicate that the ELB could be close to negative four percent, however that is dependent upon the length of time the interest rates are kept at low levels.

Several factors, both direct and indirect, influence the level of the Effective Lower Bound before the liquidity trap sets in. Direct effects could be the reduced impact of the monetary policy tools on interest rate levels and the costs of holding and managing cash (Sveriges Riksbank, 2015), while examples of indirect factors are the bank’s ability to limit the pass-

through of the negative rates to their customers, the characteristics of the depositors and the expected length of the period the rate will be kept low (Bech & Malkhozov, 2016 / Svensson, 2010). Bech and Malkhozov's research conclude that the Effective Lower Bound most likely will increase as the negative interest rate period gets longer because people develop methods to lower the cost of cash while adapting to the new situation. Furthermore, as some of the costs related to cash holdings are fixed, it might become more attractive to accept these costs and access the cash if it is expected that the low interest rate period is long lasting. The consequence of such behaviour will be an upward pressure on the Effective Lower Bound (Bech & Malkhozov, 2016).

In addition to the effects mentioned above, other influencing factors have been uncovered by recent research. In addition, new research within the field is published continuously. Still, the last years' economic and monetary policy development implies that the Effective Lower Bound is the dominating theory over Zero Lower Bound. However, the Zero Lower Bound might still have effects in limiting the interest rate adjustments of the central banks, decreasing their scope of action and the real effects of any policy adjustment (Jackson, 2015).

3.3 Unconventional Monetary Policy

The idea of negative interest rates, "taxation of money", goes back to Silvio Gesell in the late nineteenth century (Ilgmann & Menner, 2011). Historically, Gesell's ideas have been highly debated, and have both been supported and strongly criticised. Today, we see that Gesell was right; negative interest rates have been implemented and are not just a strange, theoretical idea. But why are banks, corporations, and households willing to accept negative interest rates? Cæure (2014), states that the willingness is closely associated with the Effective Lower Bound; that the negative rates are accepted because the costs of alternative investment of money are higher than the cost of the negative rates.

Even though several central banks have implemented negative key policy rates today, the questions are many: Why implement negative rates? Does not the central bank have any other alternative actions? What is the central bank trying to accomplish by lowering the policy rate into negative territory? How is the transmission mechanism into economic

activity affected by going below zero? What are the real consequences? There should be some positive effects as the central bank is setting negative rates, but this is unknown territory for operations. Is the central bank aware of all the potential pitfalls? Based on current research, we will try to answer these questions in this subchapter, and we will start by considering the central bank's action alternatives when the interest rates are close to the lower bound.

3.3.1 The central banks' action alternatives

When the interest rates are close to the lower bound, the central banks have limited opportunities to use the interest rate channel to stimulate the economy. Instead, other policy tools must be utilized. Romer (2012) mentions several such tools: Firstly, the government can use fiscal policy through reducing taxes or increasing spending. Secondly, the central bank can aim at affecting the real rate without changing the nominal rate. This can be done by increasing the money supply through open market operations, an action that should result in higher inflation expectations and a lower real interest rate. Despite the theoretical simplicity of this action, it might not be as easy in practice: The low interest rate can encourage people to keep the cash they earn when selling their bonds to the central bank, instead of reinvesting it (Romer, 2012). Implicitly, the increase in money supply will have limited effect on economic activity. Further, Romer (2012) emphasise that people might believe that money supply will be reduced once the effects of the cash infusion transmit to the economy due to the stabilisation objective of the central banks. In this case, the increase in money supply will not impact the expected inflation, which consequently will reduce the transmission of the policy action to the real economy. An exchange market intervention is a third operational tool that can be utilized to stimulate the economy when the interest rate channel is blocked. By purchasing foreign assets or currency with domestic currency, one will experience a depreciation that in turn can contribute to increased economic activity.

Reza, Santor and Suchanek (2015), focus on quantitative easing as the key channel to stimulate the economy when the interest rates are close to the lower bound. They focus on stimulation through quantitative easing in two ways: First, subsidising the banks' funding costs of lending in certain markets could encourage lending and thereby contribute to a

boost in economic activity. Second, large quantum asset purchases could contribute to pushing up asset prices in a particular class of assets. This will, in turn, lower the yield due to the inverse relationship between price and yield. Resultantly, the demand for other assets will increase through portfolio rebalancing, and contribute to increasing the economic activity (Reza, Santor and Suchanek, 2015).

3.3.2 The Goal of the NIRP

According to Jackson (2015), the motivation behind implementing a negative interest rate policy is generally the same as when conducting conventional expansionary interest rate adjustments; the economy is in recession, facing weak growth, low inflation rates and reduced inflation expectations going forward. The central bank thereby needs to try to boost economic activity and increase the inflation expectations. Or, as in the case of Denmark and Switzerland, the central bank initiate expansionary actions to deter capital inflows and reduce appreciation pressure on the domestic currency. Jobst and Lin (2016) follow Jackson's arguments and state that the interest rate reduction will be implemented to stabilize inflation and close the output gap. However, with the market in a state where interest rates are close to zero, the central bank has, according to Zero Lower Bound theory, little room to manoeuvre. By breaking through the zero floor, the central bank can restore their signalling capacity, and rebuild their transmission channels from policy decisions to economic activity (Jobst and Lin, 2016).

Bassman (2015) points to another main reason for the central bank's implementation of an expansionary policy in general, and negative interest rates: They wish to generate an incentive for asset substitution where households and firms shift their investment preferences from low yield to higher yielding assets. This will, in turn, generate economic growth. Under the NIRP this substitution will function as an incentive to move away from bank savings at negative deposit rates, to investments in real assets.

Another argument for going below zero is presented by Cæure (2014): The difference between the central bank's lending and deposit rates determines the incentives to lend in the interbank market. Keeping deposit rates lower than lending rates ensures that there is room for interbank transactions, keeping the interbank market active. This is highlighted by Cæure as an important factor to obtain price signals about the transmission of policy rates to

the economy. Another important argument is that by pushing the nominal rates below zero, the central bank can make sure excess liquidity is kept in circulation in the interbank market instead of being placed in the central bank deposit accounts, ensuring capital inflow to the economy.

3.3.3 Transmission of NIRP

The transmission mechanism of policy rates to economic activity when the policy rates are negative is highly debated. While some argue that an interest rate cut from positive figures to zero or lower will be like a conventional interest rate cut that leave the interest rates positive (Jobst & Lin, 2016 / Arteta et al, 2016). Others, like Bassman (2015), argue that the transmission of an interest rate cut into negative territory will be different relative to an equivalent rate cut in positive territory. Bassman's reasoning is based on a consumer behaviour approach; the consumers' general risk aversion affects the linear path of consumer responses to interest rate cuts, creating non-linearity around the zero rate. In other words, when the policy rates become negative, the market reactions to interest rate cuts will change, and probably deviate from general transmission mechanism theory. This is supported by Reza, Santor and Suchanek (2015) that state that the transmission mechanism will be somewhat different under conventional and unconventional monetary policy. A reduction of the short-term interest rate will in the conventional case lead to expectation of a decrease in the long-term rate. This is because one of the components in the real long-term interest rate function is the expected future short-term interest rates. Quantitative easing under an unconventional policy state will have the same effect on the long-term rate. However, long-term rates could also be reduced by a lowered term premium following portfolio rebalancing. According to Ashworth (2015), "term premium" is defined as *"the extra yield required by bond investors to hold on to a long-term bond in place of a series of short-term bonds."* The reduction in the term premium is a consequence of the central bank purchasing assets with duration risk, reducing the availability of risky assets in the market. In turn, this will lower the premium the investors require to be willing to invest in the remaining assets (Reza, Santor & Suchanek, 2015).

Another argument related to transmission of negative policy rates is presented by Jackson (2015); she notes that even though the market reactions to an interest rate cut into negative

territory might be like an interest rate cut in the positive territory, "*the transmission may, however, be less powerful when the policy rates fall below zero*". Jackson further points to the fact that commercial banks may be reluctant to pass through the policy rate cut to deposit and lending rates to maintain profits as the main reason for the reduced effect. Alternatively, if the rate cuts are passed through, this could reduce bank profitability and may lead to a general reduction in credit supply. In addition, competition between banks is also an element to consider, as pass-through of negative rates also could lead to loss of customers. Reza, Santor and Suchanek (2015) and Arteta, Kose, Stocker and Taskin (2016) also support the theory that unconventional policy may have reduced effect relative to conventional policy. These researchers, however, use another argument for their reasoning; that a compression of the term premium, which unconventional policy relies heavily on in policy transmission, have a relatively smaller effect than what is seen in conventional policy transmission. However, the researchers emphasise that there are contradicting evidence around this argument.

3.3.4 Consequences

When researchers talk about potential consequences of the NIRP, they most commonly refer to possible negative effects of the implementation of negative interest rates. The positive consequences are usually ignored, because if the actions undertaken by the central bank function as intended, this is the positive outcome of the implemented policy. In this subchapter, we will go into detail on researchers' raised concerns related to the NIRP. Nevertheless, we will commence by looking at some factors that could compensate for the unfavourable effects of the NIRP.

3.3.4.1 Compensating effects

Jobst and Lin (2016) enhance the following three important factors that could compensate for the disadvantageous effects of the NIRP: Stronger credit growth and/or higher non-interest income, higher asset prices and lower funding costs, and stronger aggregate demand through portfolio rebalancing. The compensating effects from stronger credit growth and/or higher non-interest income relate to bank profitability, and the researchers argue that the reduced income from lower lending rates can be offset by increased market credit demand. Even though individual interest amounts will be reduced, the quantity of

loans outstanding will compensate for the income reduction. Further, the researchers also state that the banks can make up for a profitability loss from margin reduction by charging fees and commissions to their clients.

The higher asset prices and lower funding costs can be positive for the economy in general and consumers in particular, through a reduction in credit and risk premium following portfolio rebalancing. Resultantly, the financial conditions will be eased, credit demand will increase, and this will support economic activity. A reduction in risk aversion will lead to increased investment in higher yielding assets, bringing up asset prices, which again is likely to increase future income, future wealth and the ability to repay debt or invest.

Finally, negative rates will also influence the level of aggregate demand. From the households' perspective consumption will increase because of a preference shift driven by a reduction in deposit rates; the households would rather spend their excess cash than deposit the cash into a bank account, a shift that will help increase aggregate demand. Negative interest rates will also reduce the cost of capital for firms by lowering the term premium on corporate bonds. In addition, a lower discount rate will increase the net present value of investment projects, making more projects profitable. Together, these effects will lead to a higher level of investment and increased credit demand in the economy.

However, it is important to note that these are only theoretical benefits of NIRP implementation. As the unconventional policy regime is new and unexplored territory, no one can with certainty say if these effects will materialize in the real economy. Similarly, the same uncertainties are also related to the negative consequences listed in the following paragraphs.

3.3.4.2 Negative consequences

When it comes to the **banking sector**, there are mainly two concerns related to the NIRP: Reduction of profit margins and reduction in reserves that can lead to liquidity problems. Even though there is not conducted much research within the field of NIRP, the bank profitability concern is one of the more researched areas (Bean, 2013 / Jobst & Lin, 2016). The lowering of the key interest rates will result in an expected decline in both interbank and commercial deposit and lending rates. If the difference between the deposit and lending

rates are kept constant or only reduces slightly, the bank profitability will remain strong. However, if the interest rate difference narrows significantly, the banks may suffer. As Jobst and Lin (2016) emphasise, the size of this effect depends heavily on how the key interest rate transmits to the economy. The general tendency has been that the deposit rates are downward sticky, whilst the lending rates have been lowered quickly in response to a change in policy rates (Jobst and Lin, 2016). The downward stickiness is, according to the authors, related to the fact that the banks are reluctant to penalize their depositors. Despite the theoretical indication of reduced bank profitability, there is limited evidence of this in practice.

In addition to the fear of cash hoarding when the interest rates fall below zero (Areta et al, 2016), there also exist international regulations that may influence the banks' willingness to accept customers' deposits (Kupiec, 2015). These regulations limit the bank's ability to finance their operations using short-term liabilities. While the solvency rules were implemented to ensure liquidity, the implementation of negative interest rates have led to a situation that contradicts initial intention: Instead of encouraging banks to secure liquidity by holding cash reserves, the rules make it unprofitable for the banks to accept large client deposits (Kupiec, 2015). As a result, the banks lower their deposit rates to force customers to withdraw their money. Bean (2013) argues that this could lead to a funding problem for the banks as they do not have cash to lend their customers, and consequently, the banking system could collapse.

The **financial markets** are also subject to several concerns related to the NIRP. The first concern relates to the potential cash hoarding as a response to negative interest rates, as this could cause bank funding problems. Jackson (2015) argues that consumers may divert from bank deposits to cash to yield a zero return rather than a negative return, leaving the bank with limited loanable funds. Randow and Kennedy (2016) support this view and claims that the NIRP can do more harm than good as it might lead to a bank run. Hayes (2016) agree, and further argues that cash withdrawals may cause a deflationary pressure. A related concern is money market failure. As Jackson (2015) underlines, a negative interest rate will make it nearly impossible for banks and other money market funds to offer

attractive yields while remaining solid and liquid. This can cause major liquidity outflow and bank closures, and the entire market segment may become significantly weakened.

Increased risk taking is another concern related to the NIRP (Arteta et al, 2016). Due to the reduced bank margins, the banks could be forced, or at least tempted, to take on more risk to ensure profitability (Jackson, 2015). If yields on low-risk assets decrease, financial institutions might take on inappropriate levels of risk to earn a higher return. Finally, there are worries related to the risk models the institutions utilize, as these are not designed to evaluate risk in a zero or negative interest rate state (Jackson, 2015 / Bassman, 2015). In other words, the risk can be higher than what the models suggest. In addition to a false evaluation of risk, the model collapse could lead to an inaccurate estimation of asset prices (Bassman, 2015 / Jackson, 2015), as the risk associated with an asset is directly connected to its price. The outcome will be inefficient as the market is not able to provide the agents with the right price and risk information.

Further, Cæure (2014) highlights how risk-taking has increased in the market after the NIRP implementation, and questions the causal chain: Is the instability caused by the search for high yields and excessive risk-taking following the implementation of NIRP, or was the NIRP implemented as a stimulus to try and create financial stability following the excessive risk-taking that led to the financial crisis? Even if the latter is the case, the NIRP might have pushed the risk taking too far, making the disadvantages outweigh the benefits.

A concern further related to the search for yield is how the NIRP will affect aggregate demand and asset prices. As Jackson (2015) puts it, *"a more aggressive search for yield could, in turn, contribute to financial imbalances through excessive asset price valuations."* In other words, the low yield will create a portfolio rebalancing effect where agents look for more attractive assets to invest their money, earning a higher yield (Arteta et al, 2016). This will cause higher aggregate demand for certain assets, pushing the prices upwards. Further, as people can take advantage of cheap money, this could contribute to even higher demand and additional price increase, which in turn could cause asset bubbles that would influence the markets significantly if they burst (Hayes, 2015).

Finally, the last financial stability concern is related to the currency channel. Basic macroeconomic theory suggests that a lower interest rate will lead to reduced demand for domestic currency, causing depreciation. This could be used intentionally to control capital inflow and increase the economy's competitiveness in international trade. In these terms, the effect seems to be positive. However, if "everyone" chooses the same action alternative, the currency channel could lose its real effect, and this will neutralize the impact of the policy decision (Hayes, 2016). Further, one might end up in a currency war where countries *"devalue their currencies through other mechanisms in a race to the bottom"* (Hayes, 2016), and end up with a relatively unchanged value of the domestic currency. Hence, no devaluation effect will transmit to the real economy (Randow & Kennedy, 2016 / Hayes, 2016).

Focusing on the **operational issues** related to the NIRP implementation, Jackson (2015) mentions issues related to compatibility of trading systems and market infrastructure, particularly in relation to floating-rate securities. Garbade and McAndrews (2015), take a more in-depth approach to the issues related to interest bearing securities, and state that the challenges show up as capital and money markets adjust to the negative interest rates. Similarly to Jackson, Garbade and McAndrews highlight system compatibility as a major adjustment issue; the system is not set up for issuers of interest-bearing securities to receive interest payments from their investors. The two researchers further suggest a set of solutions to avoid the system default and the most straightforward one of these is to issue zero coupon bonds and sell these at a premium. The effective yield will be negative, but the system shortcomings will be avoided. Another suggestion is for investors to omit interest payments for the duration of the bond, and rather subtract the omitted payments from the principal at maturity. Even though this might seem like a good idea, there are further problems related to this solution: Firstly, one would have to set up a system to keep track of individual investors and their omitted payments. Secondly, compensatory principal reductions need to be identified, as a one to one reduction would effectively yield a zero rate from the time of the omitted interest payment to maturity. Garbade and McAndrews conclude their article by stating that the structural challenges related to a NIRP state will

probably lead to the invention of new design of interest bearing securities, making the negative consequences insignificant in the long run.

Further, there are a set of raised concerns within the area of **business and investments**. The first worry is related to a phenomenon called "zombie-firms". As Jobst and Lin (2016) put it; "*the reduced debt service burden under NIRP could delay the exit of nonviable firms, hurting demand prospects of healthy firms by adding to excess capacity and delaying the efficient allocation of capital and labour."* Caballero, Hoshi and Kashyap (2008) investigate the Japanese economy in the early 1990s and discuss how damaging the existence and support of non-viable firms is for the economy. Their research indicates that existence of zombie firms create biases and weaken the restructuring mechanism that, in turn, decreases job creation and productivity in the economy. Kwon, Narita and Narita (2009) also consider the Japanese economy in the 1990s, and conclude that the efficiency is reduced when banks facilitate the survival of otherwise insolvent firms. Peek and Rosengren (2005) support the findings of both Caballero et al and Kwon et al when they research the misallocation of credit related to the bank regulations that encourage banks to support non-viable firms. They find that firms in bad financial condition are more likely to receive support from their lender than other firms that have a healthier financial position.

In addition to the fear of zombie firms and inefficient resource allocation, there is also a concern related to the investment level of firms under NIRP. According to Jobst and Lin (2016), lower discount and lending rates help reduce the costs of debt-financed investments and increase the net present value of investment projects. Consequently, the investment level is expected to increase. It is therefore argued that the low interest rates can lead to overinvestments as some of the projects will not be profitable in the case of a future raise in the interest rate. Availability of cheap money will thereby facilitate investments that turn out to be value destructing rather than value creating (Schnabl & Hoffmann, 2008 / Hayes, 2016).

Lastly, there are also a set of concerns related to **consumer behaviour**. Jobst and Lin (2016), highlight that negative interest rates could have a re-distributional impact on wealth and income. If the policy rates are transmitted to the commercial banking market, borrowers will

be better off with reduced borrowing costs, while savers will have to pay for their deposits. This could lead to a preference shift where savings will be reduced, while borrowing will increase. However, as Jackson (2015) points out, a significant reduction in deposits will reduce the availability of loanable funds, and push borrowing rates upwards, an effect that will have an adverse effect on the initially feared consequence.

Further, Jobst and Lin (2016) argue that negative interest rates may also influence wealth distribution between generations. Elderly people will experience a reduction in retirement income as the return on their savings will be reduced. However, the reduction of the interest rates will also increase the present value of real assets, which will have an offsetting effect.

Finally, Jobst and Lin (2016) argues that the lower rates will support consumption and investments, which will outweigh the effect of reduced returns on savings. Hayes (2016) argues that it is possible that there will be an increase in credit purchases. Repayment of these acquisitions will be postponed for as long as possible to accrue a small amount of associated interest during the credit period. Further, Hayes suggests that some people may start to pre-pay or overpay expenses, leases, invoices and tax bills to transfer cost of holdings to the counterparty.

3.4 A Research Overview

To round off this theory and literature review chapter, we will provide an overview of some of the research conducted within the fields of negative interest rate policies, and the zero and effective lower bounds. We will also highlight the research related to our problem statement and sets of sub-questions presented in chapter one.

In general, we find that the major part of the research has been executed using a highly theoretical approach. We have found several VAR-analyses and autoregression approaches to investigate the effects of unconventional monetary policy, examples being Lutz (2015), Jamaldeen and Jolivet (2015) and Dahlhaus and Vasishtha (2014). A more empirical approach has also been taken on by some researchers, like Bech and Malkhozov (2016) that look at how the Danish, Swedish, Swiss and the European central banks have implemented NIRP, and how the transmission of the policies have been. Finally, a third widespread research approach is discussion papers based on theory and some empirical observations.

Examples of this third type of research papers are Palley's paper from 2016 (a) that tries to answer why NIRP is ineffective and dangerous; Agarwal and Kimball (2015) look at ways to and implications of breaking through the ZLB; Reza, Santor and Suchanek (2015) investigate quantitative easing as a policy tool; Svensson (2010) looks into financial markets and monetary policy when the interest rates lie close to the Effective Lower Bound; while both Jobst and Lin (2016) and Borio, Gambacorta and Hofmann (2015) look at consequences of NIRP implementation for bank profitability.

Looking more closely at research directly related to our problem statement, we find that there are primarily three research papers that examine the general effects of the negative interest rate policy implementation. Arteta, Kose, Stocker and Taskin's paper *"Negative interest rate policies: sources and implications"* (2016) investigates the transmission channels and effects of these under NIRP. Moreover, they consider a series of financial variables and the impact of these after the negative policy rates were adopted. Lastly, they consider concerns of potential financial instability and whether these concerns have materialized. Further, Jackson's Staff Discussion Paper for the Bank of Canada review the international experience with negative policy rates, with emphasis on Denmark, Sweden, Switzerland and the Euro Area. Finally, Marx, Nguyen and Sahuc (2016) consider monetary policy actions undertaken in the Euro Area since 2014, and the macroeconomic impact of these measures. The three research papers all cover a wide range of topics, primarily presenting observations and discussing potential deviations from conventional monetary policy theory. None of the papers are doing in-depth research related to specific areas of interest. This is a contribution we wish to provide with this master thesis.

Now, turning the focus to the first sets of sub-questions related to investments, we find that this is an area that has been researched to some extent, but not in the same economies as those we are focusing on. Honda (2016) researches how the NIRP influences investment decisions in Japan. The approach is empirical, and his findings show that NIRP is effective in stimulating households' investment. Jobst and Lin (2016), highlight the potential of overinvestment following NIRP implementation but have not researched this any further. Schnabl and Hoffmann (2008) have taken an in-depth look at how stimulating monetary policy may lead to overinvestments in new and emerging markets. They have, however, not

considered negative interest rate policies in their research, but the approach and findings are still transferrable. Finally, Palley (2016b) points out that "*NIRP continues and actively encourages the debt-led asset price inflation model of economic growth that has caused so much trouble. Not only will NIRP not solve the problems posed by the financial crisis and Great Stagnation, it risks aggravating them."* However, Palley does not perform any kind of empirical analysis, he is only providing arguments from a theoretical perspective.

The second set of sub-questions is related to liquidity-constrained households and firms, and the effect this has on the economy. Related research is performed by Caballero, Hoshi and Kashyap in 2008 and Kwon, Narita and Narita in 2009. Both groups of researchers are focusing on so-called zombie-lending, depressed restructuring and resource allocation in Japan in the 1990s. Caballero, Hoshi and Kashyap's research showed that continued bank lending and interest rate reductions to insolvent firms contributed to prolonging economic stagnation in Japan in the 1990s. Kwon, Narita and Narita found that extended bank lending to firms on the verge of bankruptcy led to an insufficient labour allocation and reduced productivity growth. Even though the market and period of interest are not the same as the ones we undertake, the research findings are adaptable to our case, and the method, particularly Caballero, Hoshi and Kashyap's, is highly relevant and can be utilized in our analysis.

To summarize, based on the previous research, we find that our focus and associated approach will contribute with a perspective of the real effects of NIRP that have not been presented before. Of course, there are many ways to perform the analysis, and our contribution will not provide an exhaustive overview of all the aspects related to the factors of interest. Still, we hope you will find the analysis and discussion valuable.

4. Method and Data

4.1 The research process

The research process was initiated in June 2016 with basic research on the topic. During autumn, the focus shifted towards developing a topic delimitation, and in addition, further topic research was conducted. Starting in January 2017, the process of defining a problem statement and related research questions was initiated and partly concluded through discussions with Harald Magnus Andreassen, Chief Economist in Swedbank Norway. The data collection process was also initiated in January before the thesis writing and analysis was conducted. The whole research process has been guided by Bent Jesper Christensen, professor at the Department of Economics and Business at Aarhus University.

4.2 The research approach and reasoning

The research approach will be abductive and empirical. We will test our hypotheses by investigating available data series, to say something about the potential consequences of NIRP. The data is an incomplete set of observations, as we are investigating a current event with a limited history. Despite the indications our observations and results may provide, these are only short-term effects of NIRP, and we will not be able to draw any long-term conclusions.

Data observations and development will form the foundation for our discussions, which again will be the baseline for any type of logical reasoning and conclusions.

4.3 General research method

The structure of the analysis chapter will take the following form: The chapter commences with an introduction that clearly explains the analysis structure. Following the introduction, the main analysis will be conducted in two steps, with each step relating to one of the two sets of sub-questions presented in chapter 1.1. Research Question.

The general approach for the two focus areas will be the same, and take the following structure: First, we will present the general related hypotheses to the topic of interest. These hypotheses are theory-based and highly relate to the theoretical transmission mechanism of an unconventional expansionary monetary policy, as presented in chapter 3.3

Unconventional Monetary Policy. The hypotheses presented will then be investigated one by one. For each of the hypotheses we will make plots of relevant data, and based on the empirical findings, we will try to draw related conclusions. These conclusions will be followed by a discussion where we put emphasis on potential research errors and market factors that could influence the results before we move on to the next hypothesis. After all the hypotheses related to one focus area are investigated, we will round of the section with a short summary and sub-topic conclusion, before we move on to the next area of focus.

To try to isolate the effects of the NIRP, we will for each of the indicator analyses look for common responses/tendencies for the four NIRP economies. Further, we will compare the indicator developments of the NIRP economies to the corresponding evolution of the indicators in a control, non-NIRP, economy. We have chosen to use the United Kingdom as our control economy, as it has faced similar economic challenges as the four NIRP economies, but the Bank of England has never implemented negative key policy interest rates. The effect of NIRP will be highlighted if the responses of our four NIRP economies deviate from the development in the control economy. The isolation of NIRP effects is a huge research challenge as the economic indicators are influenced by a series of factors. However, by looking at general common tendencies, followed by a deviation-comparison with a non-NIRP economy, we could potentially uncover general effects caused by NIRP.

4.4 Data collection

We have used a range of sources to collect the data needed to perform the analysis. For the collection of monetary policy related data, we have primarily been using the four economies' central banks' databases. The other data has been assembled through various databases including OECD Data, OECD Stat, Bloomberg, and Datastream. For a complete list of databases used, please see the following section. As all data included in the analysis was already gathered and available in various databases, we did not have to collect data ourselves.

There exists a risk related to the use of secondary sources in research papers, such as this thesis, as we do not know how the data has been collected and handled. However, the databases we have used are all large and well-known, and we, therefore, rely on the data

retrieved from these sources. The specific reliability considerations are also provided in the following section.

4.5 Data sources

Presented below is an exhaustive list of databases used for collection of indicator time-series, including a short description of the databases and an evaluation of the data source.

OECD's databases; OECD Stat and OECD Data: These are OECD's online platforms for statistics and data research, created by the OECD Statistics Directorate. All data is available to the public. OECD is the Organisation for Economic Co-operation and Development, an intergovernmental organisation that provides a platform for exchanging policy experience and cooperating to find sustainable solutions to common problems, and is considered a highly reliable source.

Datastream: The database is provided by Thomson Reuters, and contains current and historical financial and economic data. The data is both collected from Thomson Reuters themselves and gathered from other external sources. The external sources are all well-known institutes such as official statistics bureaus and central banks, and we thereby evaluate the data collected to be highly reliable.

Bloomberg: The database provides current and historical news, data, analyses, and videos related to economics, business and financial information. The company also provides financial software tools through their Bloomberg Terminals. The data is both collected from Bloomberg LT themselves, and through external sources. All external sources are well-known and controlled by Bloomberg, and the data is thereby highly reliable.

Trading Economics: The company provides an online database, with limited data available to the public, and full data access may be purchased. The database provides current and historic information about a range of financial variables and economic indicators, and the database is built using official sources, no third-party data is included. The database is a secondary source, but the data provided is checked regularly for inconsistencies and other faults, and hence, we evaluate the data collected as reliable.

Eurostat: The European Union's statistical database collects and provides statistics for European countries, both for members and non-members of the European Union. The database is built up of data collected and processed by the data provider. Eurostat is the database of the European Union's statistical bureau and is therefore considered highly reliable.

IMF data: IMF works to ensure stability of the international monetary system, and as a part of the work towards this objective, they publish time series data like exchange rates, IMF lending, GDP and other indicators for the IMF member countries. The IMF database is considered a solid database providing reliable data.

Central banks' databases: The European Central Bank, Sveriges Riksbank, Danmarks Nationalbank and Swiss National Bank provide direct current and historic data on the key interest rates, and other monetary policy data, for their respective countries. The central banks are a primary source and are considered highly trustworthy.

4.6 Data types

We have based our analysis on observation of a range of different macroeconomic variables related to interest rates, saving and borrowing, investment, production, output, business cycles, bankruptcies, and labour. These groups of variables are the most crucial to answer the two sets of problem statement sub-question sets, as they can reveal tendencies related to the economy. By looking at several variables at the same time and comparing NIRP tendencies to the trends in the control economy, we are, to a larger degree, able to evaluate the NIRP effects. In turn, we should be able to confirm or reject our hypotheses.

5. Analysis

We have now reached the section where we conduct the analysis and discuss our findings. The chapter is divided into two main parts, each focused towards answering one of the sets of sub-questions outlined in chapter one. The analysis will commence with the research related to investments and round off with the study linked to liquidity-constrained households and firms. The two sections will be divided into different partial analyses, each considering a specific hypothesis. The hypotheses will be analysed and discussed one by one, and will be rounded off with a sub-conclusion that aims to answer whether the hypothesis should be accepted or rejected. In addition to the hypothesis-specific conclusions, each of the main parts will be finished off with a short summary of our findings. Then, the final analysis conclusion will follow in the next chapter, titled "6. Conclusion".

5.1 Investments

As mentioned above, the first analyses will focus on investments, and aim to answer the following questions: Could the NIRP implementation facilitate a preference shift from savings to investments? Could NIRP through transmission to the discount rates influence the level of corporate investments? Focusing on the aggregate economy, how has the investment level developed, and is this development driven by NIRP? Could NIRP be a facilitator of a potential overinvestment bubble?

The first two hypotheses will investigate the economic behaviour of households and corporations to find out whether there are any indications of a preference shift. Further, we will investigate whether the corporate investment level has been influenced by the reduction in the discount rate, following the NIRP implementation. The two final hypotheses will focus on the overall investment development of the economy and try to address whether the NIRP has facilitated a potential overinvestment bubble.

5.1.1 Deposit rate driven preference shift?

As the NIRP transmits to the commercial banking market, the deposit rates will fall and the return on bank deposits will be reduced. Due to the reduction of interest rates, the general belief is that households and firms will look for alternative investments of their excess cash to gain a higher yield (Bassman, 2015). Stated differently, agents will rebalance their

portfolio to generate a higher return on their excess cash. The related hypothesis is whether the implementation of NIRP will influence consumer preferences and force a shift from bank savings towards investments; lowering the level of savings and increasing the level of investments.

5.1.1.1 Transmission to the market deposit rates

To analyse the effects of NIRP on consumer preferences, we must first uncover whether the negative policy rates have transmitted into the commercial banking markets cash deposit rates. The test is performed by calculating and interpreting the correlation coefficients between the key policy interest rate and the 6-month and 1-year cash deposit rates, respectively. Both historical and NIRP specific coefficients will be calculated, to compare the long-term transmission to the transmission after the unconventional policy was implemented. A high correlation coefficient will indicate that the interest rates follow each other closely, and will move in the same direction. Note that a correlation test will not establish causation, but economic theory tells us that it is the commercial banking rates that are being adjusted according to key policy rate decisions (Jackson, 2015). With this established, a positive correlation coefficient will indicate that the policy rate decisions influence the commercial banking markets' cash deposit rates. The results from the correlation test are presented in the table below.

Table 5.1.1.1 Correlation between policy and cash deposit rates

Rate	Period	Denmark	Sweden	Switzerland	Euro Area	United Kingdom
6-month cash deposit rate	From 2004	0,983	0,972	0,956	0,979	0,979
	From NIRP	0,797	0,961	0,544	0,889	N/A
1-year cash deposit rate	From 2004	0,980	0,966	0,952	0,975	0,974
	From NIRP	0,794	0,948	0,582	0,878	N/A

Note: *Relevant policy rates: Denmark - Certificate of Deposit rate; Sweden - Repo rate; Switzerland - Sight Deposit rate; Euro Area - Deposit Facility rate; United Kingdom – Official bank rate.* ***Last observation:*** *December 2016 for all economies.*
Source: *Self-calculated numbers based on data from the Central Banks and Datastream (Thomson Reuters).*

Historically, there is high correlation between the different cash deposit rates and the key policy rates. When shifting the focus from a historical to NIRP perspective, we find a reduction in the correlation coefficient. Still, all the estimates are evaluated to be strong or very strong, except the Swiss that are considered moderate. This indicates that the negative rates have transmitted to the Danish, Swedish and Euro Area markets, to a larger extent than to the Swiss.

To conclude, the historical correlation analysis has uncovered that the policy rates have transmitted to the commercial banking markets' cash deposit rates, and this also applies to the negative policy rates we see today. Hence, we can form an expectation that the NIRP will have influencing power over factors related to deposit rates, and this form the foundation for the following analyses.

However, it is important to note, that even though the policy rates transmit to the cash deposit rates, the commercial deposit rates did not enter negative territory immediately after NIRP was implemented. The timing of the commercial cash deposit rates entering the negative territory are as follows:

Table 5.1.1.2 Implementation of negative commercial cash deposit rates

	Denmark	Sweden	Switzerland	Euro Area
6-month	2015	2016	2015	2016
1-year	2015	2016	2015	2016

Source: *Datastream (Thompson Reuters).*

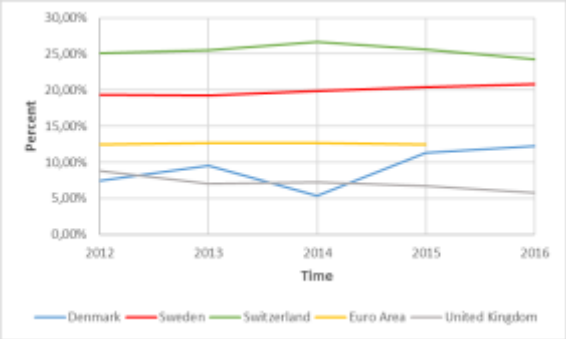
For further analysis, a graphical presentation of the development of the policy and deposit rates from 2004 to 2016, and a table illustrating the development of the cash deposit rates from 2012 to 2016 can be found in appendix 1.

5.1.1.2 Savings preferences

We will in this section investigate whether the deposit rate reduction has led to a change in the saving preferences of households and corporations. Our hypothesis is that the reduction in the commercial deposit rates will force a decrease in savings. The analysis will be

conducted by examining the development of household and corporate savings in percent of disposable income.

Figure 5.1.1.1 Household savings in percent of disposable income



***Last observation**: A. End of year 2015 for the Euro Area, end of year 2016 for all other economies. **Source**: Self-calculated numbers based on savings and gross disposable income data from Datastream (DG ECFIN AMECO)*

The overall tendency and findings for Denmark in the period following NIRP implementation are opposite of what we expected; when the policy and deposit rates decreased, the savings ratio for Danish households increased. The tendency is similar in Sweden, even though the savings ratio growth is lower than in Denmark. The savings ratios in Switzerland, the Euro Area, and the United Kingdom show a negative development in line with theory. However, to be able to draw any conclusions regarding savings for the NIRP economies, we also need to account for the development of gross disposable income.

The gross disposable income has been increasing for all economies since the years of NIRP implementation. For detailed information on the gross disposable income, please see appendix 2. Considering the increase in gross disposable income, we find that the upward trend of savings in Denmark and Sweden is stronger than indicated by the graphs presented above. Shifting the focus to Switzerland and the Euro Area, we find that the growth in gross disposable income following NIRP is around 12% in Switzerland and approximately 4% in the Euro Area. For growth rate calculations please see appendix 3. The implications of this are that the real change in household savings in Switzerland is still negative. However, the change is not as negative as implicated by the ratio above, since the increase in disposable income outweighs a portion of the reduction in the ratio. In the Euro Area, the gross disposable income growth fully compensates for the share reduction of savings relative to

disposable income, and we find that the value of savings increases. The numerical support for these findings is presented in appendix 4.

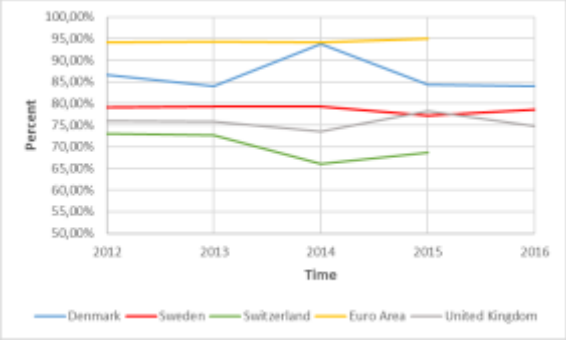
As the negative key interest rate in Switzerland showed weaker transmission to the deposit rates than in the other NIRP economies, the Swiss findings will be given less weight when trying to uncover a common NIRP tendency.

Focusing on the empirical evidence thus far, we find that there is a positive trend in the household savings after the NIRP implementation, disregarding the Swiss results. This is the opposite of what we expected, but could potentially be explained by looking at non-rational consumer behaviour. The households might feel the need to build a security net in case of a new financial crisis or to secure their financial position today when operating in a market dominated by uncertainty. Moreover, the historical levels of saving to gross disposable income have been particularly low in Denmark, but also in Sweden. It is reasonable to assume that such low levels of savings cannot be persistent for a prolonged period. Thereby, the increase in savings was a natural response to compensate for the low historical savings levels, bringing the households' economies back to balance. For detailed information on the historical development of the ratios, please see appendix 5.

After uncovering the common NIRP tendency with respect to household savings, we need to investigate whether this is an isolated effect of NIRP implementation or not. The isolation test will be conducted by comparing the NIRP tendency to the development in the United Kingdom, a non-NIRP economy. At first glance, it looks like the NIRP tendency deviates from that of the control economy, as there has been a negative development of household savings in this market since the beginning of 2012. However, we need to consider the gross disposable income development for the United Kingdom as well. Gross disposable income development, presented in appendix 3, show that the disposable income fluctuates over time. However, the beginning to end of period growth is positive and approximately 11%. Still, the growth in disposable income does not compensate for the savings rate reduction. Meaning that household savings for the period have experienced overall negative growth. This further support that NIRP is the source of the savings tendency of the NIRP economies.

At the same time, there may be other relevant factors explaining the difference between the NIRP economies and the control economy. The historical saving to gross disposable income ratio of the UK does not imply that there should be any reversion of the savings. Particularly not when comparing the savings ratio to the NIRP economies, as Denmark is the only country that has a lower savings ratio. Finally, the business cycle may also account for some of the development. A rational assumption is that households reduce their savings during recessions to keep consumption constant, while they save the excess cash obtained during a period of expansion. Looking at the business cycle development of all the economies, as presented in appendix 6, we find that the business cycles closely follow each other until 2014, where a few deviations appear. Based on this, we cannot find any reason for the deviating savings preferences between the control economy and the NIRP economies. Therefore, our conclusion with respect to household savings is the following: NIRP seem to influence households' savings preferences, but in contrary to our hypothesis, the NIRP implementation seem to cause an increase in savings.

Figure 5.1.1.2 Corporate savings in percent of disposable income



***Last observation**: End of year 2015 for the Euro Area and Switzerland, end of year 2016 for all other economies. **Source**: Self-calculated numbers based on savings and gross disposable income data from Datastream (DG ECFIN AMECO)*

Now, shifting the focus to corporate savings, we find that the development across the different NIRP economies varies. While the corporate savings rate in Denmark fluctuates largely, the Euro Area rate follows a slightly increasing growth path. Furthermore, we see that the Swedish corporations initially experience a decrease in the savings ratio, while the Swiss corporations experience an increase. It is therefore very difficult to deduct a common NIRP tendency based on these empirical findings.

To further investigate the corporate savings preferences, we need to account for the development of gross disposable income. The gross disposable income has followed an upward trend for all the economies, except Denmark which has fluctuated largely since the implementation of NIRP. For details please see appendix 3. Still, the development of gross disposable income has not had a compensating effect on corporate savings, and the tendencies shown above are thereby representative of the value of savings. Savings values measured in billion EUR are presented in appendix 4. Based on these findings, it is still not possible to deduct a common NIRP tendency for corporate savings.

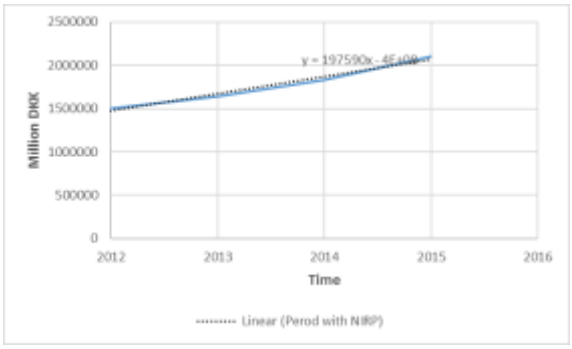
As we are not able to deduct a common NIRP tendency, we do not have the grounds to try to isolate a NIRP effect. Still, it is important to note that the implementation of negative policy rates and transmission of these into commercial deposit rates, could have had a significant impact on an economy-specific level. However, our focus in this thesis is to uncover general economic tendencies following the implementation of unconventional monetary policy, and we are not able to do so in this case.

5.1.1.3 Investment preferences

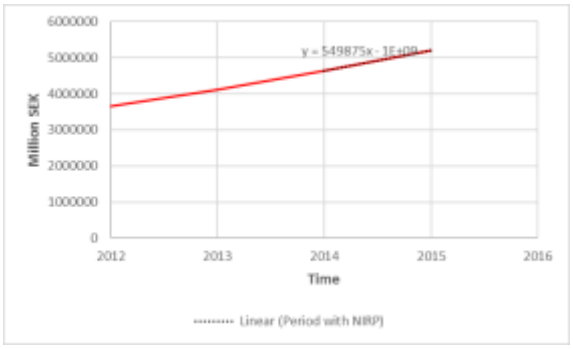
Even though we found that the common NIRP tendency is an increase in household savings and that there were no common responses for corporate savings, we keep the original hypothesis of a preference shift. We will in this section investigate whether investments have increased following the implementation of NIRP. The test will be conducted by investigating the development of households' assets of equity and investment fund shares, and corporate gross fixed capital formation (GFCF) investments. The choice of investment indicators is based on the following argumentation: If households redirect their surplus from bank deposits to investments, equity and investment funds are the most accessible investment assets in the short-run. Focusing on corporations, investment fund and equity shares are a less relevant investment indicator since corporations rather invest their surplus in new projects with positive net present values, when these are available. In the short-term investment in equity and investment fund shares could be relevant, however, those types of investments might not be covered by the operational mandate of the management. We therefore choose to focus solely on corporate GFCF investments.

Figure 5.1.1.3 Households' equity and investment fund shares (assets)

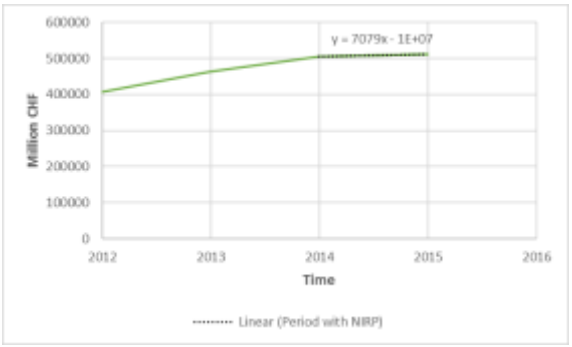
A. Denmark



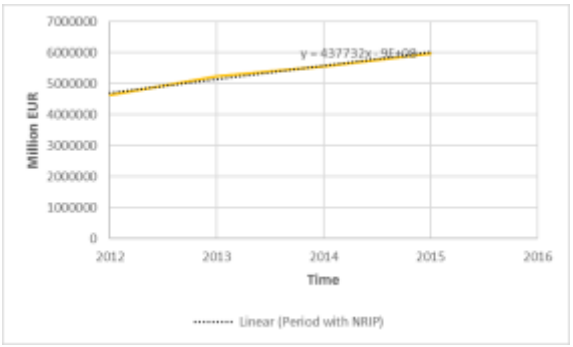
B. Sweden



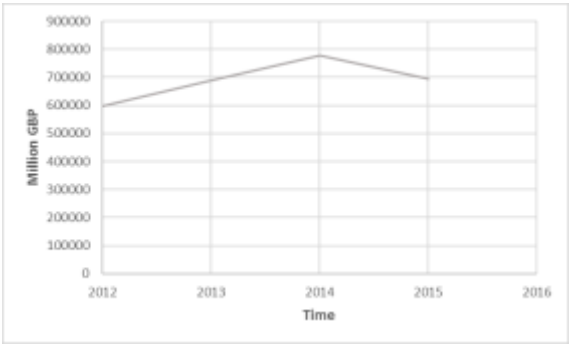
C. Switzerland



D. Euro Area



E. United Kingdom



Note: *Equity and investment fund shares are the net position of assets held by households.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *Datastream (Eurostat)*

The plots show growth in equity and investment fund shares for all NIRP economies, making it clear that the common NIRP trend is household investment growth. Whether this is an isolated effect of NIRP is a more complex question to answer. Looking at the investment development in the United Kingdom, we find that the UK also experienced an increase in investments from 2012-2014, signifying that the experienced investment growth might not be a consequence of NIRP. All economies experienced investment growth in this period, also

Sweden and Switzerland which, at this point, had not yet implemented NIRP. This is another indicator that the investment growth may not be NIRP driven.

However, while the investment trend in the UK reverted in 2014 and household investment started decreasing, the other economies, now all NIRP economies, still experienced investment growth. In contrary to the findings from 2012 to 2014, these findings indicate that NIRP may be a driving force of household investments after all, or at least for the period following 2014. On the other hand, the investment reduction in the United Kingdom might be partly explained by the historically high value of households' assets of equity and investment in 2014. This makes the reversion logical in a sense of market stabilization. A graphical presentation of the households' historical development of equity and investment fund shares can be found in appendix 7.

Historical economic events may help explain the overall investment growth. Following the financial crisis in 2008, the level of household investments in equity and investment fund shares experienced a huge drop in all economies. For details, please see appendix 7. This reduction could be caused by a drop in asset values, and/or cash withdrawal. When the major hit of the financial crisis abated, all states were eager to recover and rebuild the economy. The following economic turn-around may be a reason for the development of the investments since then. This theory is further supported by the fact that the level of investment in 2012, was corresponding to, or lower than the initial pre-crisis investment levels. Moreover, looking at the business cycles of the economies we find that each of them was facing a boom period starting around 2012, indicating that the business cycle and output growth might have contributed to the growth in investments as well. For details on the business cycles, please see appendix 6.

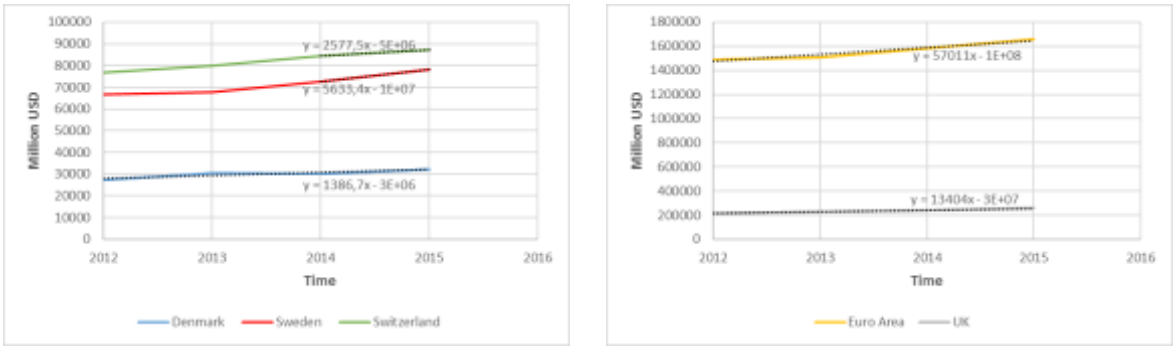
However, an important argument to consider is whether the economic expansion would have taken place without the central banks' expansionary monetary policies, and later NIRP implementation. This is an effect we are not able to isolate as the Bank of England also has stayed true to expansionary monetary policy. Still, the tendency we see following 2014 might indicate that the presence of NIRP is a contributing factor to further growth, while the

UK experienced reversion as their low, but positive, rates did not provide the same economic boost as the negative rates in the other economies.

Finally, looking at different investment growth rates for the economies following NIRP implementation, as presented in appendix 8, we are not able to deduct a tendency that overall household investment growth is higher in the NIRP economies than in the United Kingdom. From this perspective, it looks like NIRP may not be a driving force, but general expansionary monetary policy might be.

In conclusion, we have found evidence supporting NIRP as one of the driving forces behind household investment growth, but the growth does not seem to be an isolated effect following NIRP implementation.

Figure 5.1.1.4 Corporate GFCF investments



Note: *GFCF is gross fixed capital formation, and consists of resident producers´ acquisitions, less disposals, of fixed assets.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *Self-calculated values based on OECD data on GFCF investment values and corporate shares of GFCF investments.*

With regards to corporations, the NIRP tendency is the same as for households; investment growth. To isolate the NIRP effect, we again compare the NIRP economies to the development in the United Kingdom. Here we find that there is a positive continuous growth in the UK as well. This observation implies that investment growth is not an isolated NIRP effect. Looking at investment growth rates, presented in appendix 9, we find that the overall investment growth in the period 2012-2016 is higher in the UK than in the NIRP economies. Focusing on the period from 2014, when all the basic economies had implemented NIRP, the UK growth rate is still very high, only exceeded by the Swedish. This further supports that NIRP is a less relevant factor determining investment growth in the corporate sector.

Looking at the historical development of corporate GFCF investments we find that there was a general reduction around 2009 for all economies. For details, please see appendix 9. Since then, the corporate investment level has risen gradually for all economies, first reaching, then exceeding the pre-crisis investment level. This could reflect several different factors, including general economic recovery, that may have been influenced by expansionary monetary policy in general, and NIRP in particular. However, it is important to note that even though the United Kingdom has not implemented negative policy rates, their policy interest rates are still very low due to an extended period with an expansionary monetary policy regime. As there is little difference between the corporate investment development in the NIRP economies and the control economy, this may suggest that it is expansionary monetary policy in general that may be the key driving force behind the development. However, we are not able to isolate and investigate this hypothesis, and it is also beyond the scope of this paper.

To conclude, we do not see that there is an isolated NIRP effect driving the development of corporate investments. The results rather suggest that it is the general expansionary monetary policy implemented after the Great Financial Crisis that is the driving force. Going forward, we might see that NIRP could play a role in keeping investment growth high, while non-NIRP economies will experience a slowdown in investment growth, but this is at this stage only speculation.

5.1.1.4 Conclusion

Overall, we do not find any preference shift and must, therefore, reject the hypothesis. However, we did identify some interesting relationships that we will keep in mind for later. For savings, we found an increase for households that we were able to isolate with respect to NIRP, but could not find any clear tendencies for corporations. With regards to investments, we identified an increase for all NIRP economies, but as the control economy showed many of the same tendencies, we were not able to draw any conclusion regarding the unconventional monetary policy contribution. At the same time, we did find a few indicators that the NIRP has played a role, but it is too early to draw any conclusions.

5.1.2 The discount rate, a corporate investment project initiator?

After choosing to investigate NIRP effects on investments, we will look at another factor that has been mentioned several times in previous research; namely the potential discount rate effect on corporate investment decisions. Jobst and Lin (2016) argue that NIRP could cause a downward pressure on the discount rate, an effect that will increase the net present value of investment projects due to the cash flow sensitivity to interest rates. When the NPV increase, more projects become profitable, and the related hypothesis is that following the implementation of NIRP, the discount rate effect will cause an increase in project initiation and corporate investments.

5.1.2.1 NIRP transmission to the discount rate

To start this analysis, we need to uncover whether the negative policy rates have transmitted to the market discount rates. The test is conducted by calculating the correlation coefficients between the policy rates and the official discount rates, both in a historical perspective and since the implementation of NIRP.

Table 5.1.2.1 Correlation between policy and discount rates

	Denmark	Sweden	Switzerland	Euro Area	United Kingdom
From 2004	0,988	0,919	0,970	0,985	0,999
From NIRP	0,065	0,844	0,889	0,791	N/A

Note: *Relevant policy rates: Denmark - Certificate of Deposit rate; Sweden - Repo rate; Switzerland - Sight Deposit rate; Euro Area - Deposit Facility rate; United Kingdom – Official Bank rate. Relevant discount rates: Denmark and Sweden, Official discount rates; Switzerland, Discounts (-) or premiums rate; Euro Area, Discount rate/Short-term Euro repo rate; United Kingdom, Discount rate/3m t-bill.* ***Last observation:*** *End of 2016 for all economies.* ***Source:*** *Self-calculated coefficients based on data from the Central Banks and Datastream (Danmarks Nationalbank, Sveriges Riksbank, IMF for Switzerland, ECB and the Bank of England).*

As shown, we find that the correlation between the discount rate and the economies' policy rates are very strong in a historical perspective. Focusing on the period following NIRP implementation, the correlations are somewhat reduced for Sweden, Switzerland and the Euro Area. Still, the analysis uncovers a strong correlation between the policy rate and the discount rate development, indicating that NIRP transmits to the discount rates of these economies. Looking at Denmark, we find a huge decline in the correlation coefficient and a very weak correlation between the variables. This indicates that the negative policy rate

regime has not transmitted to the discount rate in Denmark. For a graphical presentation of the historical development of the policy and discount rates, please see appendix 10.

Based on the findings, it is reasonable to assume that NIRP could have an influencing effect through the discount rate for Sweden, Switzerland and the Euro Area, but not for Denmark.

5.1.2.2 Discount rate and corporate investment relationship

Further, we need to investigate the relationship between the development of the discount rates and corporate GFCF investments. The hypothesis is that when the discount rate decreases, the level of investments will increase, as the discount rate will function as an incentive to initiate investment projects. To examine the potential relation between the two variables, we will test the correlation between the historical development of the official discount rates and corporate GFCF investments. Here we expect to find a negative correlation.

Note that we in this correlation analysis are not able to test the post-NIRP implementation correlation coefficients, as the data available for corporate GFCF investments is reported annually. This leaves us with few data points, insufficient to calculate a reliable correlation coefficient. It is also important to note that this test does not establish causation, however, general economic theory suggests that the discount rate does influence the investment decision (Brealey, Myers & Allen, 2011).

Table 5.1.2.2 Correlation between discount rates and corporate GFCF investments

	Denmark	Sweden	Switzerland	Euro Area	United Kingdom
From 2004	-0,330	-0,299	-0,352	-0,420	-0,388

Note: *Denmark and Sweden, Official discount rates; Switzerland, Discounts (-) or premiums rate; Euro Area, Discount rate/Short-term Euro repo rate**;*** *United Kingdom, Discount rate/3month t-bill rate**.*** ***Last observation:*** *End of 2015 for all economies.* ***Source:*** *Self-calculated coefficients based on discount rate data downloaded from Datastream (Danmarks Nationalbank, Sveriges Riksbank, IMF for Switzerland, ECB and the Bank of England) and self-calculated values of corporate GFCF investments based on OECD data.*

For all the NIRP economies, the correlation coefficients are evaluated to be weak to moderate. The correlation test for the control economy also generates a weak coefficient. This uncovers that there is no significant difference between the NIRP economies and the control economy, at least in a historical perspective. As the estimates of the economies are

so similar, we do not have a clear indication of a NIRP effect. However, as we are not able to calculate reliable post-NIRP coefficients, we cannot, with certainty, confirm these findings. In other words, no isolated NIRP effect can be proven, and the discount rates' impact on corporate investment looks to be more of a constant decision factor to consider when making an investment decision.

A potential cause for the weak correlation coefficients could be that even though the discount rate influences the investment decision, it is only one of many factors to consider when determining whether to undertake an investment project or not. Still, the coefficients show a negative and inverse relationship, as expected based on general economic theory. For a graphical illustration of the co-development of the discount rate level and the corporate GFCF investments, please see appendix 11.

Another argument that may explain the weak correlation coefficients, is the fact that relying solely on a discount rate reduction and net present value evaluations, might not be sustainable in the long run. The danger of using the discount rate as the main argument behind investment initiation is that the discount rate fluctuates. What seems to be a profitable project today may not be profitable in the future if the underlying economic conditions change. A firm making an investment decision need to consider what is the added value of the project, both today and in the future. If the corporate market participants act rationally and do not get blinded by the abnormal current economic state, this supports the finding of a weaker correlation coefficient. Further, this indicates that firms today make wise and economically sustainable investment decisions. However, based on the findings, it is reasonable to assume that the reduction in discount rate will influence investment decisions to a certain degree.

5.1.2.3 Conclusion

As shown at the end of section 5.1.1.3, we find empirical evidence of investment growth in the corporate sector. In that section, the discussion related to a preference shift due to low deposit rates, and in this section, we introduced the argument of a discount rate effect. The correlation coefficient analysis of discount rates and corporate investments could not conclusively reveal a NIRP effect. However, we were not able to reject a relation either, due

to the lack of data. Thereby, we can neither accept nor reject our hypothesis that NIRP has influenced the level of corporate investments through discount rate transmission.

5.1.3 Aggregate economy investment growth

The analyses have so far been conducted on a sector-specific level, with focus on households and corporations. Now, we will raise the perspective to the overall economy, focusing on the development of the aggregate investments in the respective economies. This analysis will, therefore, be independent of the analyses in section 5.1.1.

To analyse the investment development in a wider perspective, the chosen variable is gross fixed capital formation (GFCF). Note, however, that GFCF is not a measure of total investment as it does not include investments in financial assets. Still, it is a representative measure of overall investment development. The general investment hypothesis is that GFCF investments will increase as a response to NIRP implementation, as the goal of expansionary monetary policy is to boost the economic activity and increase output (GDP). This will, in turn, lead to an increase in GFCF investments.

5.1.3.1 Development of GFCF investments

However, before focusing on the development of aggregate investments, we will investigate whether the assumed relationship between GDP and investment development is valid in the economy. This test will be performed through the calculation of correlation coefficients, and the assumption will be confirmed if the correlation estimates are positive. We only calculate the historical correlation coefficient, as we lack sufficient data to compute reliable post-NIRP correlation coefficients.

Table 5.1.3.1 Correlation between GDP and GFCF investments

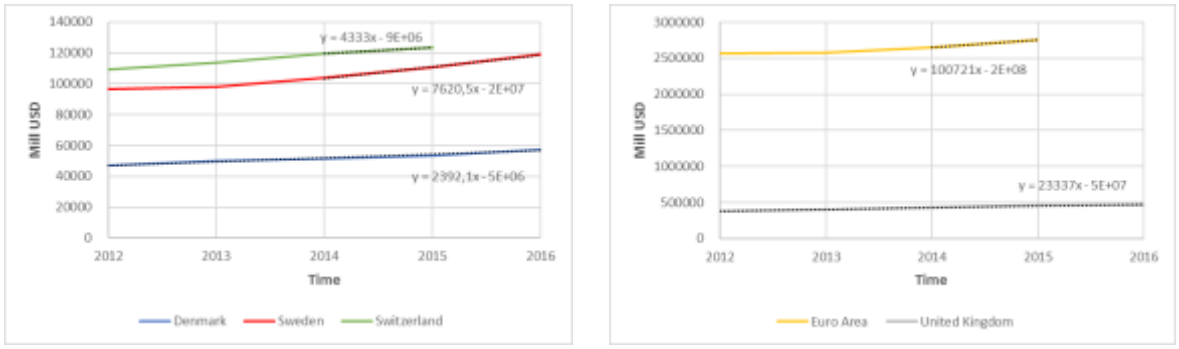
	Denmark	Sweden	Switzerland	Euro Area	United Kingdom
From 2004	0,493	0,733	0,911	0,727	0,574

Last observation: *End of year 2015 for Switzerland and the Euro Area, end of year 2016 for Denmark, Sweden and the UK.*
Source: *Self-calculated estimates based on data from Datastream (DG ECFIN) and OECD Data.*

The correlation estimates are all positive and evaluated to be “moderate” for Denmark and the UK, “strong” for Sweden and the Euro Area, and “very strong” for Switzerland. The

estimates are all satisfactory. One reason why we only got one “very strong” estimate could be that it normally takes time for the monetary policy actions to transmit to economic activity and further to investments. The observed correlation coefficients confirm that there exists a relationship between the GDP and the GFCF. With this clarified, we will now investigate the main hypothesis; whether NIRP contributes to investment growth.

Figure 5.1.3.1 GFCF investments



Note: *GFCF is gross fixed capital formation, and consists of resident producers´ acquisitions, less disposals, of fixed assets.* ***Last observation:*** *End of year 2015 for Switzerland and the Euro Area, end of year 2016 for the other economies.* ***Source:*** *OECD data*

For all the NIRP economies we see an increase in GFCF investment following the implementation of the unconventional expansionary monetary policy. The common NIRP trend is thereby easy to deduct; investment growth. However, there has been corresponding investment growth in the United Kingdom. In fact, the UK experienced the second highest average annual growth rate for the years following NIRP implementation in the other economies, suggesting that investment growth may not be caused by NIRP. An overview of the calculated growth rates is presented in appendix 12. Please note that the average annual investment growth rate for the UK is calculated based on investment development from 2012 to 2016.

The lack of an isolated NIRP effect is further supported by looking at the historical development of investments. There has been a constant positive trend in GFCF investments for all economies, except for a small downturn following the financial crisis. For a graphical presentation of the historical development of investments, please see appendix 13.

The business cycle development could potentially have been another driver behind the uncovered growth. However, the cycle fluctuations are not directly transferred to the investment development, so the business cycle can only provide a partial explanation. For details on the business cycle development please see appendix 6. Still, the overall cycle trend shows economic growth and turnaround following the 2008 financial crisis. The latest argument also highlights the importance of monetary policy in connection with investment development. It is very unlikely that the economic recovery would have been feasible without the implementation of expansionary monetary policy following the European recession in 2008-2009. Further, there is always a question whether the NIRP economies would have been able to generate a corresponding investment growth and recovery relying solely on conventional expansionary monetary policy. However, that analysis is beyond the scope of this paper.

Based on the analysis above, we are not able to conclude whether NIRP has influenced the investment growth we uncovered. However, what has become clear is that it is not NIRP alone that has caused the growth. We do find indicators that expansionary monetary policy, in general, may be a contributing factor. To further investigate if the monetary policy has an influencing effect, we will in the following section try to determine which policy tool, fiscal or monetary, that is the major driver behind the investment growth.

5.1.3.2 Sector driver

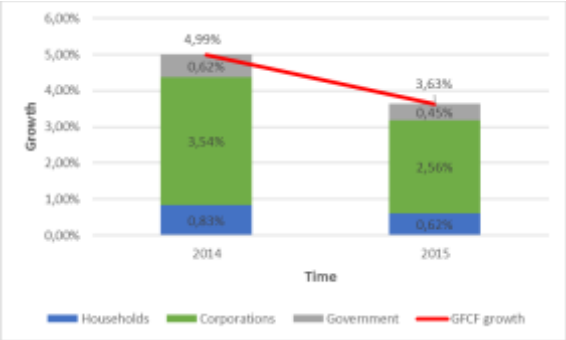
The evidence in the previous analysis suggested that conventional monetary policy could be a key driver behind the investment development. To try to determine whether it is, in fact, monetary policy, we will conduct a sector analysis that will provide indications of which sector is the driving force for the investment growth. If government is the driving sector, this will indicate that fiscal policy is the dominant factor. On the other hand, if we find the corporate and household sectors to be the drivers, the evidence will support growth through monetary policy.

The reasoning behind the assumption is that fiscal policy and governments are interrelated as fiscal policy is how the government determine spending and tax regimes. While the markets that corporations and households operate in are directly affected by monetary policy through policy rate transmission mechanisms.

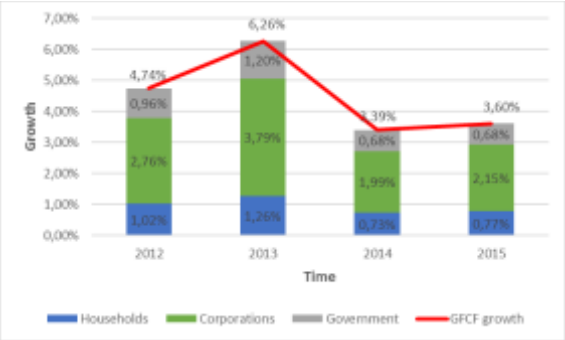
The test will be conducted through calculating the weighted average sector growth calculated from sector GFCF investments and annual growth in GFCF following the NIRP implementation. The analysis will only be conducted for the NIRP economies.

Figure 5.1.3.2 GFCF investment by sector

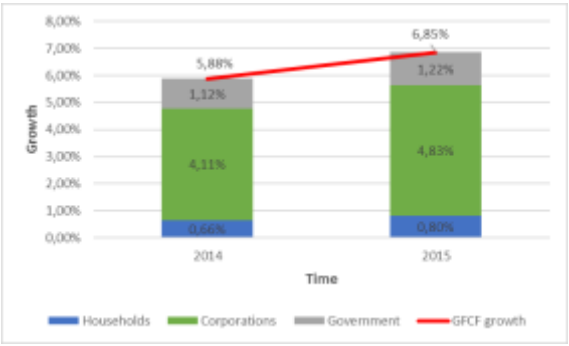
A. Denmark



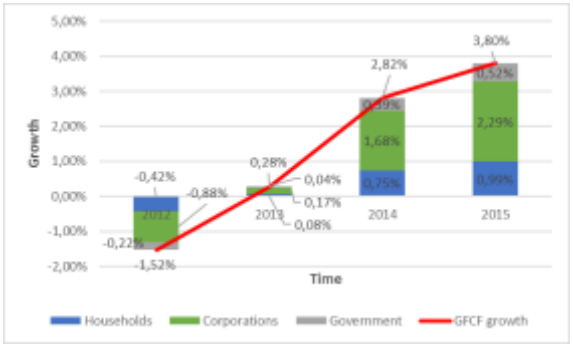
B. Sweden



C. Switzerland



D. Euro Area



Last observation: *End of year 2015 for all economies* ***Source:*** *Self calculated values based on OECD data on GFCF investments and sector GFCF shares.*

The corporate sector has been the largest driver behind the GFCF investment growth in all economies. In 2012, the Euro Area experienced negative growth in GFCF investments, and the corporate sector was the driving force behind this development as well. Which of the other two sectors that have been the second largest contributor to the growth has varied across the economies: In Denmark and Switzerland, the government has dominated over households, while the roles are reversed in Sweden and the Euro Area. The findings thereby suggest monetary policy to be the dominating policy behind investment growth in all economies.

Finally, it is also interesting to evaluate why corporations seem to be the main driver of the GFCF investment development. Compared to households, one explanation may be that there is more money in circulation in the corporate sector, which facilitates a higher degree of investments. Another argument is related to the type of investments measured by GFCF. It is reasonable to assume that corporations invest more in long-term fixed assets, while households to a larger degree invest in more short-term assets, including financial assets. The former type of investments is included in the GFCF measure, while the latter is not. Finally, a possible explanation of the observation that corporations seem to be a larger driver than the government, can be explained by the fact that even though the government has sizable capital to invest, a significant proportion of this is foreign investments, which will not be included in the GFCF, as the variable only takes domestic investments into account.

5.1.3.3 Conclusion

Summing up, we were not able to isolate NIRP as the driver behind investment growth in the economy. However, based on the findings in the second analysis, it might seem like expansionary monetary policy has contributed to the observed increase in GFCF. Despite the failure to isolate a NIRP effect, there are some related questions that are worth rising: Would we have seen the same investment growth in the NIRP economies if the unconventional expansionary monetary policy was not implemented? Would conventional expansionary monetary policy have been sufficient to drive the investment growth, or is the NIRP a key factor in realizing the development? In terms of our findings and discussion, we are not able to accept nor fully reject our hypothesis of an increase in GFCF investments following NIRP implementation.

5.1.4 Overinvestments

By the previous sections, we have been able to show investment growth both in the household and corporate sectors, as well as in the aggregate economy. However, we have not been able to prove that this is directly caused by NIRP. Still, the results indicate that the investment growth is driven by expansionary monetary policy, hence NIRP could be a driving force. Even though a strict causality relation between NIRP and investment growth has not been established, it is still interesting to investigate whether the investment growth has caused overinvestment tendencies in the economies. If this is the case, are these tendencies

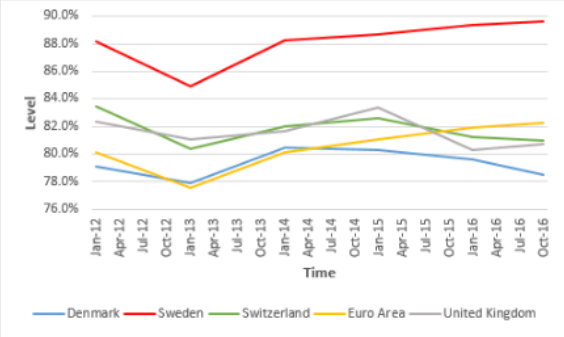
more present in the NIRP economies? If this relationship is uncovered, we may conclude that NIRP is an overinvestment driver.

In general, the concern related to overinvestments is that people invest in projects that will be unprofitable in the future when the economic condition changes. This could create an overinvestment bubble that, when it bursts, causes a new economic crisis through unutilized capacity, business closure, and large employment cuts. Note, however, that there is a difference between various types of overinvestments: Excessive investments that do not expand the asset base or capacity will have limited real economic consequences under changed conditions. The real apprehension is related to overinvestment in new fixed asset capacity: If the newly built capacity is not needed in the future, the overinvestment may form the foundation of an overinvestment bubble.

5.1.4.1 Capacity utilization

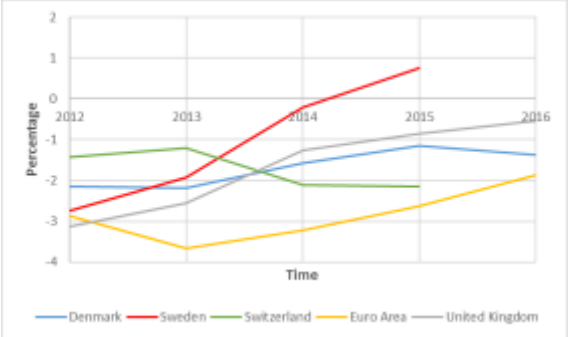
As mentioned, one of the major concerns related to overinvestments is that new capacity is built and stays unutilized. By investigating the capacity utilization together with output gaps, we could uncover tendencies of overinvestments in an economy if the output gap is positive while capacity utilization is declining.

Figure 5.1.4.1 Capacity utilization



Note: *Capacity utilization is a measure of potential economic output being utilized* ***Last observation:*** *October 2016 for all economies.* ***Source:*** *Datastream (DG ECFIN, Statistics Sweden and Swiss Economic Institute (KOF))*

Figure 5.1.4.2 Output gaps



Note: *Output gap is a measure of actual to potential GDP. Last* ***observation:*** *End of year 2015 for Sweden and Switzerland, end of year 2016 for the other economies.*

Focusing on capacity utilization in isolation, we find some common development tendencies. However, there are also some significant deviations, making it difficult to deduct a common NIRP tendency. We also find that the control economy closely follows the development of

the NIRP economies. Despite the lack of a common NIRP trend and isolated NIRP effect, we may still perform the overinvestment evaluation on an economy-specific level.

As explained earlier, the overinvestment tendencies would be uncovered if the economies faced a positive output gap and a reduction in capacity utilization. Looking at the output gaps, we find that the only economy operating on an economically inefficient high production level is Sweden, all other economies produce less than what is socially optimal. We thereby do not find evidence of any economy with positive output gap and negative development in capacity utilization. In other terms, we are not able to find evidence of potential overinvestments using this indicator.

Overinvestment tendencies were not uncovered. However, the findings reveal information about the current state that may be used to form recommendations going forward, avoiding future overinvestment: An increase in capacity utilization in Denmark, Switzerland, the Euro Area and the United Kingdom could be a critical factor for closing these economies' output gaps. In Sweden, it looks like a production slowdown, freeing up some capacity, would be the preferable action. An increase in investment capacity thereby does not seem necessary in any of the economies. Adding more would rather contribute to a development heading towards overinvestments. However, it is also important to keep in mind that some fixed investments, for example investing in assets with new improved technology, could lead to a beneficial reduction in capacity utilization, if the new and more efficient production plants replace the old and out-dated.

To summarize, the investigated variables do not indicate overinvestment in any of the economies, but there are several resource utilization discussions to be extracted from the findings. Further, the evidence indicates that no further capacity investments seem to be needed in the economies. However, an investment slowdown could also reduce the implementation of new and improved technology, which would be disadvantageous for the economy in the long-run.

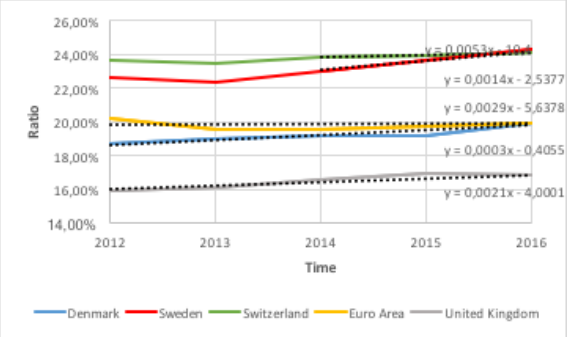
5.1.4.2 General economic overinvestment tendencies?

Another major indicator of potential overinvestment in an economy is found by calculating the investment to gross domestic product (GDP) ratio, and investigate how the ratio

develops over time. In general, a growing ratio could be a sign of overinvestment in the economy (Hoffmann, 2009). However, it could also be temporary and an effect of correcting historical investment lags or an initial low level of investments.

When we calculated the investment to GDP ratio, we used gross fixed capital formation (GFCF) as our investment indicator. The ratio values can be found in appendix 14.

Figure 5.1.4.3 GFCF to GDP



Last observation: *End of year 2016 for all economies.* ***Source:*** *All data downloaded from Datastream (DG ECFIN)*

Looking at the empirical evidence, we find overall GFCF/GDP growth for all the NIRP economies following NIRP implementation. Even though we see an initial drop in the Euro Area after the negative rate implementation, this does not influence the overall positive trend. The common NIRP tendency is thereby growth in the investment to output ratio. However, comparing the results from the unconventional expansionary monetary policy economies to the control economy, we find that growth in the GFCF/GDP ratio is not an isolated market reaction following NIRP implementation. As mentioned earlier in the thesis, the Bank of England has also committed to an expansionary monetary policy, but they have chosen not to enter the unconventional negative territory. With this as a basis, one can speculate that one of the driving forces behind the GFCF to GDP ratio is expansionary monetary policy, but we are not able to affirm nor deny the speculation based on this analysis.

Even though we do not find an isolated NIRP effect, we are still able to interpret the results in terms of potential overinvestment in the different economies. As we find growth in all the economies, we know that this could be a sign of excessive investment. However, looking at historical development, as presented in appendix 15, the development does not suggest

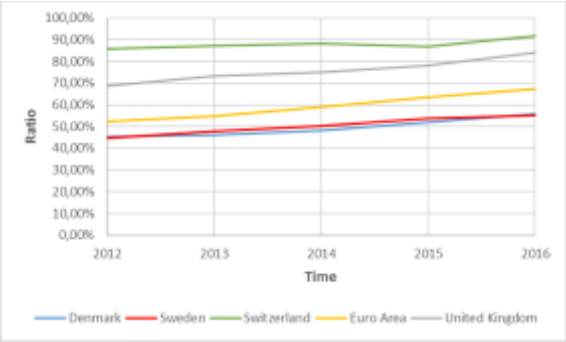
overinvestment in the economies, except Sweden, as the current ratio levels all are lower than the levels back in 2004. For Sweden, the historical development together with the current ratio level raises a red flag. Not only is the end of year 2016 GFCF to GDP ratio in Sweden higher than in any of the other economies, but the current level is also significantly higher than the 2004 level, and even exceeding the pre-crisis investment to output ratio in 2008.

Still, looking at the ratio development following the NIRP implementation, we do not find evidence of "exploding" growth, indicating that NIRP implementation has not put an acute, and potentially dangerous, upward pressure on investments relative to output. At the same time, it will be key to follow the development of these factors closely, as a continued long period with abnormally low, and negative, interest rates could facilitate a potential future overinvestment issue. Particularly the Swedes need to be aware of the development going forward.

1.2.4.3 Mises-Hayek overinvestment theory

According to Mises-Hayek theory, increase in the money to gross domestic product (GDP) ratio may be an indicator of overinvestment (Hoffmann, 2009). Following this theory, we calculated the relevant ratios based on the money supply of narrow money (M1) and the economies' GDP development.

Figure 5.1.4.4 Money supply to GDP



Note: *Relevant money supply variable is the narrow money supply (M1).* ***Last observation:*** *End of year 2016 for all economies.* ***Source****: Self-calculated ratio based on Datastream (OECD) data of narrow money (M1) and GDP downloaded from Datastream (DG ECFIN)*

First, focusing on the NIRP economies, we find that the economies, except Switzerland, experienced initial growth. However, all economies experienced overall growth throughout

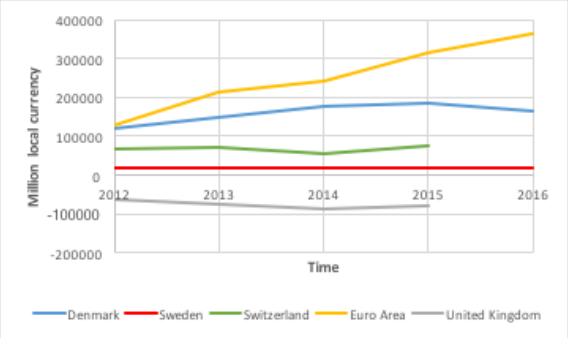
the entire period of interest (2012-2016), and the market reaction following NIRP implementation did not stand out. This indicates that this effect might be a more general economic tendency. In addition, by including the development of the ratio for the control economy, we observe the same growing path over the same period, further supporting that this is not an isolated NIRP effect. Looking at the historical development of the ratio, presented in appendix 16, we find that the ratio has kept a stable growing trend for the last decades. The ratio has not been particularly affected by business cycles or other relevant economic events. This unaffected development could be explained by looking at the ratio components' development relative to each other, where we find a common tendency of higher growth in M1 relative to the growth in GDP. The figures are presented in appendix 17. To summarize, the ratio development seems to be unaffected by economic events and monetary policy in general, and by NIRP in particular.

Despite the lack of NIRP effect, we are still able to use the information to evaluate whether any of the economies are facing overinvestment. According to the theory outlined above, ratio growth could be a sign of overinvestments. We do find significantly positive growth rates for the economies since 2012 and 2014, please see appendix 17, providing us support of a potential overinvestment trend. However, we also find continuous strong growth rates in a historical perspective, both before, during and after the 2008 financial crisis, contradicting that the growth pattern we see today is abnormal and indicative of overinvestments. We are thereby not able to conclude whether the development we see is a natural continuation of a historical trend, or if the last period growth is unhealthy and building an overinvestment bubble that is on the brink of bursting.

5.1.4.4 Credit-induced overinvestment bubble?

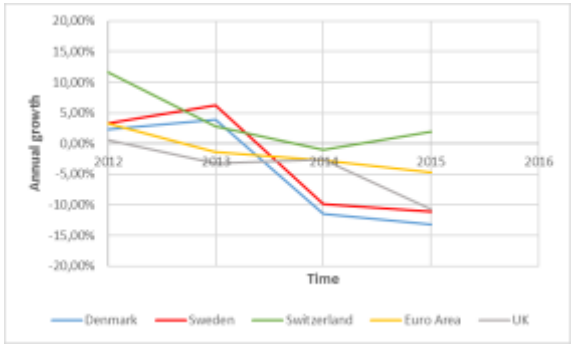
The two last overinvestment analyses will be conducted with the intent to uncover potential credit induced overinvestment bubbles. According to Hoffmann (2009), current account deficits together with credit growth and high growth in output could indicate an overinvestment bubble. The development of the three variables of interest has been the following, since the first NIRP implementation in 2012:

Figure 5.1.4.5 Current account balance



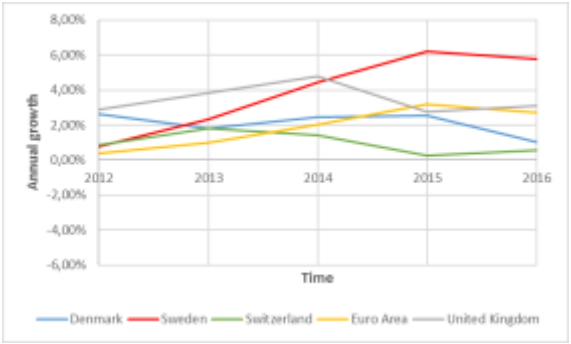
Last observation: *End of year 2015 for Switzerland and the United Kingdom, end of year 2016 for all other economies.* ***Source:*** *Datastream (Statistics Denmark, Statistics Sweden, Swiss National Bank, European Central Bank and the Office For National Statistics, United Kingdom).*

Figure 5.1.4.6 Gross external debt



Last observation: *End of year 2015 for all economies.* ***Source:*** *Self-calculated growth rate based on gross external debt figures downloaded from Datastream (World Bank QEDS).*

Figure 5.1.4.7 GDP growth



Last observation: *End of year 2016 for all economies.* ***Source:*** *Self-calculated growth rate based on GDP figures downloaded from Datastream (DG ECFIN).*

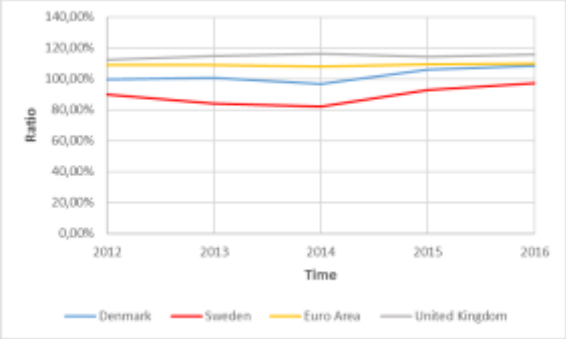
As shown, the only economy with current account deficits is the control economy. Further, looking at the gross external debt, only Switzerland has experienced growth in the latest years. GDP growth has been moderate for all economies. NIRP or not, these indicators do not show any evidence of a credit induced overinvestment bubble for any of the economies. We could potentially have uncovered sector-specific overinvestment tendencies if these were investigated, but that is beyond the scope of this paper. The aggregate economy variables do not show evidence of overinvestments.

Another way to uncover a potential credit induced overinvestment bubble is by looking at the ratio development of production of capital goods to production of consumer goods. Hoffmann (2009) presents the arguments on how abnormally low interest rates could

facilitate a change in the production structure, increasing the level of capital goods production. This could create a bubble that will burst when the interest rates are raised back to a more natural level, and the investments in capital goods production will no longer be profitable. We use these arguments, calculate the ratio and investigate the post-NIRP developments to see if we find further support for the findings in the previous analysis, or if this test may uncover a potential overinvestment bubble driven by eased credit structures.

An overview of the calculated ratio values can be found in appendix 18. Also, please note that there is no consumer goods data available for Switzerland, so we are not able to calculate the ratio and perform the empirical analysis for the Swiss economy.

Figure 5.1.4.8 Production of capital goods to production of consumer goods



Note: *There is no data available for Switzerland. Capital goods are defined as goods used to help increase future production, while consumer goods are outputs from production intended for consumption.* ***Last observation:*** *End of year 2016 for all economies.* ***Source:*** *Self-calculated ratio based on data from Datastream (Eurostat)*

Looking at the plots, we find that there generally has been little development in the ratio for all economies. The Euro Area rate is quite stable, but slightly increasing over the period. Focusing on Denmark and Sweden, we find a more significant increase in the ratio from 2014 to the end of 2016, a development that started at the same time as Sweden implemented NIRP. We are thereby able to deduct a common NIRP tendency following 2014, with an increase in the capital to consumer goods production ratio.

Comparing this finding to the control economy, we find that the ratio development in the UK shows a slight reduction. Even though the effect is modest, there is a development difference between the NIRP economies and the control economy, suggesting that the development is an effect of NIRP implementation. However, in this conclusion, we disregard

the contradictory effects seen in Denmark and the Euro Area from 2012 to 2014. These initial deviating effects may indicate that the change in production structure is more a result of a prolonged period of negative policy rates rather than immediate effects. At the same time, why would we see the effect in Sweden immediately after implementing NIRP?

The discussion could go on, and the only way to conclude is by conducting supplementary analyses on exogenous factors affecting development of production. Still, we can extract some valuable arguments related both to overinvestments and effects of NIRP implementation: We do find growing rates in the NIRP economies, however, the growth is modest and the ratios of the NIRP economies are all inferior to the one of the control economy, suggesting that there might not be immediate danger of overinvestments. Further, the inverse development between the control economy and the NIRP economies could indicate that eased credit structures when in positive interest rate territory do not cause the same effects as implementing negative policy rates, even though there are some findings we are not able to explain. Still, we may here witness an isolated NIRP effect in this variable, even though the results are not fully conclusive and require further analyses.

5.1.4.5 Final discussion and conclusion (overinvestments)

First, it is important to note that there is always uncertainty related to analyses trying to uncover potential overinvestment bubbles, as it is very difficult to foresee a bubble building. Therefore, the indicators we have used are often highlighted after the crisis is a fact, trying to explain why it happened in the first place. Still, the indicators provide valuable and highly relevant indications on both NIRP effects related to overinvestments, and potential warning signals for the economies of interest.

Summing up the findings of the different tests and analyses, the overall conclusion is that we cannot find clear evidence supporting a NIRP-driven overinvestment bubble building. We do not find any clear indicators of overinvestment at all, even though the general economic overinvestment indicator in section 5.1.4.2 raised a few concerns related to the Swedish economy. Further, the common trends between the NIRP economies and the control economy made it impossible to isolate NIRP as a driving force behind the development of the variable. However, in the final analysis in section 5.1.4.4, we could uncover some

development deviations in the later years, but the results were not conclusive. Hence, we need to reject our hypothesis of a NIRP driven overinvestment bubble.

Even though we were not able to conclude with overinvestment tendencies or NIRP effects today, there is still uncertainty related to future development of the variables and potential consequences of NIRP. Overinvestments could still be a negative long-term effect following NIRP implementation, even though current experience does not indicate such a relationship. The difference between short-term effects and long-term effects of NIRP is in that case highly relevant to evaluate.

5.1.5 Investment conclusion

To sum up, in the analyses related to investments, we could isolate the NIRP effect for household savings, even though the savings reaction was the opposite of the expected. For the other variables, we did not find conclusive evidence of a NIRP effect. However, we did find some indicators that the NIRP could have an influencing effect. In addition, it is important to emphasize that we do not know the long-term effects of NIRP implementation. What happens if the negative rates stay negative for an extended period, and what if interest rates become even more negative? Moreover, what is good policy in the short perspective, does not need to be a good strategy in the long run. Further, a good policy in one economy will not necessarily work well in another economy. We are not able to answer the raised questions today, as the experience with NIRP and available data is limited. However, these questions will open for future research. Therefore, it is our opinion that the types of analyses and evaluations executed in this paper should be conducted on a regular basis going forward, as we do not know the long-term effects of this type of unconventional expansionary monetary policy.

5.2 Liquidity-constrained households and firms

The transmission of negative policy rates to the commercial banking market does not only influence deposit rates, it also influences the commercial lending rates. In a market, there will always be households and firms on the verge of bankruptcy. These entities only generate enough money to cover their costs, but do not manage to create an operational surplus. This is a state that is not viable in the long run, as a negative change to any input factor will force

bankruptcy. However, a reduction in lending rates following transmission of NIRP to the commercial banking market could help these households and firms, saving them from default. Thereby, our hypothesis is that following NIRP implementation, non-viable firms would be kept alive due to the unnaturally low lending rates. This artificial state of company survival could, in turn, disturb the natural cycle of creative destruction and bring the economy to a sub-optimal steady state with depressed restructuring and inefficient resource allocation.

5.2.1 Survival of non-viable firms

To start the investigation, we will perform a series of analyses to try to uncover whether the NIRP implementation has led to a significant increase in the survival of non-solvent firms.

5.2.1.1 Transmission to lending rates

To analyse whether we can observe an increase in survival of otherwise non-solvent firms, also known as zombie firms, following NIRP implementation, we first test if the negative policy rates have transmitted to the commercial lending rates. We include both household mortgage rates, consumer loan rates and corporate loan rates in the investigation to provide a full picture of the transmission. We will calculate both historical and post-NIRP correlation coefficients.

Table 5.2.1.1 Correlation between policy and market lending rates

		Denmark	Sweden	Switzerland	Euro Area	United Kingdom
Mortgage rate	From 2004	0,907	0,952[1]	0,834	0,874	0,376[1]
	From NIRP	0,812	0,964	0,263	0,875	N/A
Consumer loans	From 2004	0,799	0,910[2]	0,825	0,703	0,636
	From NIRP	0,862	0,962	0,449	0,938	N/A
Corporate loans	From 2004	0,899	0,986[3]	Data not available	0,935	0,994
	From NIRP	0,751	0,964		0,904	N/A

Note: *[1]The historical data for the mortgage rate in Sweden is only available from September 2005, and the UK rate from Q1 2009. [2]Historical consumer loans rate in Sweden only available from October 2005. [3]Historical corporate loans rate for*

Sweden only available from September 2010. ***Last observation:*** *Third quarter 2016 for the mortgage rate in the UK,* ***f****ourth quarter 2016 for the consumer loan rate in Switzerland and the UK, November 2016 for all other rates and economies.* ***Mortgage rates:*** *Denmark, outstanding loans for house purchase with duration >5Y; Sweden, lending rates for house purchase; Switzerland, variable mortgage lending rate for new business; Euro Area, household mortgage rate with duration 1-5Y; United Kingdom, fixed mortgage lending rate 1-5Y* ***Source:*** *Bloomberg and Datastream (European Mortgage Federation) for the UK.* ***Consumer loan rates:*** *Denmark, household outstanding balance sheet item with duration 1-5Y; Sweden, household lending rates for other consumer loans; Switzerland, average rate on consumer loans; Euro Area, consumption loan rate with duration 1-5Y; United Kingdom, average rate on consumer loans* ***Source:*** *Datastream (Oxford Economics) for Switzerland and the UK and Bloomberg for the other economies.* ***Corporate lending rates:*** *Denmark, rate for non-financial corporations with duration 1-5Y; Sweden, rate for non-financial corporations, all accounts; Switzerland, NO DATA; Euro Area, Large corporate loans with duration 1-5Y; United Kingdom, fixed non-financial corporations' loans rate.* ***Source:*** *Bloomberg and Datastream (Bank of England) for the UK.*

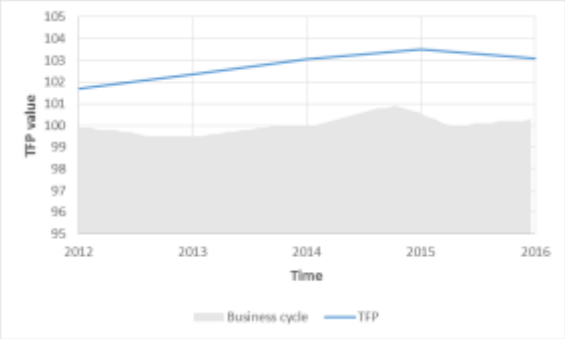
Generally, there has been high historical correlation between the lending rates and the key policy rates in the NIRP economies, and lower correlation in the control economy with exception of the corporate loans rate. When we narrow the timeframe of interest to after NIRP implementation, we find that the estimates vary more. Still, most of the correlations are characterized as "strong" or "very strong", with the deviation found in Switzerland. As the table indicates, we lack data on the Swiss corporate loans rate, and we are thereby not able to calculate the correlation coefficient. However, the data we do have indicate that the NIRP transmission to the Swiss lending rates has been somewhat weaker than for the other economies. For further details related to the co-movement of the policy rates and the commercial lending rates, please see the graphical presentations in appendix 19. However, it is important to note that despite the high correlation estimates, none of these lending rates have entered the negative territory.

5.2.1.2 Development of TFP and business cycle

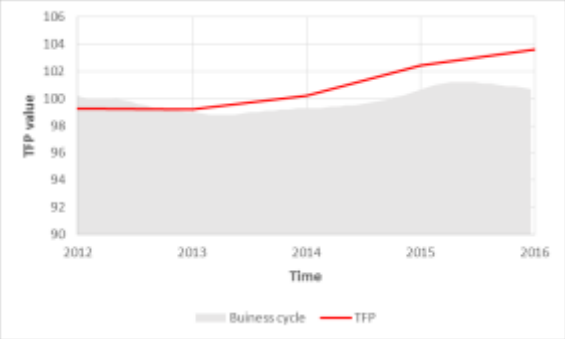
Zombie firms are low productivity units, and their existence might, therefore, contribute to a reduction of the economy's average productivity (Caballero, Hoshi & Kashyap, 2008). This relationship forms the basis to state that productivity reduction may be evidence of zombie existence. In our analysis, we will investigate the development of total factor productivity (TFP) as this is a key indicator of the overall productivity in the economy. Further, as the TFP is expected to be significantly influenced by the business cycle, we must control for the development of ratio to trend GDP. A historical correlation test further support the relationship between TFP and the business cycle, for calculated coefficients please see appendix 20.

Figure 5.2.1.1 TFP index controlled for the business cycle

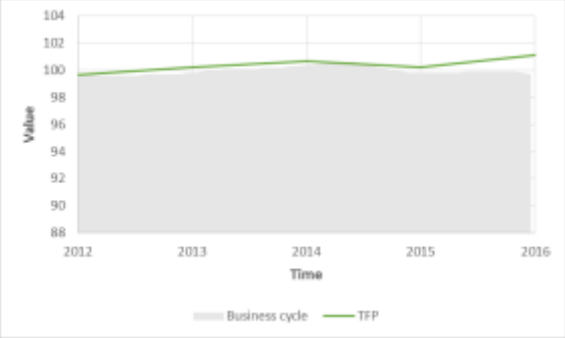
A. Denmark



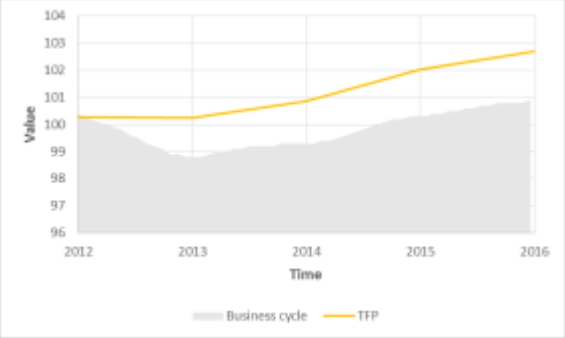
B. Sweden



C. Switzerland



D. Euro Area



Note: *Total factor productivity (TFP) is an effectivity measure of inputs in a production process.* ***Last observation:*** *TFP index: End of year 2016 for all economies. Ratio to trend GDP: September 2016 for all economies.* ***Source:*** *TFP index from Datastream (Directorate General for Economic and Financial Affairs), Business cycle data is retrieved as the GDP ratio to trend indicators from OECD statistics.*

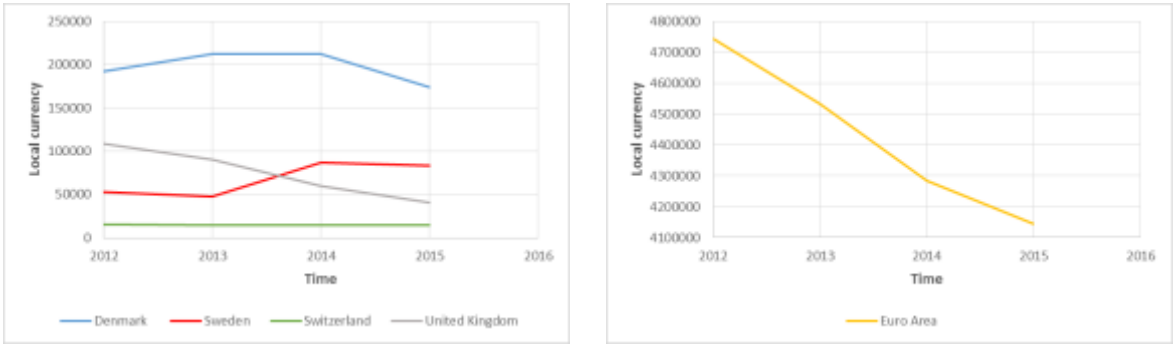
The economies' TFP has followed a positive trend after NIRP implementation. Further, the development of TFP closely follows the business cycle. However, there are some deviations worth taking note of. These findings become more evident when considering the annual growth rates of the two variables, as presented in appendix 21. In the rare cases of deviations, the growth rate of the TFP is positive while the ratio to trend GDP growth rate is negative, without exception. These findings do not imply a presence of zombie firms. However, we have one interesting observation in Denmark in 2015, when the TFP reduction was stronger than the reduction in the business cycle, a potential sign of zombie presence in Denmark.

As we cannot find any common evidence of zombie presence in the NIRP economies, we will not try to isolate the effect. However, as noted above, the 2015 TFP to business cycle in Denmark could be an indication of zombie presence.

5.2.1.3 Development of non-performing loans

To provide a second perspective, we will investigate the potential increase of non-solvent households and firms by investigating the development of non-performing loans. As zombie survival facilitates fewer insolvency proceedings and loan defaults, a reduction in non-performing loans could be an indicator of zombie presence.

Figure 5.2.1.2 Non-performing loans



Note: *Non-performing loans are defined as loans that are at default or close to default.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *IMF data.*

By looking at the plots, it becomes clear that the Euro Area has faced a significant decrease in non-performing loans since the NIRP implementation. The development in Sweden and Switzerland been nearly stable since 2014. However, looking at the details, the tendency has been slightly negative in Sweden, and slightly positive in Switzerland. In Denmark, the development has been fluctuating, with initial increase before the trend turns towards the end of the period. However, the overall development from beginning to end of period shows a reduction in non-performing loans.

Based on the findings, it is difficult to deduct a common NIRP response. However, considering the overall development in Denmark, Sweden, and the Euro Area, we might have evidence indicative of increased zombie presence. The Swiss results conflict with these findings. Still, we may argue that there is a common trend as NIRP was implemented in Switzerland in December 2015, and the NIRP development may therefore not be covered by the data available. The same goes for the Swedish tendencies as the Riksbank did not enter negative territory before October 2014. This indicates an overall reduction in non-performing loans in the two economies that were the first to implement NIRP, suggesting an

increase of zombies. Further, we could potentially find the same tendencies in the 2014 NIRP-economies once more data is made available.

Despite the lack of a common NIRP trend, we will still compare the NIRP economies to the control economy to see if expansionary monetary policy could be the cause of the development. The fact that the UK also experienced a reduction in non-performing loans, suggest that it is the abnormally low interest rates that are the real cause of the development. At the same time, this could not explain the developments in Sweden before 2014, neither in Switzerland, suggesting that there might be another driver.

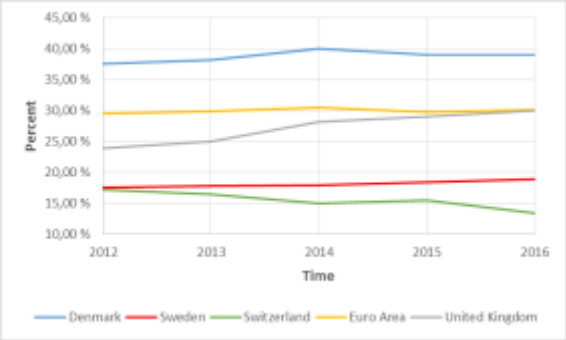
The historical development of non-performing loans presented in appendix 22 could uncover important reasons for the development we have found. The historical perspective uncovers that the number of non-performing loans exploded in the Euro Area from 2007 to 2008, a growth that may help explain the reduction in the following years. For the United Kingdom, the case was similar, but the growth was not even close to the one in the Euro Area. Sweden also experienced an increase around 2008, but has not faced the same decrease afterwards. This may indicate that if the growth is moderate, the historical increase might not be sufficient to explain the following decrease.

Summing up, we have found some indicators of increase in zombie presence in some of the economies, but the results are inconclusive. In addition, we were not able to isolate a NIRP effect, but speculate that the tendencies uncovered may be effects of expansionary monetary policy in general.

5.2.1.4 Development of corporate profits/corporate debt

We will round of the series of analyses by investigating the development of corporate profits to corporate debt. According to Hoshi and Kim (2012), zombie firms have low profitability and are highly indebted. This provides the foundation of our analysis, where a reduction in the corporate profits to corporate debt ratio could provide a good indication of increase in zombie presence.

Figure 5.2.1.3 Corporate profits to corporate debt



Last observation: *End of year 2016 for all economies.* ***Source:*** *Self-calculated data based on corporate profit data from Datastream (Oxford Economics) and corporate debt data from IMF data.*

The development has been quite stable in all economies since the implementation of NIRP. However, there are some economy specific developments worth mentioning. In Denmark, the ratio increased until 2014, before it reverted. Still, there is an overall growth tendency for the period. Sweden and the Euro Area have also experienced a slight increase in the ratio since the implementation of NIRP. Switzerland deviates from the other NIRP economies and underwent a ratio reduction. A common NIRP trend is thereby difficult to deduct. The ratio development in the control economy has experienced the highest increase of the five countries, suggesting that NIRP implementation might have had a dampening effect on the ratio development.

The initial findings do not suggest an increase in zombie presence in any of the economies, except for Switzerland. We know that zombies are not able to generate a surplus, as they are just able to cover their costs. A second approach to uncover potential escalation of zombie presence could be to look at the corporate profit development, as presented in appendix 23. The corporate profits have been growing since NIRP implementation in all economies, except Switzerland, further supporting our previous findings. Still, the deviating responses within the economies, neither support NIRP or expansionary monetary policy as the key driver behind the development. However, one could always argue that the weak transmission of policy rates to the commercial lending rates in Switzerland indicate that the Swiss economy should be less weighted, an omission that uncovers a common upward trend in the other economies. This effect does not imply increased zombie presence, but opens for expansionary policy being the driver. At the same time, the current profit levels are quite

low in a historical perspective, indicating that the effect we see is more of a recovery tendency following the Great Financial Crisis. The historical development is presented in appendix 23.

Summing up, the evidence may be interpreted in multiple ways, supporting several arguments. The findings are thereby inconclusive. Still, it is interesting that the United Kingdom has faced a more significant ratio growth than the other economies. This might imply that NIRP is slowing the growth of the ratio. However, this is only speculation. Further, the findings do not support growth in the number of zombie firms. At the same time, the dampening development in the NIRP economies may suggest that there are zombies influencing the results.

5.2.1.5 Conclusion

There is little empirical evidence of zombie growth following NIRP implementation. However, we have found some economy specific indicators that could indicate an increase, but these findings are inconclusive. We thereby must reject our initial hypothesis. However, one can always argue that it is unreasonable that NIRP implementation and transmission to the lending rates have not facilitated survival of otherwise non-viable firms. Still, these effects may not have been captured by the analyses. The analysis focus has been on the aggregate economy, and this may not be the best approach to uncover expansion of zombie presence. Sector or industry-level analyses could have provided more specific details and reliable results. It is reasonable to expect that lower lending rates would result, to some degree, in increased survival of non-viable firms, and that the lack of empirical evidence in these analyses, therefore, might not be evidence of zero growth, but rather confirm that zombie presence is difficult to uncover on an aggregate economy level.

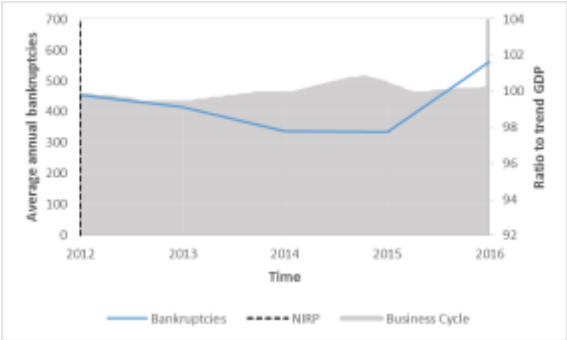
5.2.2 Depressed market restructuring

A potential consequence of survival of non-solvent households and firms is that it could restrict the creative destruction process, and lead to depressed market restructuring. Further, this could influence the natural cycle of the economy, limiting future economic growth. In other words, the issue is related to the low interest rates keeping inefficient and low-productive firms alive, prohibiting the natural cycle of business creation and destruction.

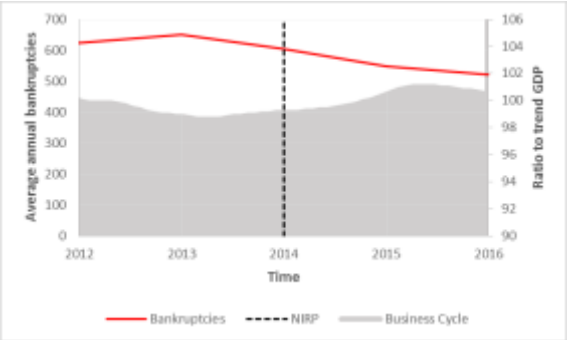
To investigate whether the fear has materialized, we will focus on the development of bankruptcies together with the business cycle, to account for the cycle effect on bankruptcies. In general, one would expect an inverse relationship between the business cycle and the number of bankruptcies. However, the artificially low interest rates could facilitate the survival of otherwise insolvent firms. Please note that we do not have a complete set of bankruptcy figures for the Euro Area, and the findings will only be indicative.

Figure 5.2.2.1 Average annual number of bankruptcies versus the cycle

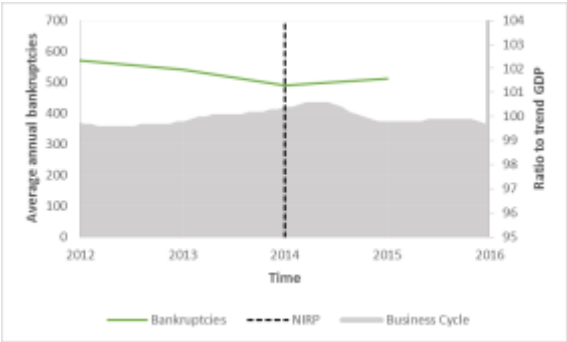
A. Denmark



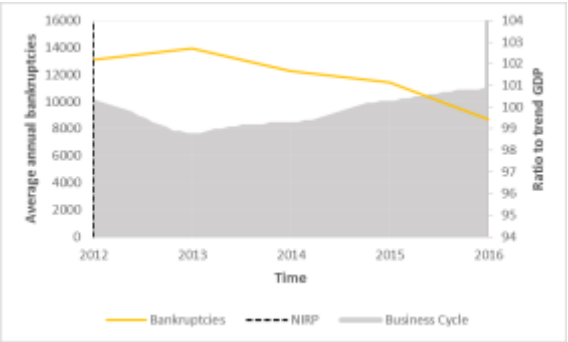
B. Sweden



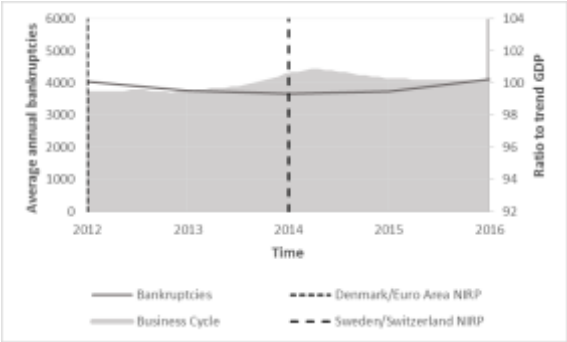
C. Switzerland



D. Euro Area



E. United Kingdom



Last observation: *Average annual bankruptcies: Last observation end of year 2015 for Switzerland, end of year 2016 for all other economies. Ratio to trend GDP: Last observation September 2016 for all economies.* ***Source:*** *Bankruptcy data downloaded from Trading economics; Euro Area figures are self-calculated based on data for different Euro Area economies; Business cycle data is downloaded from OECD statistics (ratio to trend GDP).*

The uncovered general tendency is a common inverse relationship between the business cycle and bankruptcy rate. Despite the general common tendency, there are a few deviations worth taking note of. In the initial period following NIRP, Denmark experienced a reduction both in the ratio to trend GDP and bankruptcies. This could be a sign of an initial NIRP effect. However, only Switzerland experience a similar co-movement of the variables in the first period, but here we see an increase in bankruptcies and an upswing in the business cycle. The effect in Switzerland is thereby the opposite of the expected NIRP effect. However, it is important to note that the Swiss National Bank implemented NIRP in December 2014, and the data available may thereby not capture the actual NIRP response. Further, the implementation of NIRP in Sweden was also late 2014, so the initial NIRP effect in that economy could be argued to be the development presented in the 2015-2016 timeframe. These findings suggest a NIRP effect with a reduced co-movement of both variables. However, there is no co-movement effect uncovered in the Euro Area. Nevertheless, the large scale of the Euro Area and the lack of data could be a disturbing factor. Still, the data is inconclusive, and we are not able to conclude that there is an initial NIRP effect.

A further deviation of interest is the deviation uncovered towards the end of the period. In Denmark, we find a significant increase in bankruptcies, while there are no significant fluctuations in the business cycle. In Sweden, the two variables both decline. In the Euro Area, the two variables move in each their direction, as expected, but there is a significant reduction in bankruptcies, while the business cycle growth is only moderate. The findings in the Euro Area and Sweden could be argued to be a NIRP effect on bankruptcies. However, there is contradicting evidence in Denmark. In Switzerland, we lack corresponding data. NIRP implementation was made at different points in time, and this timing difference makes it hard to uncover periodic NIRP effects. Highlighting deviations is, therefore, more a statement of anomalies rather than a tool to uncover periodic NIRP tendencies. The different findings in the economies do not support a common NIRP tendency but could suggest economy-specific NIRP effects.

However, there is an important factor to be noted related to the end of period deviation in Denmark. The development we find here may be a long-term effect of NIRP implementation:

The sharp increase in bankruptcies, despite the flat business cycle, could be a sign that the NIRP effect keeping zombie firms alive has come to an end. Even though we have not found any conclusive evidence of a NIRP effect on bankruptcy rates, an effect might still be present. If NIRP was not implemented in the economies, the bankruptcy rates could potentially have been significantly higher. The NIRP would thereby have a calming effect on the bankruptcy rates, even though we were not able to prove this in our analysis. The end-of-period development in Denmark could support this theory. However, at this point the data available is insufficient, so the discussion is only speculative. Based on our findings we must reject our hypothesis, but as more time goes by and more data become available this conclusion might change.

5.2.3 Resource allocation

All firms occupy a part of the labour force, as they need employees to conduct their operations. Usually, employment is beneficial in an economic perspective, as it ensures households income, which contributes to market demand. However, if the employment rate in the economy is so high that firms struggle with filling open positions, one might enter a state of inefficient resource allocation. In that state, a part of the labour force is tied up in low-productivity firms, prohibiting workflow to higher productivity firms, limiting market efficiency and output. The presence of zombie firms could create such a state of suboptimal resource allocation, and this is the hypothesis we will investigate in the following analyses.

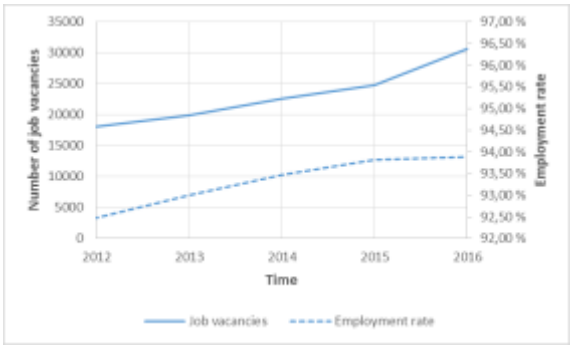
5.2.3.1 Job vacancies

The first analysis is directed towards the potential mismatch of employment and job vacancies. The implementation of NIRP could lead to an unhealthy market allocation of resources, where vacancies in higher productivity firms are not fulfilled.

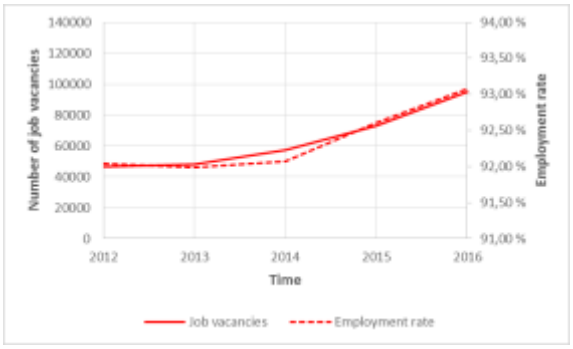
By looking at the development of job vacancies relative to the level of employment, we will try to uncover if the NIRP implementation could have led to an inefficient allocation of labour resources. In this case, an increase in job vacancies together with a high employment rate will be evidence of suboptimal distribution of labour capital.

Figure 5.2.3.1 Job vacancies versus employment rate

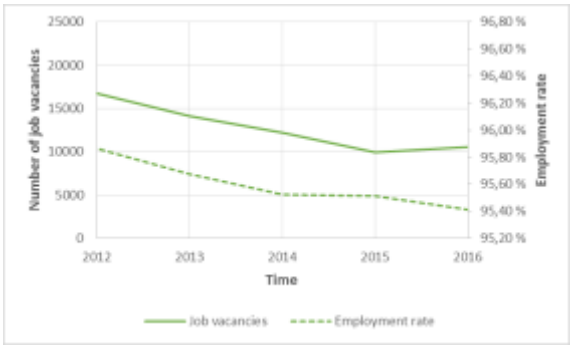
A. Denmark



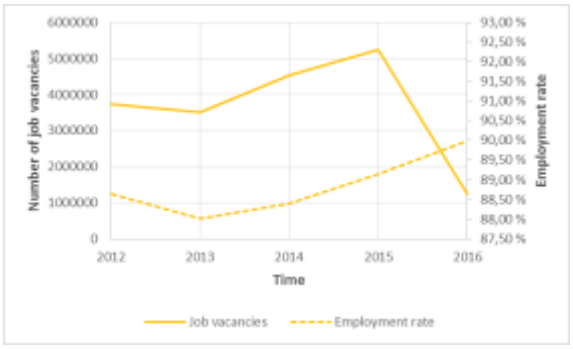
B. Sweden



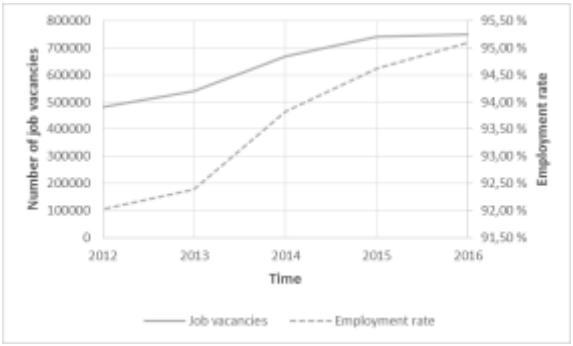
C. Switzerland



D. Euro Area



E. United Kingdom



Note: *Job vacancies is calculated as average annual number of job vacancies based on monthly job vacancy data.* ***Last observation:*** *Job vacancies: Last observation end of year 2016 for all economies. Employment rate: Last observation end of year 2016 for all economies.* ***Source:*** *Average annual job vacancy figures self-calculated based on data from Trading Economies. Employment rate self-calculated based on data from OECD statistics.*

In the first period after the NIRP implementation, we find that the number of job vacancies and employment rate increased in both Denmark and Sweden, while Switzerland and the Euro Area experienced a reduction. These findings propose a lack of a common NIRP effect. However, looking at the details, we might conclude differently: The increase in Denmark and Sweden both uncovers a mismatch between job vacancies and employment. Focusing on the

Euro Area, we find that the reduction is stronger for the employment rate than the job vacancy rate, suggesting a mismatch here as well. However, in Switzerland, the reduction in employment was weaker than the reduction of job vacancies. The Swiss findings are contradicting the other NIRP economies, making it impossible to deduct a common NIRP tendency. Still, as uncovered in section 5.2.1.1, the transmission of NIRP to lending rates was significantly weaker for Switzerland, opening for omitting the Swiss evidence. Thus, ignoring the Swiss effects, the common NIRP trend is a mismatch caused by a tied-up labour force.

Looking at the following periods, we still find the same tendency in Denmark: Job vacancies keep increasing, while the employment rate follows the same growing pattern before it flattens out. An equivalent conclusion may be drawn for Sweden. The increased employment is not able to compensate for the Swedish economy's labour demand. In Switzerland, a mismatch tendency is uncovered following 2015, as the employment rate reduces at the same time as job vacancies increase. However, this mismatch is not in line with the NIRP and zombie presence theory, as this imbalance does not stem from a tied-up labour force. Finally, in the Euro Area, we find a mismatch pattern with growth in both variables until 2015, when the job vacancy rate suddenly drops. Again, there is a common tendency in the development of Denmark, Sweden, and the Euro Area, while the Swiss findings deviate. If we set aside the Swiss findings with the same reasoning as above, the evidence still suggests a common NIRP-economy mismatch from a tied-up labour force.

Focusing on the control economy, we find that there is a co-movement of the two variables in the UK as well: Both the number of job vacancies and the employment rate is increasing. Thereby, it seems like the effect uncovered may not be an isolated effect of NIRP. However, it could still be an effect of expansionary monetary policy. The abnormally low interest rate levels of the economies could facilitate the survival of zombie firms, and could further be the driver of the development. However, this is only speculation.

To conclude, we are not able to isolate a NIRP effect, however, the common tendencies suggest that there is an imbalance between job vacancies and employment, that may stem from a tied-up labour force. This could be caused by abnormally low interest rates following

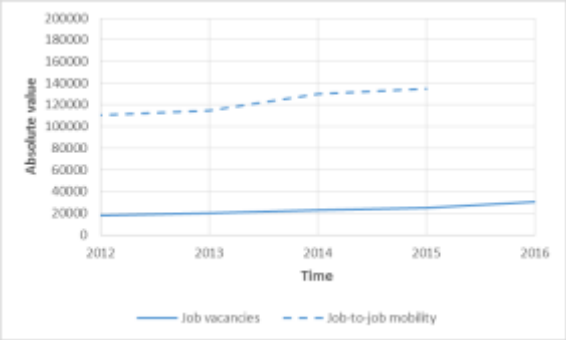
the implementation of the expansionary monetary policy regimes. However, the findings and evidence are inconclusive, as further tests are required to obtain conclusive results.

5.2.3.2 Job mobility

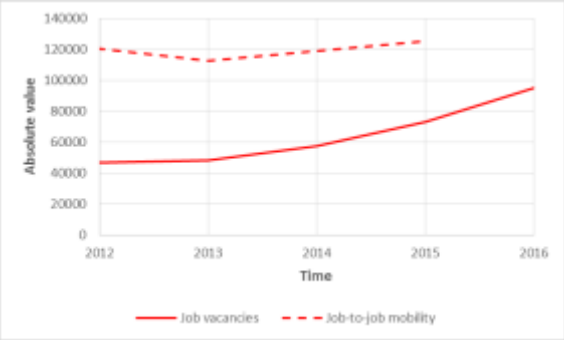
To follow the rigidity argument of the workforce, we will in the following analysis investigate the tendencies uncovered by job mobility patterns. Low job mobility indicates low flexibility and rigidities in the economy. If we find a reduction in job mobility together with an increase in job vacancies, this would be a sign of market mismatch or inefficient resource allocation.

Figure 5.2.3.2 Job-to-job mobility versus job vacancies

A. Denmark

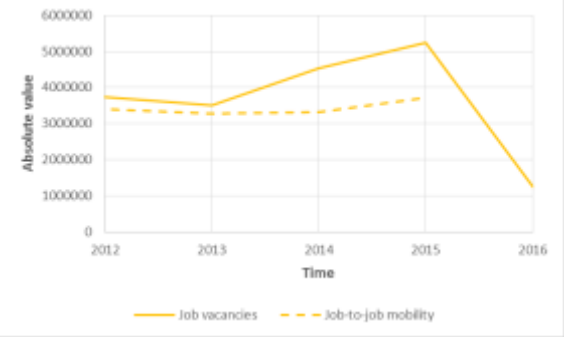


B. Sweden

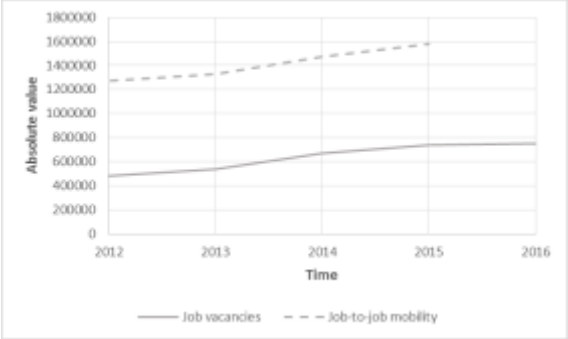


C. Switzerland

D. Euro Area



E. United Kingdom



Note: *Job-to-job mobility is defined as movement of an employee between one employer to another from year to year. The figures do not include labour market inflow or mobility from unemployment to employment. Job vacancies is calculated as average annual number of job vacancies based on monthly job vacancy data.* ***Last observation:*** *Job-to-job mobility: End of year 2015 for all economies. Job vacancies: Last observation end of year 2016 for all economies.* ***Source:*** *Job-to-job mobility figures from Eurostat. Average annual job vacancies calculated based on data from Trading Economies.*

Following NIRP implementation, the economies, except the Euro Area, have experienced an upswing in job mobility. The Euro Area underwent an initial downturn from 2012 to 2013 but has since then experienced job mobility growth. The same growing tendency is present in the United Kingdom, indicating that this is not an isolated effect of NIRP.

Comparing the job mobility development to the job vacancy rate, we find that none of the economies experience the feared reduction in job mobility together with an increase in the number of job vacancies. However, in Sweden and the Euro Area, the job vacancy rate is growing at a steeper rate than the job mobility, indicating potential mismatch.

None of the concerns related to job mobility and resource allocation seem to be present in the NIRP economies. Still, it could be interesting to evaluate some potential influencing factors behind the uncovered development. Conventional expansionary policy may be causing the development, instead of NIRP. This hypothesis is supported by the common development tendencies between the NIRP economies and the control economy. Further, by looking at the historical development of the variables, as presented in appendix 24, we might be able to explain the rigidity reduction in the mobility variable. The findings here show a drop in job mobility following the Great Financial Crisis. Note however that we do not have data available for Switzerland. The post-crisis reduction could potentially have become a big problem for the economies, and we can speculate that the implementation of the expansionary policies was crucial to turn the situation.

To sum up, the effect we found is positive in terms of reduced mobility rigidity. However, we were not able to isolate a NIRP effect but have a theory that the tendency may be driven by the expansionary monetary policy conducted in all economies.

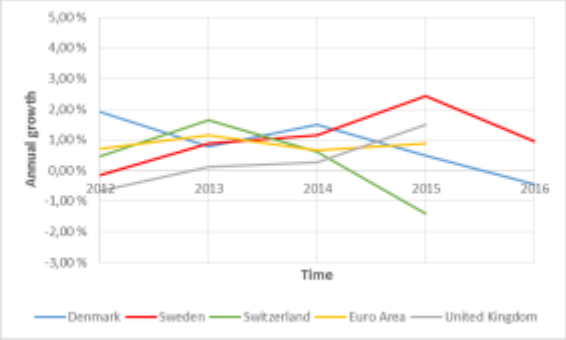
5.1.3.3 Labour productivity

According to Bartelsman et al (2004), the evidence suggests that in well-developed economies, flexible reallocation regimes is productivity enhancing. Similarly, an economy with rigid reallocation patterns may experience reduced productivity. If the labour force is

not allocating from less productive to more productive businesses, this will be expressed through reduction in the productivity measures.

Based on the theory, we will look at the development of labour productivity, and use the findings to evaluate whether the labour force seems to be tied up in low-productivity firms or not.

Figure 5.2.3.3 Labour productivity



Note: *Labour productivity is measured as growth in GDP per hour worked.* ***Last observation:*** *End of year 2016 for Denmark and Sweden. End of year 2015 for all other economies.* ***Source:*** *OECD data.*

Following the NIRP implementation in the economies, we find positive growth in labour productivity in all NIRP economies, except in Switzerland. The annual growth in labour productivity upholds for Sweden and the Euro Area through the entire period of interest, while Denmark experiences negative growth towards the end of the period. The overall NIRP effect for the full period is, therefore, impossible to deduct.

Disregarding the NIRP effect, focusing solely on interpreting the results in terms of determining the effects related to resource allocation, it seems like there is no strong evidence of the labour force being tied up in any of the economies, maybe with an exception of Switzerland following NIRP implementation in late 2014.

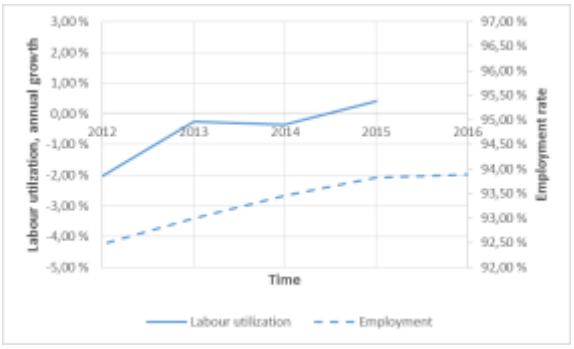
5.2.3.4 Labour utilization

In the final analysis related to labour allocation, we will investigate the development of labour utilization together with the employment rate. A reduction in labour utilization could indicate an inefficient resource allocation, while the inclusion of the employment rate could help uncover if people are employed and utilized, or employed without maximizing the resources available. In general, a reduction in labour utilization together with employment

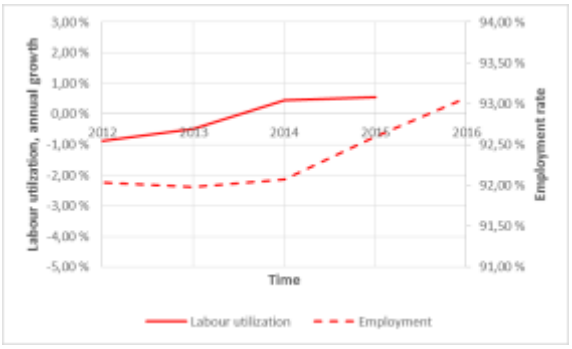
growth will suggest that resources are not maximized. In addition, we will also test to see if we can isolate a NIRP effect based on the findings.

Figure 5.2.3.4 Labour utilization versus the employment rate

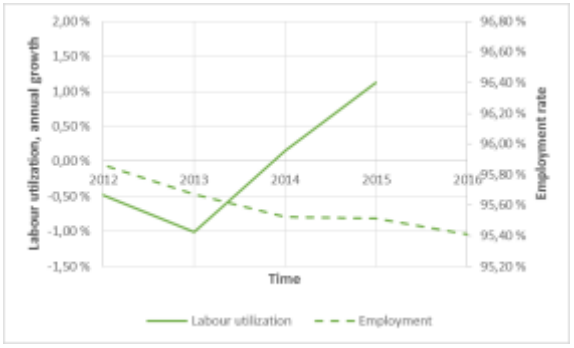
A. Denmark



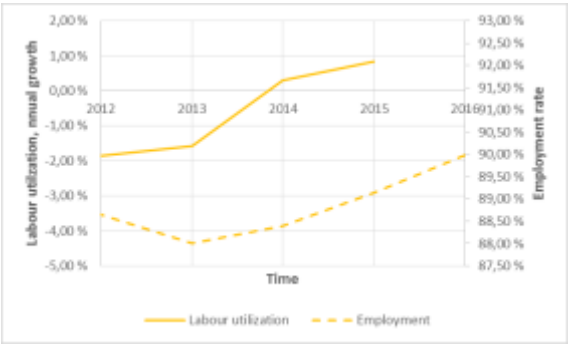
B. Sweden



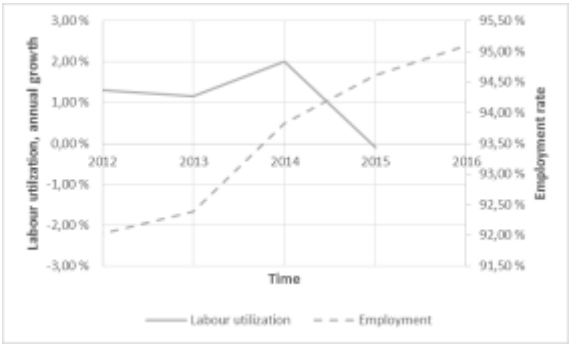
C. Switzerland



D. Euro Area



E. United Kingdom



Note: *Labour utilization is measured as change in hours worked per capita.* ***Last observation:*** *Labour utilization: Last observation end of 2015 for all economies. Employment rate: End of year 2016 for all economies.* ***Source:*** *Labour utilization: OECD data. Employment rate: Self-calculated based on data from OECD statistics.*

Following NIRP implementation, we found that the growth in labour utilization was negative in Denmark and the Euro Area, and positive in Sweden and Switzerland. In this perspective, it is not possible to deduct a common NIRP tendency. However, looking at the trends for the entire period of interest, 2012-2016, we find that labour utilization was declining in all the

NIRP economies until 2014 when the trend seemed to turn. In the same period, the control economy experienced growth in labour utilization. The shift around 2014, that turned the negative trends in the NIRP economies to growth, also reversed the positive trend in the UK economy. There is thereby definitely a difference between the control economy and the NIRP economies, but the development seems to be independent of the year of NIRP implementation.

Including the employment rate in the discussion, we can expand our utilization argument. For Denmark, we see the feared relationship of employment growth and negative utilization growth following the NIRP implementation. In the Euro Area, the first year after the unconventional monetary policy was implemented, the employment rate was also reduced. However, the second period uncovered the same feared development as in Denmark. Sweden and Switzerland do not display any of the disturbing developments. In Sweden, there is growth in both variables, while we in Switzerland find a favourable development with increasing labour utilization and employment reduction, suggesting improved utilization of labour resources. In the control economy, we first uncover worrying tendencies after 2014, when the initial tendencies had reverted; labour utilization declined while the employment rate increased. Once again, there is a clear difference between the NIRP economies and the control economy; while there were worrying tendencies in the beginning of the period for the NIRP economies, and the control economy looked healthy, the roles were reversed towards the end of the period. However, two big questions remain: What are the main drivers behind the development, and what caused the difference between the NIRP economies and the control economy?

The final questions are hard to answer and would require a series of further analyses. Unfortunately, we do not have room to include these analyses in this thesis, but there is no doubt that this is a very interesting topic for further research.

5.2.3.5 Conclusion

Summing up the findings in the different analyses, we found that we were not able to isolate a NIRP effect in any of the first three hypotheses. However, in the fourth, we found a clear difference between the control economy and the NIRP economies, indicating a significant difference, and a potential NIRP effect. Further, in the first analysis, we were not able to

deduct any conclusive results. However, the evidence in the three latter analyses suggests that the concern related to sub-optimal labour resource allocation and rigidity has not materialized since the NIRP implementation. To the contrary, the empirical findings rather suggest an improvement. To conclude, we must reject our hypothesis.

5.2.4 Conclusion

In the above analyses, we have proven that the negative policy rates have transmitted to the commercial banking markets' lending rates. Further, we have investigated the effect this transmission has had on liquidity-constrained households and firms, and if this effect is driven by NIRP implementation.

We started off by investigating whether NIRP implementation has led to signs of increased zombie presence on an aggregate level, but had to conclude that we could not find evidence in the aggregate variables. Still, we argued that it is unreasonable that the significantly lower lending rates did not facilitate survival of some liquidity-constrained firms, even though we were not able to prove it through the analyses. Further, we analysed whether the implementation of NIRP has caused suppression of creative destruction. We noted some interesting findings both in terms of depressed market restructuring and NIRP effects, however, the findings were inconclusive. In the final section, we considered the NIRP effect on allocation of labour resources. In general, we were not able to isolate a NIRP effect in the analyses, and in contrary to what we expected to find, the implementation of expansionary monetary policy and NIRP seems to have reduced the allocation rigidity in the labour market rather than enforcing it.

6. Conclusion

To answer our main problem statement, we first take a closer look at the sets of sub-questions and hypotheses we have been investigating. We will start off with the set of sub-questions related to investments.

The first sub-question was related to a potential preference shift and analysed in section 5.1.1. We found that the correlation between deposit rates and key policy rates has been high both historically and post NIRP, indicating that the transmission to the market has been strong. Further, we isolated an increase in households' savings following NIRP implementation. Focusing on corporate savings, we were not able to deduct a common trend, nor isolate a NIRP effect. For the investments, we found growth in both sectors. However, we could not conclude that NIRP was the sole key driver behind the observed development. Overall, we were not able to find evidence of a preference shift due to the negative interest rate policy implementation and had to reject our hypothesis.

The second investment sub-question aimed at answering how the level of corporate investments had been affected by NIRP through the discount rate. Due to a relatively strong correlation between the key policy rates and the discount rates, we concluded that the transmission was strong. The negative coefficients between the GFCF investments and the discount rates indicated the expected inverse relationship, but the correlations were weak. To address whether the NIRP was the key driver behind the development, we compared the correlations for the NIRP economies to the one of the United Kingdom. As the coefficients were quite similar, and we did not manage to obtain reliable post-NIRP coefficient, we could not accept, nor reject the hypothesis that NIRP influenced the investment level through the discount rate.

In the third analysis, we investigated aggregated macroeconomic variables related to investments, to answer whether NIRP caused the development in the aggregate economy. First, a test was conducted to check the correlation between GDP and investments, and the analysis established a significant relationship between the two variables. Further, we studied the development of GFCF investment and uncovered that there has been an investment growth in all economies following NIRP implementation. However, as the control economy

faced a similar development, we concluded that NIRP was not the isolated driver. The evidence rather suggested expansionary monetary policy to be the cause of the development, and a sector-specific analysis further supported these findings. Summing up, we established aggregate investment growth but had to reject the hypothesis that NIRP was causing this development.

Lastly, we investigated NIRP effects with respect to overinvestments through a series of different analyses including capacity utilization, output gaps, GFCF to GDP ratio, M1 to GDP ratio and indicators of credit induced overinvestment bubbles. We found a few warning signs for the Swedish economy, but the overall results did not show any evidence of an overinvestment bubble building. We thereby had to reject the hypothesis.

Turning to the sub-questions related to liquidity-constrained households and firms, the first hypothesis concerned whether NIRP could contribute to an increase of zombie firms. We started the analysis by investigating the transmission effect of policy rates to the commercial lending rates, and the test results indicated a high degree of transmission. However, none of the lending rates had entered negative territory. Later, we investigated the development of the TFP index controlled for the business cycle, non-performing loans and corporate profits to corporate debt, to see if zombie presence was increasing on the aggregate level. Even though it is reasonable to assume that the rate cuts have facilitated some degree of zombie survival, the analyses did not provide any evidence of an increase in zombie presence, and we had to reject the hypothesis.

Focusing on the hypothesis related to potentially depressed market restructuring following NIRP implementation, we looked at the development in the average number of bankruptcies controlled for the business cycle. The output showed an inverse, healthy relationship for all economies, including the UK. There were some interesting deviations, however, they were not large enough to influence the conclusion. Thereby, we had to reject the hypothesis.

Finally, we investigated if NIRP implementation had caused rigidity in labour resource reallocation, and influenced labour utilization. Through the analyses, we were not able to isolate a NIRP effect, and in contradiction to the hypothesis, the evidence suggested an improvement in labour reallocation rigidity. In addition, the current trend in the NIRP

economies is an improvement with respect to labour utilization. Based on the findings, we had to reject our hypothesis.

After reviewing the sub-questions and hypothesis conclusions, we are now ready to draw a conclusion with respect to our main problem statement: Following NIRP implementation, what are the main hypotheses and concerns related to investments and liquidity-constrained households and firms, and have these materialized? We conclude that there has been limited realization of the concerns related to NIRP implementation. We were only able to isolate a few NIRP effects and these uncovered effects of NIRP implementation contradictory to what we expected to find. For example, increased savings and a higher degree of labour utilization. However, we cannot disregard the possibility that another research design, for instance, a sector analysis or an analysis including abnormally low, but still positive, key interest rates, could have resulted in another conclusion. In addition, the empirical findings in this thesis only uncover some of the short-term effects of NIRP implementation. As time goes by and more data become available, we cannot rule out that one or several of these conclusions might change and that the long-term effect of NIRP implementation may differ largely from the short-term effects.

7. Final Remarks

There is no doubt that the thesis process has been a valuable experience, leaving us with new and important knowledge, both on an academic and a personal level. We started our preparations early, and soon experienced the benefits from this decision. The importance of preparation, continuous work and ambitious goals have been key to succeed. As we were not in control of the data and the direction the findings took us, we learned that no plan survives the entire process, and thereby how crucial an open mind is. We had to adjust our plans several times during the process, as some things came out differently and were more or less time consuming than initially assumed. Finally, we experienced that things are often more complex than they look. Despite that we read up well up front, the complexity of the topic became more visible the further in the process we came. In some cases, the complexity felt too challenging and difficult to overcome, but we tried to turn it around and rather use it as a motivational factor driving our work forward.

This paper is in no way an exhaustive study of the topics we have chosen to investigate, and could be improved in many ways: If we had the time and resources we would have tried to further isolate the NIRP effects though adding more control economies that were targeted more directly to each of the four NIRP economies, or conducted event studies aiming at uncovering initial market responses to monetary policy decisions. We also talked about building a macroeconomic model for a representative comparable model that not implemented negative policy rates. In addition to further efforts isolating NIRP effects, we also wished to investigate the effects that we have speculated to be consequences of conventional expansionary policy more deeply.

A further consequence of the limitation in time and resources was that we had to leave some approaches unexplored. Initially, we were thinking of including a section on NIRP influence on wealth. This is a topic that, to our knowledge, has not been researched yet. This was a truly interesting perspective, that we followed for a while, as it could have contributed to a wider understanding of the topic. Relevant sub-topics could be re-distributional effects on wealth and income, intergenerational inequalities and pensions. However, we had to omit the topic due to time and content constraints. Further, we had to cut the analyses

investigating price effects and potential asset bubbles, which is another interesting element related to the search for yield in a market with low bank deposit rates.

Further, we considered to include a Taylor evaluation of the NIRP implementation, with the aim of highlighting whether entering negative territory was a good decision initially and further evaluating if the policy rates still should be negative today. That analysis would have been rounded off with a discussion on what would be a wise monetary policy strategy going forward. This could have represented a valuable perspective in the discussion trying to determine when the negative rates have outplayed their role. All the mentioned areas that we, unfortunately, did not have room to include, could be subject to future research. When time runs by and more data becomes available, it is also possible that other interesting perspectives and areas of research that can contribute to the understanding of the NIRP phenomenon, become visible.

There is no doubt that the topic is vast, and many topics and concerns are yet to be analysed. Our empirical approach aims to provide a new perspective and current state analysis related to some of the feared consequences of NIRP implementation. Still, as NIRP is still a quite new phenomenon, the experience and data available is limited and thus limiting our research and conclusions. However, the more time that passes by, the easier it is to conduct more detailed research, drawing more conclusions. Still, we believe that the perspectives presented here are valid and useful in terms of the short-term consequences of NIRP implementation.

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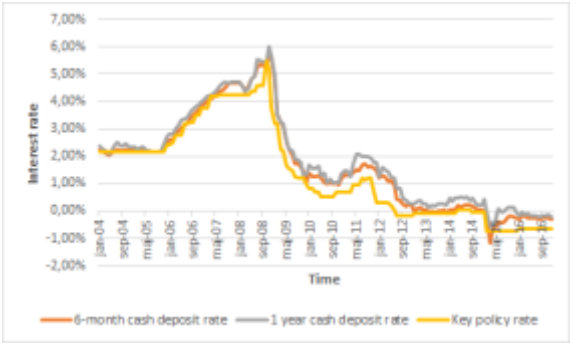
9. Appendices

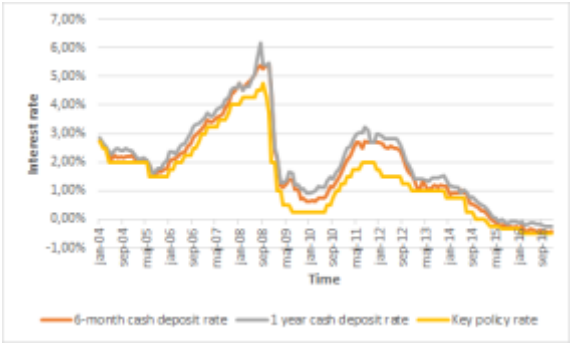
List of appendices

Appendix 1: Historical development of cash deposit rates and the key policy rate

A. Denmark

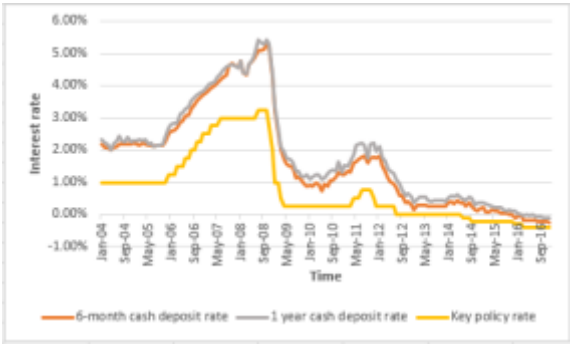


B. Sweden

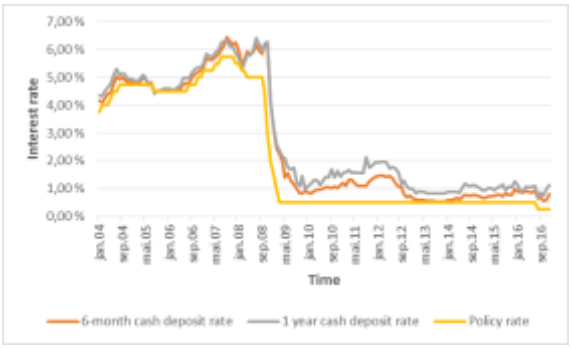


C. Switzerland

D. Euro Area



E. United Kingdom



Notes: *Final observations in December 2016. Relevant policy rates are the A. Certificate of Deposit rate B. Repo rate C. Sight Deposit rate D. Deposit Facility rate E. Official Bank rate.* ***Sources:*** *Cash deposit rates retrieved from Datastream (Thomson Reuters). Key policy rates retrieved from the central banks: A. Danmarks Nationalbank B. Sveriges Riksbank C. Swiss National Bank D. European Central Bank E. Bank of England.*

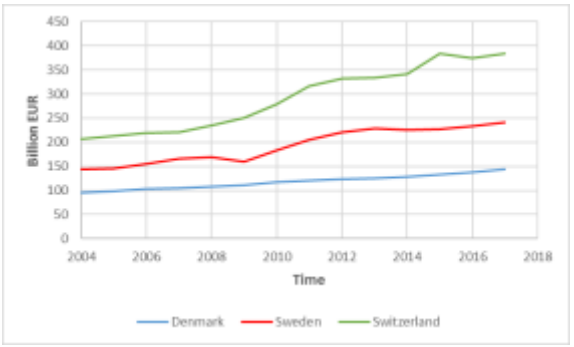
Development of cash deposit rates since 2012

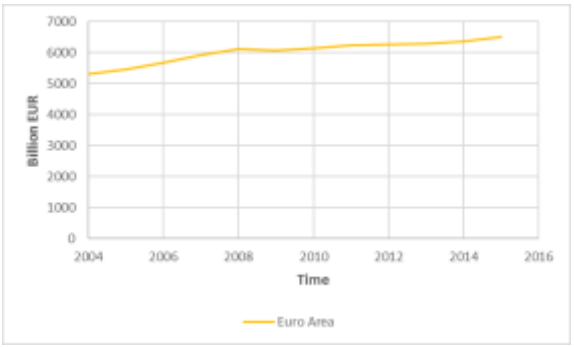
		2012	2013	2014	2015	2016
Denmark	6-month	1,25%	0,07%	0,05%	-0,50%	-0,26%
	1-year	1,20%	0,29%	0,47%	-0,16%	-0,03%
Sweden	6-month	2,50%	1,18%	0,89%	0,16%	-0,45%
	1-year	2,80%	1,50%	1,09%	0,32%	-0,21%
Switzerland	6-month	0,14%	0,07%	0,06%	-0,55%	-0,85%
	1-year	0,40%	0,24%	0,19%	-0,70%	-0,59%
Euro Area	6-month	1,16%	0,30%	0,40%	0,15%	-0,18%
	1-year	1,50%	0,55%	0,57%	0,27%	-0,04%
United Kingdom	6-month	1,43%	0,57%	0,59%	0,73%	0,92%
	1-year	1,94%	0,89%	0,92%	1,03%	0,98%

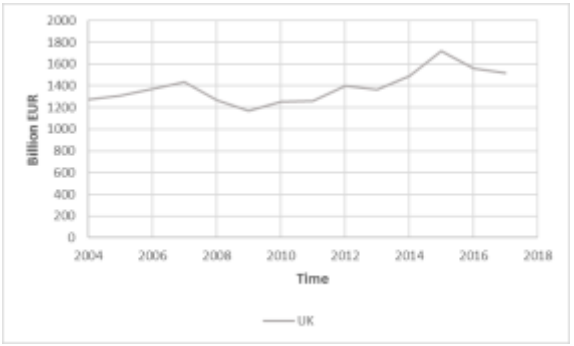
Sources: *Cash deposit rates retrieved from Datastream (Thomson Reuters).*

Appendix 2: Historical development of gross disposable income

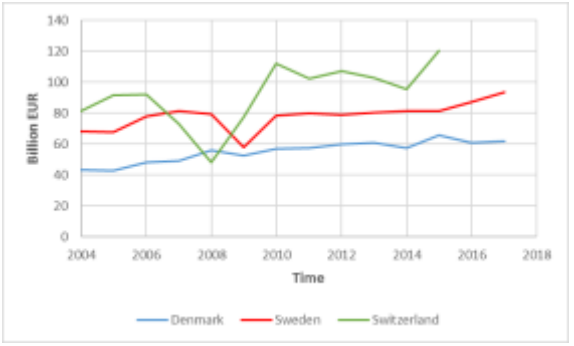
A. Households

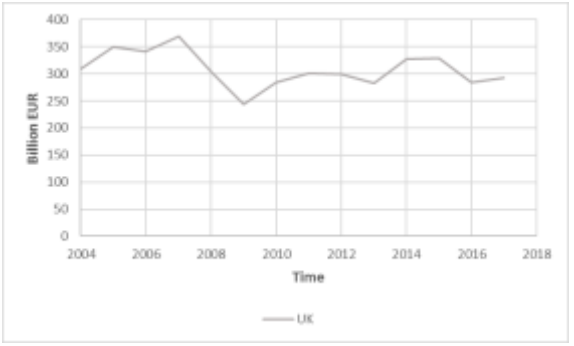






B. Corporations





Notes: *Gross disposable income for households and corporations.* ***Last observation:*** *A. End of year 2015 for the Euro Area, March 2017 for all other economies, all figures annualized. B. End of year 2015 for Switzerland and the Euro Area, March 2017 for all other economies, all figures annualized.* ***Source:*** *Datastream (DG ECFIN AMECO)*

Appendix 3: Historical development and growth rate of gross disposable income since NIRP implementation

A. Households

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Growth 2012-2016
Denmark	95,618	99,24	103,858	105,498	107,929	110,434	116,829	120,795	123,467	125,613	128,384	132,96	138,292	143,767	0,120073
Sweden	143,903	146,061	154,693	165,655	168,782	159,754	183,295	204,594	221,179	227,969	225,101	226,542	232,865	241,753	0,052835
Switzerland	207,232	212,281	218,601	220,221	234,967	250,76	278,6	317,319	332,852	334,314	342,431	384,036	374,014	384,41	0,123665
Euro Area	5304,722	5464,18	5687,903	5917,017	6109,174	6080,475	6132,032	6249,976	6265,127	6300,231	6375,047	6502,759			0,037929
UK	1271,118	1312,653	1374,79	1435,71	1270,852	1172,023	1255,165	1258,146	1401,973	1367,718	1487,636	1717,527	1557,609	1521,062	0,111012

B. Corporations

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Growth 2012-2016
Denmark	43,062	42,802	48,06	49,164	55,666	52,653	56,906	57,483	59,573	60,788	57,195	65,474	60,606	61,867	0,01734
Sweden	68,049	67,734	77,643	81,139	79,296	57,86	78,441	79,69	78,562	80,141	81,088	81,094	86,991	93,58	0,107291
Switzerland	81,269	91,673	92,046	72,784	48,013	77,238	111,958	102,182	106,912	102,523	95,238	120,325			0,125458
Euro Area	1085,328	1108,814	1137,934	1230,214	1181,274	1228,024	1391,641	1429,032	1360,519	1402,336	1459,027	1543,211			0,134281
UK	309,83	350,313	341,169	369,337	303,113	244,491	284,141	301,599	299,618	283,264	327,282	328,675	283,627	292,182	-0,05337

Notes: *Last observation: A. End of year 2015 for the Euro Area, March 2017 for all other economies. B. End of year 2015 for Switzerland and the Euro Area, March 2017 for all other economies.* ***Source:*** *Datastream (DG ECFIN AMECO). The growth rates are annual average and are self-calculated as an average based on the figures available following the NIRP implementation and until 2016. The United Kingdom growth is calculated based on the years 2012-2016.*

Appendix 4: Historical development of savings

A. Households

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark	6,112	3,681	6,835	5,871	5,36	9,277	10,841	9,822	9,184	11,972	6,86	15,051	16,871
Sweden	13,546	12,901	16,479	21,85	29,782	26,027	27,778	33,935	42,873	43,855	44,784	46,187	48,384
Switzerland	42,215	43,755	49,117	53,199	54,942	59,434	65,988	77,908	83,406	85,394	91,414	98,479	90,816
Euro Area	759,493	737,923	749,099	772,287	815,438	894	817,107	809,419	781,945	797,47	808,483	811,566	
UK	98,08	91,555	91,183	106,252	72,965	115,238	147,33	119,457	122,663	95,558	107,025	115,437	89,798

B. Corporations

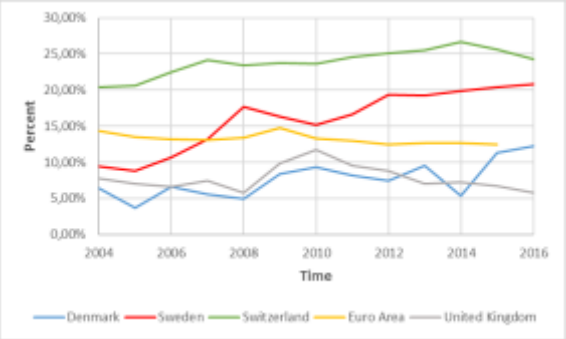
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark	35,96	36,648	38,17	37,965	43,73	41,688	47,118	49,688	51,551	51,024	53,639	55,228	50,885
Sweden	59,188	58,733	67,593	68,969	63,257	47,576	64,797	65,381	62,223	63,48	64,339	62,626	68,383
Switzerland	63,495	73,133	72,448	52,131	27,16	56,021	87,14	73,431	78,056	74,506	62,898	82,686	
Euro Area	1025,653	1042,831	1071,753	1162,858	1100,632	1147,397	1316,486	1353,247	1279,619	1321,644	1374,244	1465,16	
UK	215,505	250,009	240,845	251,458	217,383	180,618	196,624	222,224	227,586	214,784	240,493	257,264	212,154

Notes: *All figures presented are in billion EUR.* ***Last observation:*** *A. End of year 2015 for the Euro Area, end of year 2016 for the other economies. B. End of year 2015 for Switzerland and Euro Area, end of year 2016 for all other economies.*

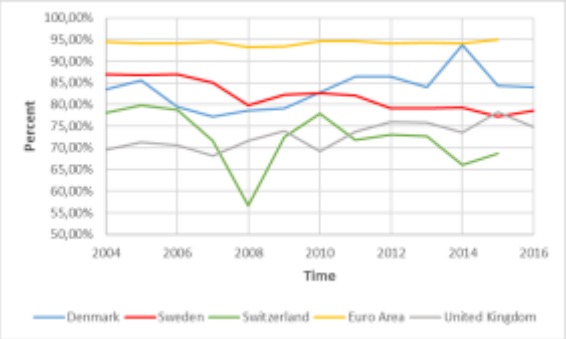
Source: *Datastream (DG ECFIN AMECO).*

Appendix 5: Historical development of household and corporate savings in percent of gross disposable income

A. Households



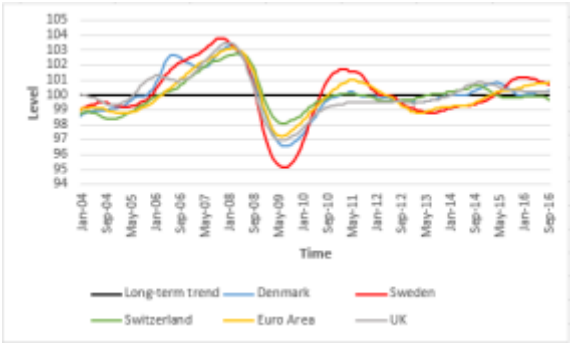
B. Corporations



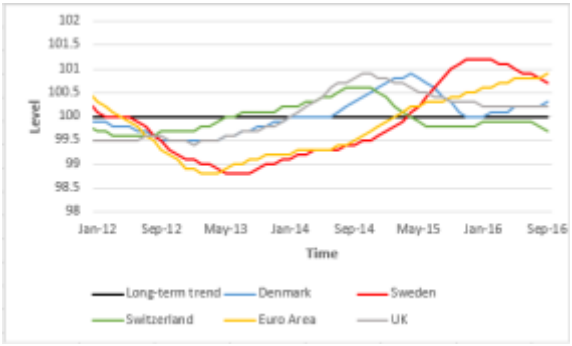
Last observation: *A. End of year 2015 for the Euro Area, end of year 2016 for all other economies; B. End of year 2015 for Switzerland and the Euro Area, end of year 2016 for the other economies.* ***Sources:*** *Self-calculated numbers based on savings and gross disposable income data from Datastream (DG ECFIN AMECO)*

Appendix 6: Business cycle development

A. Historical business cycle development, 2004-2016



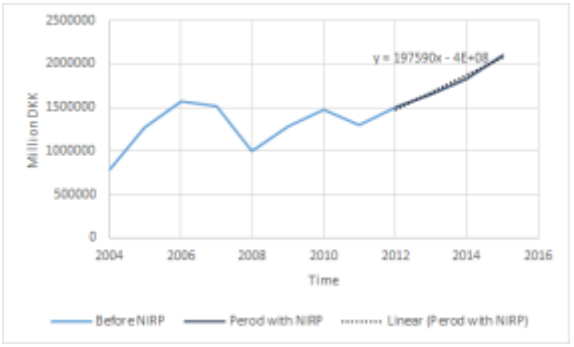
B. NIRP business cycle development, 2012-2016



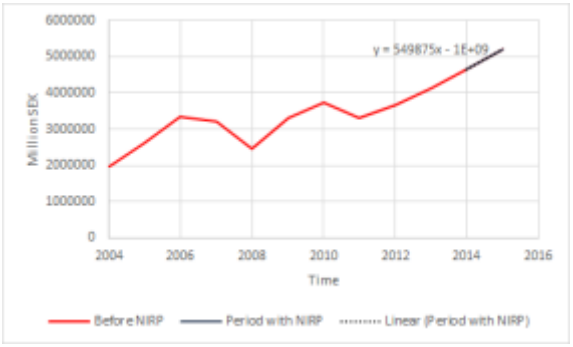
Notes: *Final observations in September 2016. rate presented is the OECD's ratio to trend GDP, where the "ratio to trend" term refers to the current GDP deviation from the long-term trend, and uncovers the cyclical behaviour of the indicator.*
Sources: *OECD statistics, ratio to trend GDP is part of the Composite Leading Indicators dataset.*

Appendix 7: Historical development of households' equity and investment fund shares (assets)

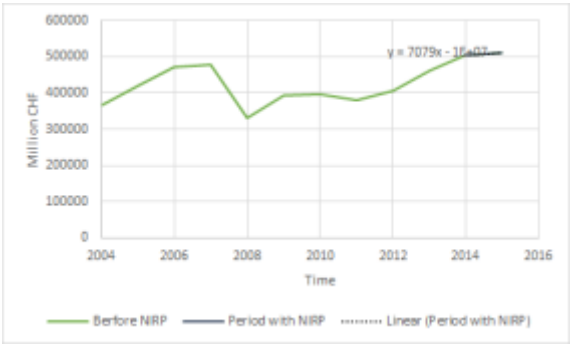
A. Denmark



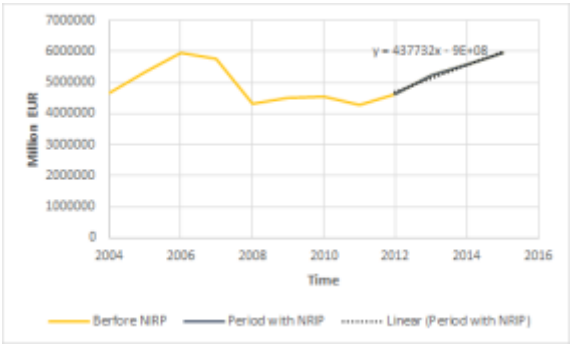
B. Sweden



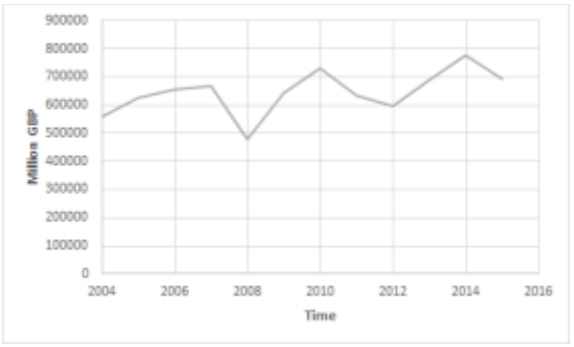
C. Switzerland



D. Euro Area



E. United Kingdom



Notes: *Equity and investment fund shares are the net position of assets held by households, measured in millions local currency.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *Datastream (Eurostat)*

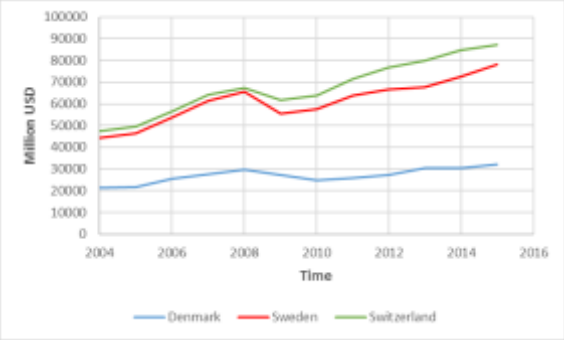
Appendix 8: Historical development and growth rate of household investments in equity and investment fund shares (assets)

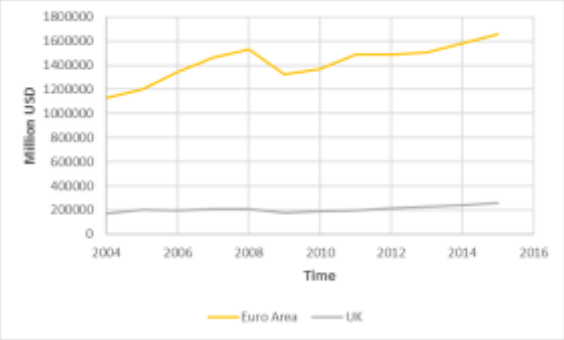
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average NIRP growth	Growth from 12	Growth from 14	Growth 2012-2013
Denmark	785450	1266431	1572593	1520302	1082474	1288612	1469926	1381447	1504446	1644882	1831918	2108733	39.63%	39.63%	14.67%	9.33%
Sweden	1976067	2629601	3349292	3199975	2466662	3312226	3748985	3324895	3655229	4124003	4648357	5198232	11.83%	42.21%	11.83%	12.82%
Switzerland	368367	419868	471896	477705	338460	392165	397101	380921	406567	463276	504514	511593	1.40%	25.85%	1.40%	13.97%
Euro Area	4648392	5346109	5962997	5782162	4335677	4492565	4530385	4285619	4623891	5246956	5568682	5975756	29.24%	29.24%	7.31%	13.47%
UK	559515	626609	665859	665764	478917	643083	729119	635202	597138	688245	777956	694748	16.35%	16.35%	-10.70%	15.26%

Notes: *Equity and investment fund shares are the net position of assets held by households, measured in millions local currency.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *Datastream (Eurostat). The growth rates are self-calculated. "Average NIRP growth" is calculated based on the years following the NIRP implementation, while "Growth from 12" and "Growth from 14" are based on the years 2012-2015 and 2014-2015, respectively. "Growth 2012-2013" is based on the values from the years 2012-2013.*

Appendix 9: Historical development and growth rates of corporate GFCF investments

A. Historical development plots





B. Development figures and growth rates

Corporate GFCF investments, million USD													Growth			
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average NIRP	From 2012	From 2014	2012-2013
Denmark	21293,3	21787,42	25641	27462,63	29708,56	27169,13	24850,18	25781,21	27379,03	30292,12	30235,14	32020,51	16,95%	16,95%	5,90%	10,64%
Sweden	44423,43	46510,13	53718,59	61343,72	65597,66	55435,01	57566,2	63796,92	66601,34	67684,14	72495,39	78128,81	7,77%	17,31%	7,77%	1,63%
Switzerland	47363,86	49597,64	56684,8	64273,72	67438,93	61643,69	63853,65	71496,39	76735,97	79898,06	84602,13	87179,6	3,05%	13,61%	3,05%	4,12%
Euro Area	1131861	1196599	1341256	1464947	1533558	1326640	1368838	1487511	1490530	1507658	1581928	1655811	11,09%	11,09%	4,67%	1,15%
UK	169208	200379,1	198143,4	208155,7	210215,7	177469,9	187872,8	197735	215953,6	226920,5	239248,6	256524,7	18,79%	18,79%	7,22%	5,08%

Notes: *GFCF is gross fixed capital formation, and consists of resident producers' acquisitions, less disposals, of fixed assets.* ***Last observation:*** *End of year 2015 for all economies.* ***Source:*** *Self-calculated figures based on OECD data of GFCF investments in million USD, and corporate share of GFCF investments. The growth rates are self-calculated. "Average NIRP growth" is calculated based on the years following the NIRP implementation, while "Growth from 12" and "Growth from 14" are based on the years 2012-2015 and 2014-2015, respectively. "Growth 2012-2013" is based on the values from the years 2012-2013.*

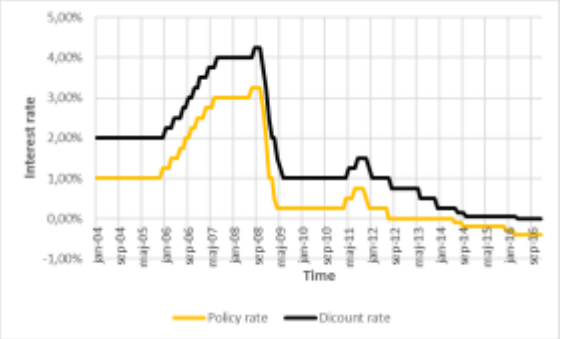
Appendix 10: Historical development of the policy and discount rates

A. Denmark

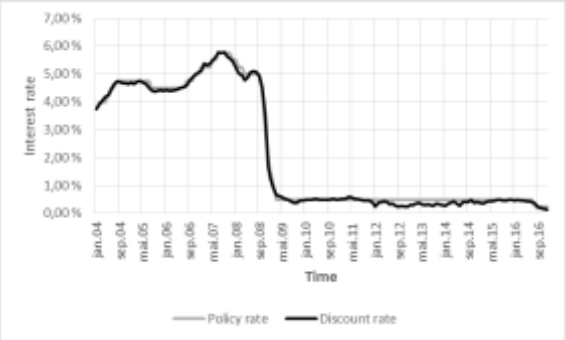
B. Sweden

C. Switzerland

D. Euro Area



E. United Kingdom

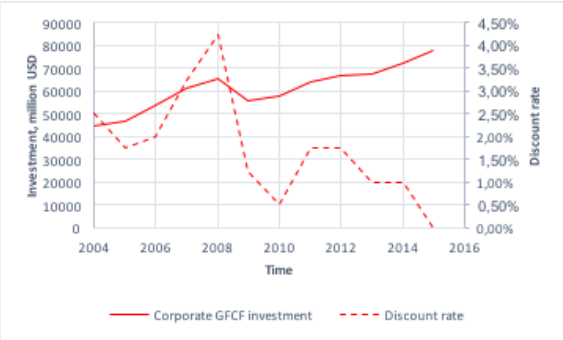


Notes: *Last observation in December 2016 for all economies. Relevant discount rates: A. Official discount rate (current-account rate = DKfolio), B. Discount policy reference rate, C. SARON end of day overnight rate, D. Discount rate (Short-term euro repo rate), E. Discount rate/3m t-bill. Relevant policy rates are the A. Certificate of Deposit rate B. Repo rate C. Sight Deposit rate D. Deposit Facility rate E. Official Bank rate.* ***Sources:*** *Downloaded from A. Danmarks Nationalbank and Datastream (Danmarks Nationalbank), B. Sveriges Riksbank and Datastream (Sveriges Riksbank), C. Swiss National Bank, D. European Central Bank and Datastream (European Central Bank), E. Bank of England and Datastream (Bank of England).*

Appendix 11: Historical development of the discount rates and corporate GFCF investments

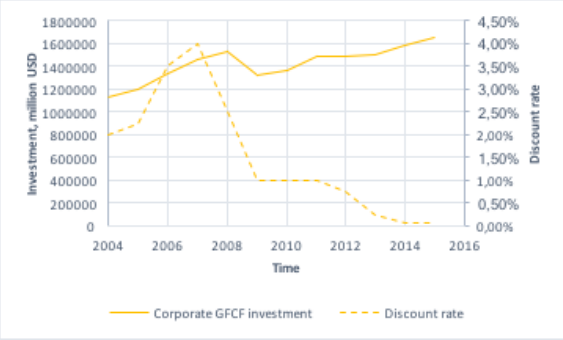
A. Denmark

B. Sweden

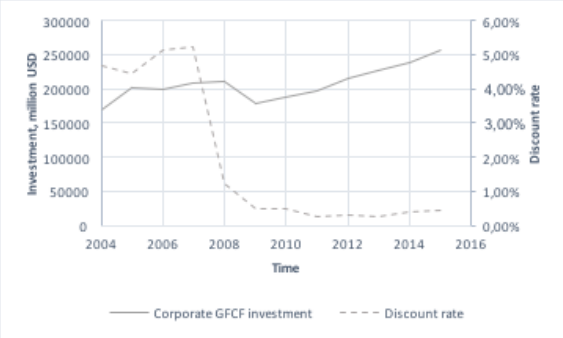


C. Switzerland

D. Euro Area



E. United Kingdom



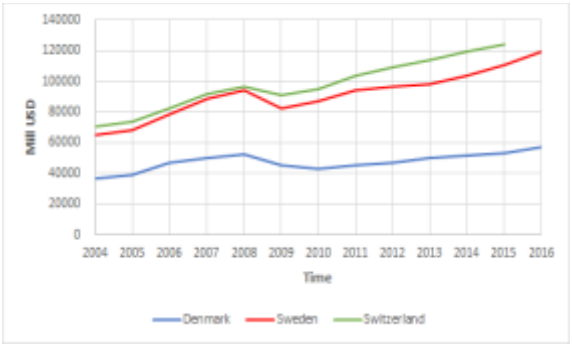
Notes: Last observation: *End of year 2015 for the discount rate in all economies, corporate GFCF investments end of year 2015 for all economies. All figures annualized. Relevant discount rates: A. Official discount rate (current-account rate = DKfolio), B. Discount policy reference rate, C. Discount rate, D. Discount rate (Short-term euro repo rate), E. Discount rate (3-month t-bill rate)* ***Sources:*** *Downloaded from Datastream (Danmarks Nationalbank/Sveriges Riksbank/IMF/European Central Bank/Bank of England) and self-calculated figured based on OECD data on GFCF investments and corporate investment shares of GFCF.*

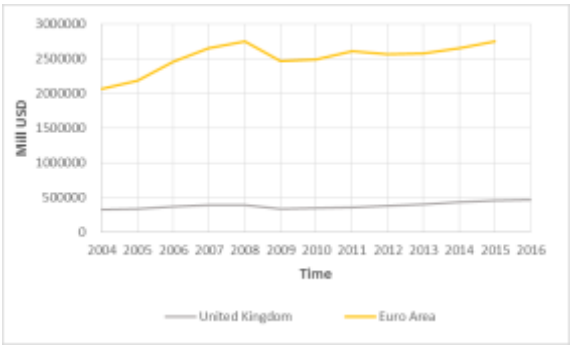
Appendix 12: Historical development and growth rates of GFCF investments

	GFCF (mill USD)												Growth rates				
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average NIRP	Average annual NIRP	From 2012	From 2014	2012-2015
Denmark	36776	39186	47221	50023	52029	44982	43293	44915	47043	49987	51684	53546	57224	21,64%	4,33%	21,64%	10,72%	6,26%
Sweden	65137	67898	78193	88647	93845	82370	86958	93819	96384	97951	103713	110823	118954	14,70%	4,90%	23,42%	14,70%	1,63%
Switzerland	70798	73587	82033	91558	96756	90786	94598	105468	109155	113653	119526	123859		3,63%	1,82%	13,29%	3,63%	4,12%
Euro Area	2069215	2187566	2452022	2653890	2748311	2470466	2493329	2609669	2569880	2577194	2649796	2750517		7,03%	1,76%	7,03%	3,80%	0,26%
United Kingdom	328027	339051	367613	389078	386426	333590	350509	361490	380200	403056	436585	460547	488141	23,13%	4,63%	23,13%	7,23%	6,01%

Notes: *Last observation end of year 2016 for Denmark, Sweden and United Kingdom. End of year 2015 for Switzerland and Euro Area.* ***Source:*** *OECD data. The growth rates are self-calculated. "Average NIRP growth" is calculated based on the available data following the NIRP implementation, and United Kingdom growth is based on the years 2012-2016. "Average annual growth" is calculated as "Average NIRP" growth divided by number of years. "Growth from 12" and "Growth from 14" are based on the years 2012-2016 and 2014-2016, respectively.*

Appendix 13: Historical development of GFCF investments





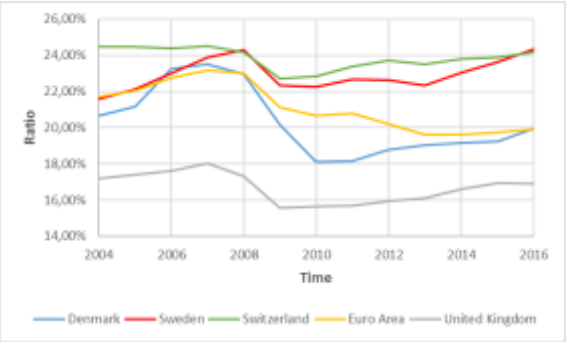
Notes: Last observation: *End of year 2015 for Switzerland and Euro Area, end of year 2016 for all other economies.* ***Source:*** *OECD data.*

Appendix 14: Investment to GDP ratio

	2012	2013	2014	2015	2016	2017
Denmark	18,78%	19,05%	19,16%	19,23%	19,94%	20,26%
Sweden	22,64%	22,34%	23,05%	23,65%	24,34%	24,58%
Switzerland	23,70%	23,50%	23,80%	23,89%	24,16%	24,17%
Euro Area	20,22%	19,60%	19,60%	19,73%	19,92%	20,22%
United Kingdom	15,93%	16,11%	16,60%	16,93%	16,89%	16,84%

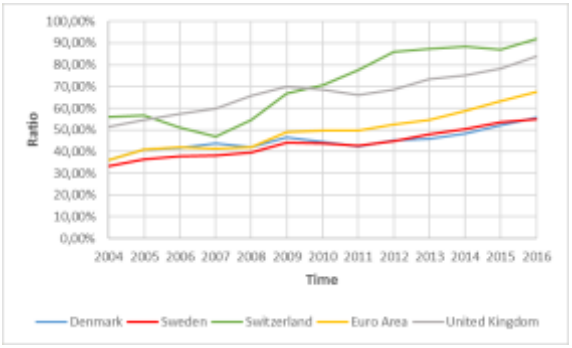
Notes: Last observation: *February 2017 for GDP and GFCF in all economies.* ***Source:*** *Datastream (DG ECFIN AMECO).*

Appendix 15: Historical development of GFCF to GDP ratio



Notes: Last observation: *February 2017 for GDP and GFCF in all economies.* ***Source:*** *Datastream (DG ECFIN AMECO).*

Appendix 16: Historical development of Money supply to GDP ratio



Notes: Last observation: *End of year 2016 for all economies.* ***Source:*** *Self-calculated ratios based on money supply data from Datastream (OECD) and GDP data from Datastream ((DG ECFIN AMECO).*

Appendix 17: Money supply to GDP

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Growth 2012-2016	Growth 2014-2016
Denmark	36,04%	40,89%	41,83%	43,77%	42,22%	46,52%	44,59%	42,57%	45,33%	45,98%	48,34%	52,00%	55,77%	23,01%	15,36%
Sweden	33,30%	36,44%	37,96%	38,39%	39,63%	44,04%	43,85%	42,60%	44,83%	47,85%	50,37%	53,71%	55,03%	22,74%	9,25%
Switzerlan	56,03%	56,75%	51,28%	46,87%	54,49%	66,90%	70,79%	77,53%	85,85%	87,30%	88,30%	86,98%	91,76%	6,89%	3,93%
Euro Area	36,12%	41,16%	42,21%	41,50%	41,89%	49,05%	49,81%	49,66%	52,37%	54,63%	58,89%	63,42%	67,39%	28,67%	14,43%
United Kin	51,39%	54,74%	57,42%	59,99%	65,78%	69,96%	68,65%	66,23%	68,57%	73,32%	75,15%	78,21%	84,03%	22,56%	11,82%

Notes: Last observation: *End of year 2016 for all economies.* ***Source:*** *Self-calculated ratios based on money supply data from Datastream (OECD) and GDP data from Datastream ((DG ECFIN AMECO). "Growth 2012-2016" and "Growth from 2014-2016" are based on the periods 2012-2016 and 2014-2016, respectively.*

Appendix 18: Production of capital goods to production of consumer goods

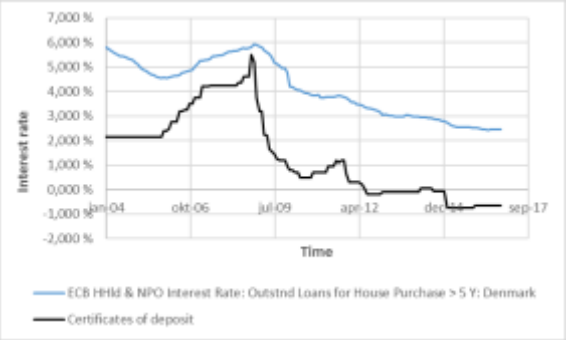
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark	92,38%	88,21%	95,87%	104,69%	113,98%	102,95%	100,19%	103,96%	99,85%	100,47%	96,71%	106,12%	108,59%
Sweden	94,23%	100,12%	101,73%	119,36%	121,54%	90,62%	99,47%	95,21%	89,70%	84,12%	82,05%	92,58%	97,01%
Switzerland													
Euro Area	100,76%	102,88%	106,61%	111,33%	112,87%	94,21%	100,01%	107,40%	108,94%	108,85%	107,97%	109,25%	109,88%
United Kin	94,13%	93,75%	96,88%	100,06%	99,02%	89,59%	99,98%	107,13%	112,25%	114,66%	116,17%	114,15%	115,69%

Notes: Last observation: *End of year 2016 for all economies, Swiss data is missing.* ***Source:*** *Self-calculated ratios based on production of capital goods data and production of consumer goods data from Datastream (Eurostat).*

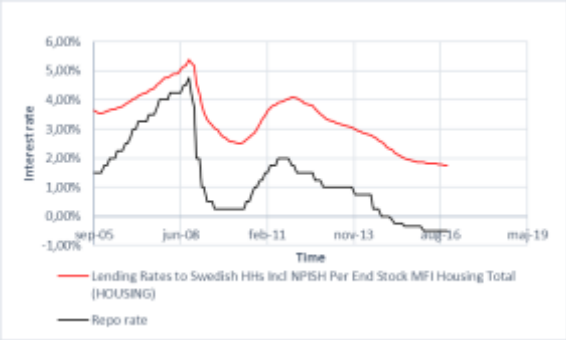
Appendix 19: Historical development of the policy and commercial lending rates

A. Household mortgage rates and the key policy rate

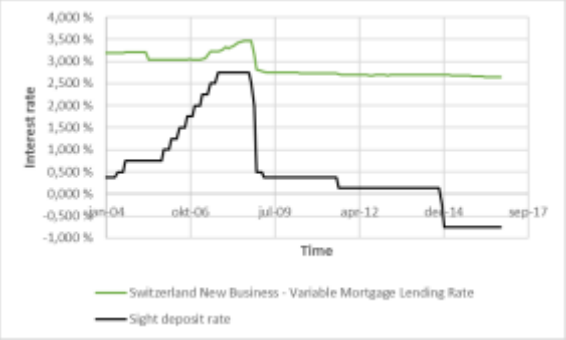
Denmark



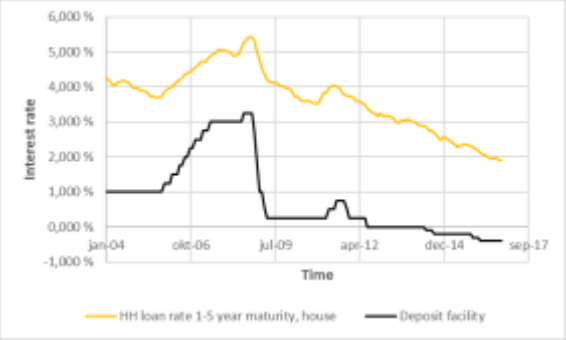
Sweden



Switzerland



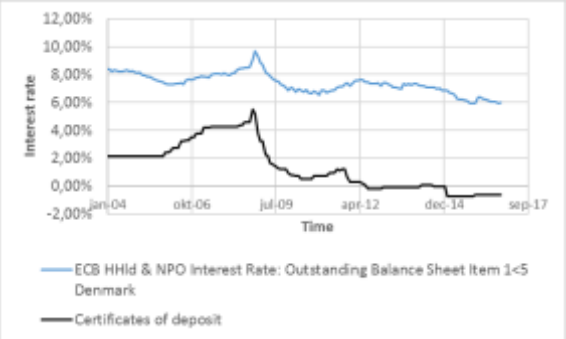
Euro Area



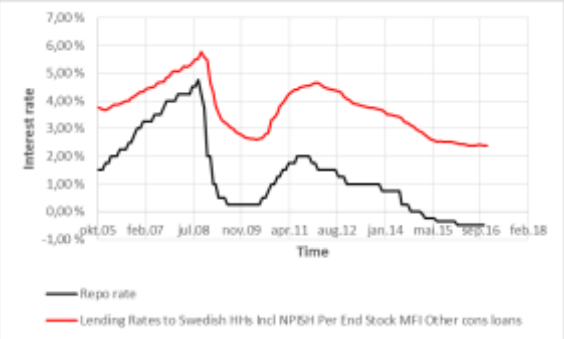
United Kingdom

B. Consumer loan rates and the key policy rate

Denmark

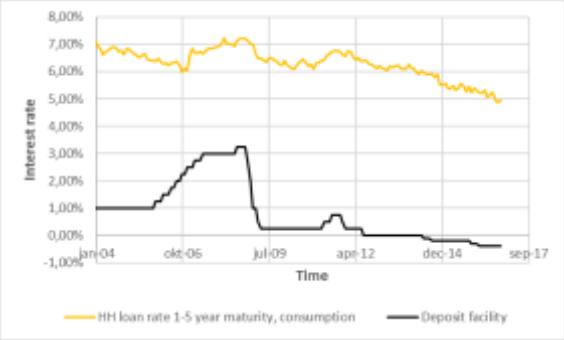


Sweden

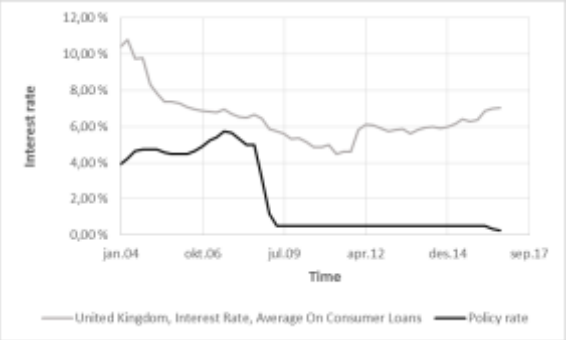


Switzerland

Euro Area

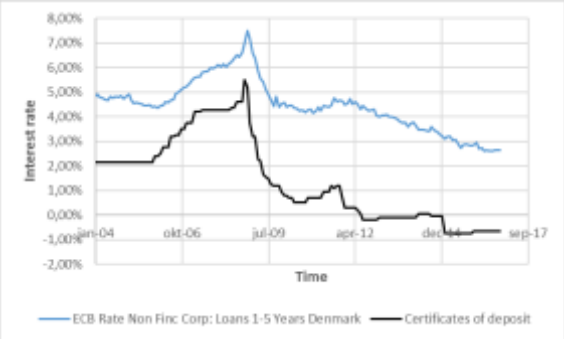


E. United Kingdom

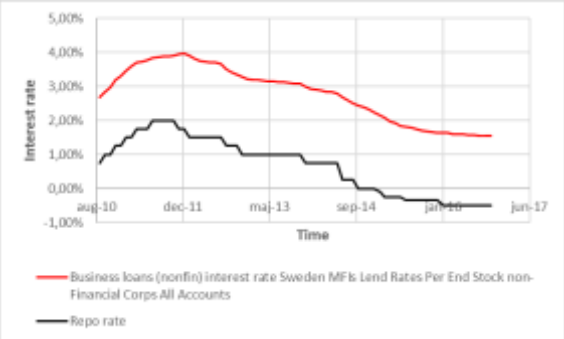


C. Corporate loan rates and the key policy rate

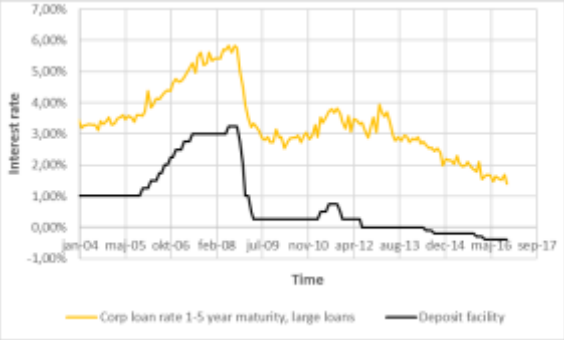
Denmark



Sweden



Euro Area



United Kingdom

Notes: *The historical data for the mortgage rate in Sweden is only available from September 2005, and the UK rate from Q1 2009. Historical consumer loans rate in Sweden only available from October 2005. Historical corporate loans rate for Sweden only available from September 2010.* ***Last observation:*** *Third quarter 2016 for the mortgage rate in the UK, fourth quarter 2016 for the consumer loan rate in Switzerland and the UK, November 2016 for all other rates and economies.* ***A.*** *Relevant lending rates: Denmark, outstanding loans for house purchase with duration >5Y; Sweden, lending rates for house purchase; Switzerland, variable mortgage lending rate for new business; Euro Area, household mortgage rate with duration 1-5Y; United Kingdom, fixed mortgage lending rate 1-5Y. Source: Bloomberg and Datastream (European Mortgage Federation) for the UK.* ***B.*** *Relevant lending rates: Denmark, household outstanding balance sheet item with duration 1-5Y; Sweden, household lending rates for other consumer loans; Switzerland, average rate on consumer loans; Euro Area, consumption loan rate with duration 1-5Y; United Kingdom, average rate on consumer loans. Source: Datastream (Oxford Economics) for Switzerland and the UK and Bloomberg for the other economies.* ***C.*** *Relevant lending rates: Denmark, rate for non-financial corporations with duration 1-5Y; Sweden, rate for non-financial corporations, all accounts; Switzerland, NO DATA; Euro Area, large corporate loans with duration 1-5Y; United Kingdom, fixed non-financial corporations' loans rate. Source: Bloomberg and Datastream (Bank of England) for the UK.*

Appendix 20: Correlation coefficients TFP and the cycle

Business cycle/TFP correlation		
	Historical	NIRP
Denmark	0,65151921	0,93033897
Sweden	0,79650151	0,99890639
Switzerland	0,56364888	-0,08369147
Euro Area	0,87715126	0,92964299
UK	0,8761842	0,80663081

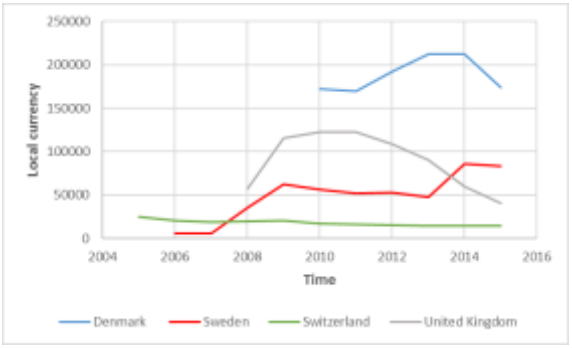
Notes: Sources: *Self-calculated numbers based on business cycle data from OECD statistics (ratio to trend GDP is part of the Composite Leading Indicators dataset) and TFP index data from Datastream (DG ECFIN AMECO).*

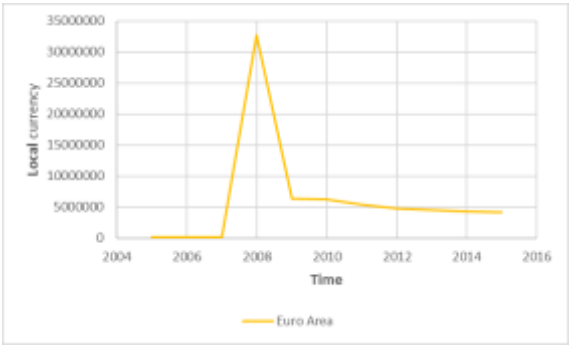
Appendix 21: Growth rates of TFP and the business cycle

Business cycles - annual average - ratio to trend																	
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Growth 12-13	Growth 13-14	Growth 14-15	Growth 15-16
Denmark	99,9666667	99,7583333	102,125	102,35	101,7166667	97,1166667	99,9166667	100,0166667	99,6833333	99,6666667	100,175	100,508333	100,1666667	-0,02%	0,01%	0,33%	-0,35%
Sweden	99,375	99,475	101,8666667	103,2916667	101,425	96,725	99,6916667	101,283333	99,7083333	99,8333333	99,3416667	100,5	100,6666667	-0,78%	0,41%	1,17%	0,49%
Switzerland	99,8333333	99,1166667	100,4416667	102,0416667	102,825	99,4583333	99,5416667	100,0166667	99,85	99,8916667	100,433333	99,5333333	99,8666667	0,34%	0,44%	-0,69%	-0,87%
Euro Area	99,8416667	99,9416667	100,8333333	102,458333	101,975	97,7	99,475	100,0166667	99,8583333	99	99,425	100,258333	100,7444444	-0,86%	0,43%	0,84%	0,48%
UK	99,85833333	100,266667	101,1883333	102,658333	101,516667	97,3	99,7833333	99,4833333	99,525	99,8416667	100,533333	100,483333	100,2	0,42%	0,09%	-0,05%	-0,28%
														Deviations			
TFP index																	
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Growth 12-13	Growth 13-14	Growth 14-15	Growth 15-16
Denmark	101,7766	102,5416	103,908	102,3828	100,3633	96,9119	100	101,2028	101,6916	102,3543	103,0855	103,5849	103,8024	0,66%	0,69%	0,43%	0,41%
Sweden	99,9635	99,6739	101,3173	102,2839	100,1803	95,5276	100	100,6884	99,2368	99,2213	100,2116	102,4547	103,4056	0,82%	1,08%	2,24%	1,12%
Switzerland	99,9635	99,9673	99,338	99,9176	100,1886	97,5774	100	99,9651	99,8884	100,2133	100,6761	100,1992	101,1167	0,32%	0,48%	0,48%	0,92%
Euro Area	100,2032	100,5443	101,8539	102,5109	101,6843	97,9697	100	101,3079	100,2599	100,2439	100,8456	102,6148	102,8983	0,02%	0,58%	1,16%	0,28%
UK	100,316	101,9143	103,1475	104,4571	102,5274	98,6714	100	100,7764	100,994	101,7332	102,8344	103,364	104,8259	0,73%	1,08%	0,52%	0,64%

Notes: Sources: *The growth rates are self-calculated based on business cycle data from OECD statistics (ratio to trend GDP is part of the Composite Leading Indicators dataset) and TFP index data from Datastream (DG ECFIN AMECO).*

Appendix 22: Historical development of non-performing loans

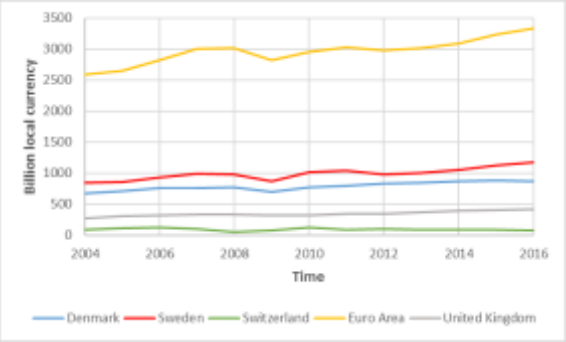




Notes: Last observation: *End of year 2015 for all economies.* ***Sources:*** *IMF data.*

Appendix 23: Historical development of corporate profits

A. Historical development plots



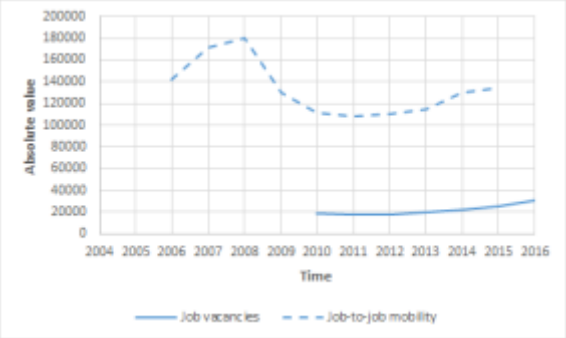
B. Development figures

Corporate profits (billions, local currency)					
	2012	**2013**	**2014**	**2015**	**2016**
Denmark	826,447	843,837	864,779	882,529	870,109
Sweden	979,534	996,3	1045,343	1127,435	1174,469
Switzerland	92,915	91,784	83,354	84,889	73,958
Euro Area	2980,688	3017,99	3092,386	3229,609	3332,394
United Kingdc	345,502	364,98	394,289	398,839	413,541

Notes: Last observation: *End of year 2016 for all economies.* ***Sources:*** *Datastream (Oxford Economics).*

Appendix 24: A Historical development of job vacancies and job-to-job mobility

A. Denmark

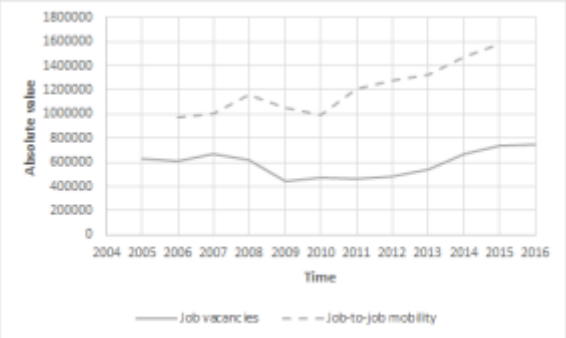


B. Sweden

C. Switzerland

D. Euro Area

E. United Kingdom



Notes: Last observation: *Job vacancies, end of year 2016 for all economies and job-to-job mobility, last observation end of year 2015 for all economies.* ***Source:*** *Job vacancies: Trading Economics. Euro Area numbers are self-calculated based on data from Trading Economics. Job-to-job mobility: Eurostat.*