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# Comparing the Taylor Rule to the European Central Bank interest rate on the main refinancing operations during the recent financial crisis

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# Abstract

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The monetary policy of the European Central Bank has been a topic of discussion recently due to introduction of the record low key interest rates. Especially since the European Central Bank has been conducting monetary policy for the Euro area only for 16 years. The Taylor Rule is a monetary policy rule for calculating what the interest rate should be taken into account the prevalent economical conditions.

The primary objective of this Bachelor's thesis is to calculate the interest rate given by the monetary policy rule called the Taylor Rule and compare the result to the European Central Bank's interest rate on the main refinancing operations during the recent financial crisis.

The theoretical framework focuses on providing a sufficient background for the empirical part of the study. The theory part includes examination of monetary policy and monetary policy rules, a deeper look into the Taylor Rule and it concludes with theory about reasons for banking crises and the timeframe of the recent financial crisis.

The timeframe of the study is 2000-2014 with the study being conducted at the end of 2014 and during the spring of 2015. The empirical part of the study is done using quantitative methods.

The research reported in this thesis was able to answer the primary research question: how does the interest rate calculated using the Taylor Rule compare to the European Central Bank's interest rate on the main refinancing operations? The research also provided answers to the secondary research questions on the accuracy and variation between the Taylor Rule and the ECB steering rate. The results show that the Taylor Rule follows the path of the European Central Bank's steering rate and in most parts mimics the fluctuations in the European Central Bank's steering rate, but the Taylor Rule has been more volatile.

**Keywords**
Monetary policy, monetary policy rule, Taylor Rule, interest rate on the main refinancing operations, European Central Bank, financial crisis

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# 1 Introduction

During and after the recent financial crisis that started in 2007 the money markets have been uncertain and tumultuous. The interest rates set by the central banks have been shifting up and down and the markets have been unpredictable. The European Central Bank's interest rate on the main refinancing operations, known as the ECB steering rate is the most important steering rate in the European Monetary Union. Most recently the steering rate of the ECB has steadily declined and come close to zero, with the Governing Council of the European Central Bank making the decision to lower the steering rate to be 0.05% on 4th of September 2014, with the decision becoming effective on 10th of September 2014. This highly intriguing phenomenon has inspired the following research and it makes the research interesting, as the interest rates are an important part of keeping the inflation in control and maintaining a well-functioning economy.

The impact of monetary policy and its effect on the money markets and the economy have been of interest to me during my business studies. Working in a bank and seeing the effect of interest rates in practice towards all lending and thus the consumers have piqued my interest to study interest rate setting and monetary policy rules. Therefore the research is based not only on its topical issues but also on personal interest on the subject matter.

An interesting question in regard to monetary policy rules directed towards interest rates is whether they have been accurate in determining the interest rate set by the central banks, and if they could and should be used as a guideline in the future. The discretion sets the interest rate based on a set of variables and it is intriguing to see whether a monetary policy rule can provide a result that is similar to the actual interest rate set by the central bank.

## 1.1 The research problem and demarcation

The objective of this thesis is to calculate the interest rate using the Taylor Rule and compare the outcome with what has been the short-term interest rate set by the European Central Bank with the timeframe of 2000-2014, focusing on the recent financial crisis.

The primary research question is

- How does the interest rate calculated using the Taylor Rule compare to the European Central Bank interest rate on the main refinancing operations during the recent financial crisis?

The secondary research questions are

- Has the Taylor Rule been accurate in determining the interest rate on the main refinancing operations set by the European Central Bank?
- How has the interest rate calculated using the Taylor Rule varied from the ECB steering rate during the financial crisis?

The study focuses on interest rates for the timeframe of 2000-2014 so that it includes the recent financial crisis that started in 2007, but also a period of time before the crisis as well as the time after the beginning of the crisis. The main reason for including time before and after the financial crisis is to see if there has been variation between the Taylor Rule and the ECB steering rate before and after the financial crisis, or has there been no variation at all.

### 1.2 Research methods

The theory section of this thesis is based on literature review consisting of relevant journals and books in order to create a good overview of the background of this study. After theory the empirical part is introduced, in which the research method used was quantitative. Quantitative method was used since the data with which the Taylor Rule is calculated and the data for the ECB steering rate is numerical and vast. Quantitative methods are also used to compare the Taylor Rule and ECB steering rate and to compare both rates in correlation with each other during the recent financial crisis.

To find answers to the research questions, the European Central Bank steering rate is taken from the website of the ECB and data is collected for the variables of the Taylor Rule. The goal of the research is then to calculate the interest rate given by the Taylor Rule and compare it to the European Central Bank steering rate.

### 1.3 Structure of the research

Chapters 2-4 present the theory involved in this thesis. Chapter 2 focuses on monetary policy. It explains the monetary policy used by the European Central Bank, and it focuses specifically on the monetary policy instruments used by the ECB. Chapter 2 concludes with explaining monetary policy rules. In chapter 3 the focus is on the Taylor Rule, which is a specific monetary policy rule and the chapter discloses the history of the rule briefly as well as how the Taylor Rule is calculated. Chapter 4 looks deeper into the causes of banking crises.

After the theoretical part has been examined, chapter 5 introduces the empirical part of the research. In chapter 5 the data collected is presented and analysed. Chapter 6 concludes the thesis with the discussion of the results, suggestions for further research and evaluation of the validity and reliability of the research.

### 1.4 Previous research

Taylor presented his original rule to describe the situation in the United States and its Federal Reserve interest rate setting (Taylor 1993). After its introduction the use of the Taylor Rule has been extensively researched not only in regards to the United States but also in regards to other countries. The Taylor Rule has also been expanded on and for example Orphanides (2007) and Clarida, Galí & Gertler (2000) have suggested variations to try to improve the rule.

Since the introduction of European Monetary Union and the European Central Bank, the Taylor Rule has also been examined in relation to the Euro area for example by Gerlach & Schnabel (2000), Sauer & Strum (2007) and Gerlach-Kristen (2003), however these studies have mainly focused on the time before the recent financial crisis. Based on the literature review, there is only limited number of research available on the Taylor Rule and recent financial crisis, especially in relation to the Euro area.

### 1.5 Abbreviations

The key abbreviations used in the following research are:

ECB = European Central Bank

ECB steering rate = European Central Bank interest rate on the main refinancing operations

Eurosystem = The European Central Bank and the national central banks of those EU member states that have adopted the Euro

Euro area = Those European Union member countries that have adapted the Euro

GDP = Gross Domestic Product

TR = Taylor Rule

# 2 Monetary policy

Monetary policy is practiced by the central bank of a country or a monetary union. Monetary policy is comprised of the actions that central banks take to regulate the amount of money in circulation (Pohjola 2012, 184). It is maintained through changes in the money supply. The central bank is the only issuer of banknotes and bank reserves and thus it is the monopoly supplier of the monetary base. (Sloman & Wride 2009, 512; Krugman, Obstfeld & Melitz 2012, 467; European Central Bank 2004, 71.)

Monetary policy can be either expansionary or contractionary. Expansionary monetary policy is used when economic growth has unexpectedly slowed down and the output goes below its potential level. Expansionary monetary policy is directed towards increasing the aggregate demand and restoring total employment. Contractionary monetary policy on the other hand is used when inflation pressure occurs. It is used to control and limit inflation and thus maintain the objective of price stability. (Tervala 2010.)

## 2.1 Monetary policy in the European Union

Starting from 1 January 1999 the European Central Bank has been responsible for conducting monetary policy in the euro area (European Central Bank 2015a). The ECB is independent from political influence. The main objective of monetary policy of the ECB is to maintain price stability in the Euro area, which in practice is defined by the Governing Council of the ECB as having a goal of keeping the annual change in inflation below but close to 2% over the medium term. While maintaining the primary objective of price stability, the ECB also supports the general economic policies, which include a high level of employment, sustainable and balanced economic growth and a high degree of competitiveness. (Pohjola 2012, 190; European Central Bank 2015b; European Central Bank 2015c; European Central Bank 2004.)

The monetary policy decisions are made by the Governing Council of the ECB. The Governing Council of the ECB includes the six members of the Executive Board and the governors of the Euro area national central banks, which in March 2015 included representatives from 19 countries (European Central Bank 2015d). The Executive Board consists of the president and the vice-president of the ECB and four other members appointed by the heads of states or government of the euro area countries. The Executive Board prepares the Governing Council meetings and implements monetary policy in accordance with the decisions and guidelines made by the Governing Council. The Governing Council is chaired by the President of the ECB or in his absence the Vice-President. One of the key

responsibilities of the Governing Council is to formulate the monetary policy for the euro area, which includes decisions about the key interest rates, the objectives of monetary policy, the supplies of reserves in the Eurosystem and establishing guidelines for implementing those decisions. They usually meet twice a month to assess the economic situation and monetary developments and to make monetary policy decisions. (European Central Bank 2015e; European Central Bank 2004, 10-11.)

In maintaining monetary policy it is important that a central bank is as transparent in its actions as possible. This means that it clearly explains its mandate and how it is interpreted, and that the central bank is forthcoming with the rationale behind its policy decisions and the principles of policy setting. This transparency assists the public in evaluating and monitoring the central bank's performance as it shows the banks credibility, provides markets a guidance to the forthcoming policy decisions and helps decision makers impose self-discipline. (European Central Bank 2004, 66-70.)

### 2.1.1 Importance of price stability

As stated before, the main objective of the monetary policy of the ECB is maintaining price stability, which refers to the goal of avoiding change in the level of prices, known as inflation or deflation. There have been many economic studies in the past confirming that the costs of either inflation or deflation are substantial and therefore it is nowadays widely acknowledged that price stability contributes to the potential for economic growth. (European Central Bank 2004, 42-55.)

Price stability contributes to the economic growth in many ways. It makes it easier for consumers and companies to notice changes in relative prices and thus make more well informed decisions about investments which leads to efficient allocation of market resources. Another benefit of maintaining credible price stability is that it makes the diverting of resources by individuals and firms to protect themselves from inflation more unlikely. In general monetary policy is seen as being effective if it stabilises and keeps inflation expectations in check. In order to practice effective monetary policy a central bank needs to specify its objective and communicate it to the general public. It should stick to a systematic method for conducting monetary policy and be consistent in its actions. These are key factors in achieving a high level of credibility, which is considered a necessity for maintaining and influencing expectations of economic factors. (European Central Bank 2004, 42-55.)

The ECB aims to pursue price stability in the medium term, which means that it does not attempt to correct small fluctuations and it does not attempt to fine-tune economic prospects within a timeframe of a few weeks or months. As the objective is to attain medium term price stability, the Governing Council is able to take other factors in to the decision making process, without having to take actions to correct inevitable short term volatility in the inflation. (European Central Bank 2004, 42-55.)

### 2.2 Monetary policy instruments

In order to conduct its monetary policy, central banks have different kinds of monetary policy instruments and they base their monetary policy decisions on many different factors. The three main instruments used by ECB are minimum reserves, open market operations and standing facilities. (European Central Bank 2014, 10-13; Pohjola 2012, 188-189.)

While a variety of monetary policy instruments are used in the operation of monetary policy, the most important one is the interest on the main refinancing operations. The changes in the interest rate on the main refinancing operations reflect heavily in the short-term money-market rates and the rate affects not only market prices but macroeconomic developments as well. The interest rate on main refinancing operations is an open market operation. (European Central Bank 2004, 73-74; Suomen Pankki 2015a; Suomen Pankki 2015b.)

#### 2.2.1 Minimum reserves

ECB requires all credit institutions to have in their accounts that they hold in national central banks compulsory deposits, which are called minimum reserves. The amount of the required reserves depends on each institutions own reserve base, which is defined in relation to the elements of its balance sheet. These deposits can be in many different forms, but the simplest version is that the central bank requires the credit institution to hold a minimum percentage of the deposits in cash or other liquid assets. (Sloman & Wride 2009, 574; European Central Bank 2004, 77.)

The main purpose of the minimum reserves is to stabilise the money market interest rates and to add to the structural liquidity shortage of the banking system. The fact that the credit institutions are required to hold reserves with their national central banks increases the demand for central bank refinancing. Because there is then more demand for central bank refinancing, it makes it easier for the ECB to steer money market rates. By heightening the minimum reserve ratio of a credit institution the central bank can tighten the lend-

ing of the institution and thus reduce the money supply. (Pohjola 2012, 188; European Central Bank 2004, 79.)

### 2.2.2 Open market operations

The interest rate setting is currently considered as the most important instrument of monetary policy. By changing the interest rate the central bank affects the demand for money that other banks want from it. (Pohjola 2012, 189.)

Open market operations are carried off on the initiative of the central bank. They are conducted in the money market, which means the market in which the maturity of transactions is usually less than a year. The purpose of open market operations in the monetary policy of the ECB is to guide the interest rates, manage liquidity in the market and indicate the stance of monetary policy. (European Central Bank 2014; European Central Bank 2004, 73-74.)

The open market operations of the ECB can be divided into four categories in accordance with their purpose, regularity and the procedures following them. The four categories are main refinancing operations, longer-term refinancing operations, fine-tuning operations and structural operations. The most important ones are the main refinancing operations that are done through the main refinancing rate, which is set by the Governing Council. The main refinancing operations are executed by the national central banks. (European Central Bank 2004, 79-80.)

The main refinancing operations are used by the ECB to lend money to its counterparties. The European Central Bank interest rate on the main refinancing operations known as the ECB steering rate, is the level of interest that the central bank uses when it is lending money to its counterparties. The lending is always done against collateral so that the Eurosystem is protected from financing risks. In the open market operations the lending occurs through reverse transactions. In this kind of reverse transactions the central bank buys assets that have a repurchase agreement, or it grants loans against assets with collateral. The reverse transactions are temporary open market operations in which the counterparties only get a limited amount of funds for a previously specified time period. (European Central Bank 2004, 74-80.)

### 2.2.3 Standing facilities

In order to control and to restrict the volatility of the short-term interest rates in the money market, the Eurosystem offers two standing facilities to its counterparties. These are the

marginal lending facility and the deposit facility, which the counterparties are allowed to use by their own initiative. (European Central Bank 2004, 74.)

As the interest rate is lowered, banks add to their credit giving to the public as they know that the price of money from the central bank is cheaper, and thus there is more money for the public. In the other case when the interest rate rises, it becomes more expensive for the banks to loan money from the central bank, so they tighten their lending and thus reduce the amount of money in circulation. (Pohjola 2012, 190.)

### 2.3 Monetary policy rules

The broad definition for monetary policy rules most commonly means a plan of action for implementing monetary policy. There are different kinds of monetary policy rules with different main targets. There are ones directed towards interest rates which includes the most well-known monetary policy rule, the Taylor Rule that is the focus of this research and will be explained more in chapter 3. Other kinds of policy rules focus on for example exchange rates or policies towards money supply. (Peura 1999.)

Monetary policy rules have been a subject of interest in monetary policy ever since the arrival of economics, as they have been often suggested and wildly researched (Taylor & Williams 2010). The question that many economists including Taylor (1993) have been trying to resolve is whether the central banks should use a clear monetary policy rule when setting the interest rate, or should the decisions be made by discretion.

Many researchers including Taylor (2012) advocate the use of policy rules in general. As stated by Orphanides (2007, 1), “it is widely accepted that well designed monetary policy can counteract macroeconomic disturbances and dampen cyclical fluctuations in prices and employment, thereby improving overall economic stability and welfare”. The benefit of using a monetary policy rule is that it helps policymakers stick to long-term goals, even if a temporary deviation from the rule might create a short run solution. When trying to reach long-term goals it is important to keep with the rule, as sometimes a short-term gain might be harmful for the long-term goal. Using the rules as a guidepost also forces the policymakers to disclose to the public their reasons for deviating from the rule. (Carlstrom & Fuerst 2003.)

# 3 Taylor Rule

The Taylor Rule, first introduced by its creator John B. Taylor (1993), is a monetary policy rule that determines how a central bank should set its short-term interest rate in accordance with inflation and the output gap. The nominal paper, in which the rule was originally presented in, focused on comparing the benefits of following a policy rule versus the monetary decisions made by discretion (Taylor, 1993).

The original rule as presented by Taylor (1993, 202) is as follows

$$\text{“}r = p + .5y + .5(p - 2) + 2$$

where

$r$ is the federal funds rate

$p$ is the inflation over previous four quarters

$y$ is the percent deviation of real GDP from a target”.

The original Taylor Rule has four components. The first one in the rule written by Taylor is the current rate of inflation ($p$). The second one is the percent deviation of real GDP from a target, which is the output gap ($y$). The third component is the Federal Reserves' long-term inflation target, which Taylor assumed to be 2. The last component is the “natural” real federal funds interest rate, which is also 2 in the original rule calculated by Taylor. (Carlstrom & Fuerst 2003; Taylor 1993.)

Taylor in his original study explained that even though “there is not a consensus about the size of coefficients of policy rules, it is useful to consider what a representative policy rule might look like” (Taylor 1993, 202). For his original policy rule he used coefficients 0,5 for the output gap and inflation from its target. These measures captured according to him the policy performance in recent years very well. (Taylor 1993, 202.)

Inflation is defined as the general increase in consumer prices. In the European Union it is measured using an index that has been harmonised across the EU members and is called the Harmonised Index of Consumer Prices (HICP). Inflation target in the EU is 2%. (European Central Bank 2015a; Tervala 2010, 165.)

Output, which is usually measured in terms of the gross domestic product (GDP) is the value of output produced in an economy over a certain time period, usually a year. Potential output is the sustainable level of output that an economy can produce when it is operating on a normal level of capacity. It is usually measured as the potential of the GDP.

These two are used to calculate the output gap, which is an economic measure of the difference between the actual output and the potential output of an economy. In the event that the actual output is bigger than the potential output, the output gap is positive. When the potential output exceeds the actual output the output gap is negative. (Sloman & Wride 2009, 393-399.)

Inflation and the output gap are both then given substantial value in determining the central banks' interest rate. In the Taylor Rule both of these figures are given the same relevance, meaning that the coefficients are the same 0,5 percentage each. (Tervala 2010, 166.)

Tervala (2010, 165) demonstrates a more general formula for calculating the classic rule without any set variables, which makes it more clear as to what each coefficient represents and he writes the rule as follows:

$$i_t = r_t^* + \pi_t + \alpha_\pi(\pi_t - \pi_t^T) + \alpha_y(y_t - y_t^p)$$

where

$i_t$ is the central banks nominal interest rate
$r_t^*$ is the nominal interest rate for long term goals
$\pi_t^T$ is the central banks' inflation target
$\pi_t$ is inflation
$y_t$ is the logarithm for GDP
$y_t^p$ is the logarithm of potential GDP.

The parameters $\alpha$ measure how strongly a central bank reacts to the changes in inflation and its target and to output and its target (Tervala 2010, 165).

The rule was originally tailored to the United States of America and it was calculated using the figures from the Federal Reserve, the central bank of United States of America and it examined the time period of 1984-1992. According to Taylor the rule was successful in describing the interest rate setting of the Federal Reserve at this time. (Taylor 1993, Tervala 2010.)

The primary reason for the success of the Taylor Rule is that it answers one of the main questions about monetary policy which is what should the central bank's steering rate be in the current economic situation (Tervala 2010). Furthermore, with his rule Taylor man-

aged to describe policy in terms of inflation and economic growth, which are the two main operational objectives of monetary policy (Orphanides 2003).

The Taylor Rule is of interest for both the central banks as well as academic researchers. For a central bank it gives information about the past and how the interest rate would have been set in those economic conditions. This may provide valuable data for policymakers deciding on future interest rates, as it provides background information about how the rule has been able to predict the steering rate in the past and they are able to analyse the history. For academics the Taylor Rule gives a model that examines the main considerations of central bank's interest rate setting. (Gerlach-Kristen 2003.)

### 3.1 The Taylor principle

As nominal interest rates normally rise one for one according to the movements in anticipated inflation, it would be pointless to raise the steering rate with one-to-one. To address this issue Taylor suggests the more-than-proportional reaction to the interest rate to inflation. (Carlstrom & Fuerst 2003.)

Thus an aspect of the rule, called the Taylor principle is that as inflation rises above the target rate of inflation, the central bank should raise the interest rate by more than one to one. The same applies to the output gap. According to the original TR if the inflation is at the target level and the output gap is zero, the nominal central banks interest rate should be 4 %. (Taylor 1993, 202; Tervala 2010, 166-167.)

What can be gathered from examining the Taylor Rule and the Taylor principle is that the effects on the economy are installed by trying to influence the real interest rate. An example of this is that when the output gap is positive to control the boom the real interest rate is increased. Vice versa when the economy is in a recession and the output gap is negative, the real interest rate is increased. (Tervala 2010, 167.)

### 3.2 Different versions of the rule

The original rule that Taylor designed looked at the figures from the Federal Reserve and it was meant for the US monetary policy. Since it's publication in 1993 the rule has been researched extensively. Some researchers further expanded on the rule while using US figures, while others made it fit to other countries and economies. A few of these cases are introduced here.

One important expansion is the one presented by for example Tervala (2010, 169), which takes into account that a central bank reacts to the changes in inflation and output gap only in small fractions. The central banks usually avoid changing the steering rate more than 0,25 or 0,5 percentages at a time and they tend to keep the steering rate moving to the same direction for a long period of time. Tervala (2010) for example presented a variation to the Taylor Rule, which includes a parameter to measure the movement pace of the steering rates. (Tervala 2010.)

A forward looking Taylor Rule has been widely researched, for example by Castro (2011) and Clarida, Galí & Gertler (2000). They make the classic Taylor Rule a forward looking rule by including to the formula coefficients to help estimate the future values of the coefficients. By using a forward looking rule they suggest that since policymakers do not have access to all the data as it is lagged, it would be more beneficial to use estimations of the future values of the coefficients.

### 3.2.1 Using the rule as a guidepost

As explained by Taylor (1993) and others such as Orphanides (2003) and Carlstrom & Fuerst (2003) after him, the narrow interpretation of a monetary policy rule by following a strict algebraic formula is not always reasonable. Rather the monetary policy seems to be more successful if the rule is used as a guidepost. If there is a rule that has in the past been able to follow and predict the interest rate set by the central banks, it should be taken into consideration by the discretion when making decisions about the future rates. (Taylor 1993, 197; Orphanides 2003, 985.)

Orphanides (2003) examined the value of using a Taylor Rule as a framework for monetary policy and he researched the broad interpretation of the Taylor Rule as opposed to the narrow interpretation, which is known as the classic Taylor Rule. It is important to understand a policy rule and how it works and for what reasons it has been so successful. The broad interpretation of the Taylor Rule gives flexibility as to how any monetary policy rule should be interpreted (Tervala 2010, 168).

# 4 Financial crisis of 2007-2008

The timeframe of this study is 2000-2014, which includes the banking crisis of 2007 that lead to the financial crisis of 2008 and the unsteadiness that has followed the global economy ever since. This chapter delves into some of the common reasons for banking crises.

## 4.1 Common reasons for banking crises

Because the amount of banking crises is still relatively limited, a lot of the research around them is done based on the same data and researchers simply apply new methods to examining the past banking crises. Many researchers focus their attention on the causes of banking crises and they try to determine how to anticipate the crises. However the fundamental reasons for banking crises and the leading indicators are not always the same and it is a difficult subject matter to try to research the causation from an economic point of view. The data is easily available for statistical analysis, but the economical reasons are much more difficult to find. (Kauko 2014.)

Despite the difficulties with finding common reasons for banking crises, there are a few general reasons that are supported by many researches as being the common indicators for a forthcoming banking crisis. (Kauko 2014.)

### 4.1.1 Overly rapid credit growth

One of the main reasons used to explain the banking crises in the world has been excessive lending. It should be within reason that the credit of a country should have a reasonable correlation with the size of the economy. For example the debt must not be the GDP multiplied by a thousand. (Kauko, 2014.)

Davis, Karim & Liadze (2011) researched the warning signs for different banking crises in the world, and found evidence that the GDP growth is an important determinant for banking crises and that rise of the domestic credit/GDP ratio is evident in banking crises.

### 4.1.2 Asset bubbles

Asset bubbles in general are defined as an asset having a price that is high and unjustified, in other words the price of an asset becomes over-inflated. This is furthered by investors who usually plan to buy an asset with the purpose of quickly selling it and thus sparking up the price without any real value to the asset. The term bubble refers to the forth-

coming burst where prices collapse quickly, which results in major losses to most parties. (Siegel 2003.)

There are different kind of asset bubbles, such as stock market bubbles or oil bubbles, but the focus in this research is the housing bubble of 2005 in the United States, which eventually led to the subprime mortgage crisis in 2006 and the banking and financial crises in 2007-2008 (Krugman 2009, 151-160). According to Kauko (2014) asset bubbles seem to be a working indicator for a forthcoming crisis, but the evidence is sparse.

When it comes to housing bubbles, it could be seen as a sensible opinion for banks to be lenient with their lending as long as the loans had proper collateral. However as was the case of the recent crisis, a lot of the loans were collateral based loans and while it was generally assumed that the house prices would continuously move upwards, the harsh reality was that they could not. When house prices started to decline and the houses started to lose their value, the debt started to pile up and suddenly the collateral was not worth the amount of the debt. This led to many credit institutions having to write up their debts as losses. The main problem was within the fact that banks and credit institutions in the United States had issued bonds based on the sub-prime loans also to many foreign countries. When the asset bubble burst and houses put as collateral started to be more and more worthless, the bonds lost their value and so when houses in the United States lost their value it led to a full banking crisis in the global scale. (Krugman 2009, 155-160.)

### 4.1.3 Current account deficit

A way to express the current account is “as the difference between the value of exports of goods and services and the value of imports of goods and services” (Ghosh & Ramakrishnan 2012). According to the definition a deficit then means that a country imports more goods and services than it exports. So in other words a deficit in the current account shows that a country’s foreign net debt has grown bigger. (Pohjola 2012.)

When considering financial stability Kauko (2012) suggests that the most problematic type of credit is foreign debt. In the latest financial crisis it was found that a current account deficit paired with a rapid credit growth was a risk factor in the global banking crisis. Rapid credit growth in itself was not found to be a contributing factor but rather credit growth without current account deficit seemed to prevent problems. (Kauko 2012.)

### 4.1.4 Other reasons

There have been various other suggested reasons for banking crises and the different coefficients have been extensively researched, but the results for these often seem weak and contradictory. The role of GDP has been researched and it has been found that during the time leading right up to the crisis the GDP growth is slow, but two years prior of the crisis the growth is fast. (Kauko 2014.)

Another factors that have been researched and gotten positive results as indicators for banking crises is periods of low GDP growth, interest rates that are high, inflation being high as well as large fiscal deficits. (Davis & al. 2011, 695.)

Another coefficient being researched is that of inflation. It has been found that a fast inflation might make the threat of a crisis more severe, but this result is not very robust (Kauko 2014).

## 4.2 The timeframe of the recent financial crisis and the ECB monetary policy

The recent crisis falls into the category of a gradually evolving crisis. A seemingly small shock caused effects on a huge scale to the point where the effects had reached systematic proportions. (Laeven & Valencia 2013, 227.)

The most recent financial crisis got its start in 2007 with the housing market of the United States and it escalated in the fall of the investment bank Lehman Brothers in 2008 (Kauko 2014). After the announcement in August 2007 that the French bank BNP Paribas suspended activities in three hedge funds specialising in US mortgage debt it became evident that there were derivatives in the markets going around that were worth less than bankers had originally thought. This led to decreasing market activity and trust declining for the whole markets. During this time the monetary policy of the ECB was considered to be frontloading, consisting of allotting more than strict refinancing for the banking sector. During this time the main policy of the ECB was to try to steer the overnight interest rate known as EONIA close to the interest rate on the main refinancing operations. This period also showed increasing cooperation between the central banks, mainly between the ECB and the US Federal Reserve. (Cassola, Durré & Holthausen 2010, 281-282; Elliott 2011.)

The crisis came to head on 15 September 2008 when the investment bank Lehman Brothers was allowed to go bankrupt by the US government. Until that point the assumption had been that the government would bail out banks in serious trouble. After there was no bailout, the previous assumption that all banks were too big to fail was not true any-

more and after that every bank was considered to be risky. The beginning of the financial crisis is widely accepted to be in August 2007. (Cassola & al. 2010, 281-282; Elliott 2011.)

After the market turmoil of August 2007 until October 2008 the markets continued to be in turmoil and the period from October 2008 until March 2009 had the global output and trade going down. During this time the money and fiscal markets were dysfunctional and the banking systems were frail. During this time the ECB conducted bolder monetary policy by steering the interest rate on the main refinancing operations from the high of 4,25 to the record low 1,0. (Cassola & al. 2010, 283).

The recovery period started sluggishly in April 2009. This time the International Monetary Fund and other global institutions were given fiscal expansions to promote jobs and growth and to assist the banks. During this time the money market interest rates were kept low and the European Central Bank introduced more refinancing operations to promote the economy. (Cassola & al. 2010, 284; Elliott 2011.)

After October 2009 the economic recovery in the euro area was starting to be more evident, albeit gradual. This was the stance of the monetary policy conducted by the ECB as well, with the focus being on slowly enhancing the markets and no major monetary policy challenges. (Cassola & al. 2010, 283.)

The timeframe of 2007-2012 has included the banking crisis, the financial crisis and the turmoil period that followed to global economy since. In 2012 the global economy started to see more recovery as the growth of the gross domestic product started going up for most countries. (United Nations 2015, 1.)

# 5 Empirical part

This chapter presents the research methods used and the data examined. It also provides charts and calculations based on the results. The empirical part concludes with a summary of the results.

The target of this research is to compare the interest rate given by the Taylor Rule to the European Central Bank interest rate on the main refinancing operations (ECB steering rate) during the recent financial crisis.

The empirical part of this research has been conducted using quantitative methods. Quantitative methods are used for data collection and calculations since the data collected was numerical and large. At first the Taylor Rule is calculated and the result is then compared to the ECB steering rate. These two interest rates are then compared using quantitative methods by calculating correlations.

## 5.1 Data used

All the data used for both the ECB steering rate and the variables for the Taylor Rule has been gathered from well known and reliable websites to maintain source criticism as well as trustworthiness of the research. The data can be accessed from these websites at any time for verification and their factuality is unquestionable.

The ECB steering rate is gathered directly from the website of the Bank of Finland (Suomen Pankki 2015c). The steering rate is given at every announcement that the ECB makes, and has been manually collected for quarterly values.

The inflation is gathered from the website of European Central Bank's Statistical Data Warehouse (European Central Bank 2015f). The inflation is measured by using the Harmonized Index of Consumer Prices for the Euro area. Inflation is given as a monthly figure and has been manually collected for quarterly figures.

The output gap is gathered from the website of International Monetary Fund (International Monetary Fund 2015). The output gap is given as a percent deviation of the actual output from the potential output for the Euro area. The output gap is given as a yearly figure.

The data has been inserted in Microsoft Excel to be analysed, as the data was originally not in an agreeable form. All data has been copied from the websites manually and orga-

nized for the calculations. The original data has been checked twice after copying in order to avoid errors.

The study period was chosen to start in 2000 and end in 2014 firstly because the data for the ECB steering rate only begins in 1999 as the European Central Bank has only been conducting monetary policy from that time. The second reason for choosing this study period was to include a sufficient amount of comparable points to the study to be able to draw conclusions from the results.

The values have been examined on a quarterly basis, so both the Taylor Rule and the ECB steering rate have been calculated from 2000 Q1 to 2014 Q4. This means that during the study period there are 60 different values compared. Quarterly examination was chosen because of the different data that was gathered for the Taylor Rule was given for different intervals. Quarterly examination also made sure that there is enough data to make conclusions from the results.

### 5.2 Calculations

The calculations for the Taylor Rule have been done using the original formula presented by Taylor in 1993, where the coefficients and variables originally presented by Taylor are used to make the calculations and the inflation and output gap are gathered. The main reason for choosing to use the original version of the Taylor Rule, instead of any of its variations, is that the aim of this research is to compare the ECB steering rate to the classic Taylor Rule. As well as wanting to analyse the accuracy of the classic Taylor Rule in the Euro area environment with the ECB steering rate, this research is done on the Bachelor's thesis level, which is not extensively broad and therefore no variations of the rule are used.

The exact figures of the ECB steering rate and the steering rate calculated with using the Taylor Rule for each quarter from 2000 to 2014 are presented in the appendices (appendix 1). For the calculations for the Taylor Rule the data gathered is presented in the appendices as well (appendix 2). The calculation for the Taylor Rule is done by making a formula in Microsoft Excel that counts the value for each of the 60 quarters being examined based on the values of the inflation and the output gap in that quarter.

### 5.3 Results

After the Taylor Rule has been calculated and the ECB steering rate gathered, both rates are compared and their movements are shown in figure 1 below.

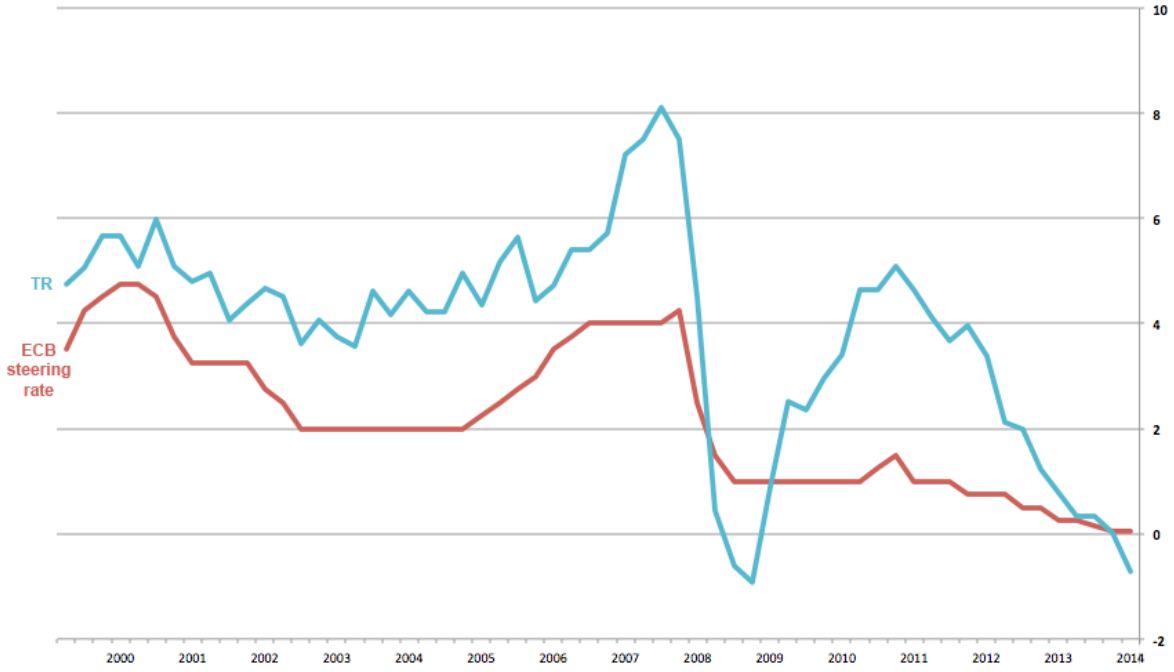


Figure 1. Comparison of the Taylor Rule and ECB steering rate 2000-2014

As can be seen from figure 1 and further examined with the calculations of the correlation coefficients in chapter 5.3.1, there has been correlation with the Taylor Rule and the ECB steering rate throughout the study period of 2000-2014. Both the calculations and figure 1 show that the interest rate calculated using the Taylor Rule fits the ECB steering rate rather well and movements occur roughly at the same time, albeit with the Taylor Rule being more substantial in its volatility.

The volatility of the Taylor Rule compared to the actual interest rate set by the ECB is considerable. The ECB has kept its steering rate on a much more stable course as opposed to the Taylor Rule which varies almost every quarter.

What is also noteworthy is the fact that during the study period the ECB steering rate has not gone negative during the period once, but the Taylor Rule calculates the interest rate to be below zero in two occasions. These occasions happen in 2009 Q2-Q3 and recently at the end of 2014 in Q4.

### 5.4 The comparison during the financial crisis

When discussing the financial crisis in the empirical part of this research the starting point has been chosen to be 2007Q3 as this includes the date in August 2007, which has been often regarded to be the start of the crisis. The ending period was chosen to be 2012Q4 to include a part of the economic recovery to the comparison period for the ECB steering rate and the interest rate calculated with the Taylor Rule.

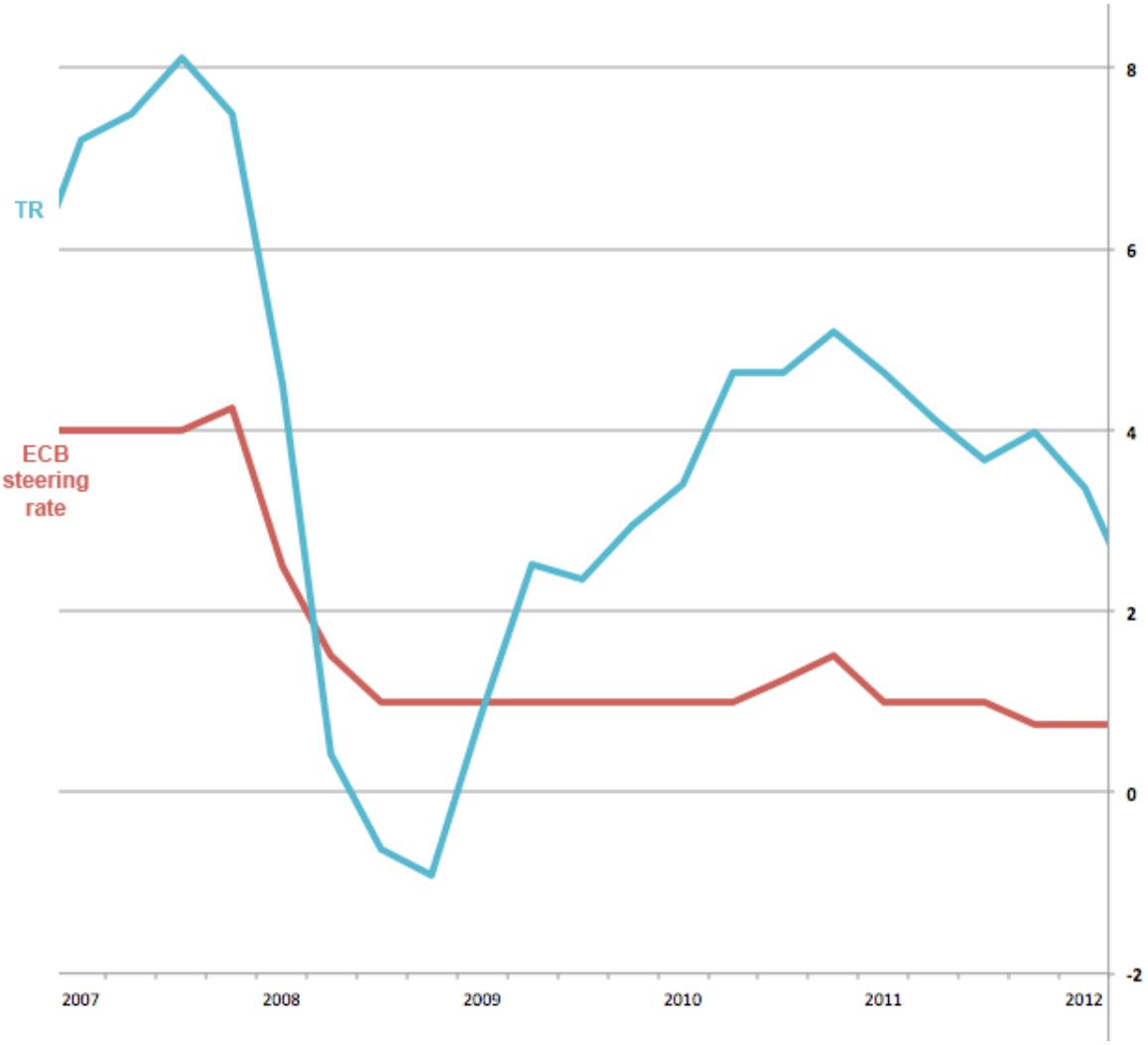


Figure 2. Comparison of the Taylor Rule and ECB steering rate 2007Q3-2012Q4

Figure 2 looks closely on the variance between the interest rates during the financial crisis and the recovery period. The change in volatility is substantial. However the Taylor Rule can still be seen as following the same pattern as the ECB steering rate, just with more strength and more volatile changes between quarters.

### 5.4.1 Major turning points

As the interest rate calculated with the Taylor Rule is much more volatile than the actual ECB steering rate, there are more turning points to be observed with the TR. Furthermore, the ECB does not tend to change its steering rate very often and prefers to keep it at a steady course, with only small 0,25 or 0,5 point changes.

During the period after the beginning of the financial crisis in 2007Q3 until the end of 2012, which saw the economy recovering, there are three major turning points to be observed for both the Taylor Rule and the ECB steering rate. In addition the Taylor Rule has a small turning point in 2010Q4, during which time the ECB steering rate stays unchanging. These are presented in table 1. The table shows the first focus point in which the rate started moving in the opposite direction.

Table 1. Major turning points between 2007Q3-2012

| | **Turning point 1** | **Turning point 2** | **Turning point 3** |
|---|---|---|---|
| Taylor Rule | 2008Q2 – 2008Q3 | 2010Q1 – 2010Q2 | 2012Q1 – 2012Q2 |
| ECB steering rate | 2008Q3 – 2008Q4 | 2009Q3 – 2009Q4 | 2012Q1 – 2012Q2 |

The first turning point in both the Taylor Rule and ECB steering rate can be seen after the beginning of the financial crisis in 2008 as both interest rates declined dramatically. From the calculations (appendix 1) it can be seen that the Taylor Rule started going down in 2008Q2 from 8,102 to 7,502 in 2008Q3 and the major declines happened in the next two quarters, with the result being that 2009Q1 had the Taylor Rule at 0,427. The ECB steering rate followed a similar path but the decline starting from 4,25 in 2008Q3 to 2,50 in 2008Q4 and the major fall happened during the next three quarters with the ECB steering rate declining to 1,00 in 2009Q2. This turning point coincides with the beginning of the financial crisis and it is clear that the ECB reacted to the market turmoil quickly. In this instance the Taylor Rule started the decline earlier, but it took the Taylor Rule longer to reach its lowest value, whereas while the ECB steering rate reacted slower in the beginning, it made the decline all together much quicker.

The Taylor Rule started its ascent quickly after the downfall with the next turning point being in the beginning of 2010 which saw the TR go from -0,923 in 2010Q1 to 0,877 in 2010Q2 and the major jump happening in 2010Q3 with the TR producing a value of 2,5085. The ECB steering rate was quicker to stop the decline of its own rate in 2009 with the policy makers making the decision to go from 2009Q3 1,50 steering rate to 2009Q4

1,0 steering rate. The ECB steering rate did not start to ascend after this though, but remained at the same level for two years.

The third simultaneous turning point occurs in 2012Q1 as both TR and the ECB steering rate have a peak. The ECB steering rate momentously rises from 1,25 in 2011Q4 to 1,5 in 2012Q1 before falling back to the 1,0 level in 2012Q2. The Taylor Rule similarly rises from 4,644 in 2011Q4 to 5,094 in 2012Q1 and falls back to the previous level of 4,644 in 2012Q2.

What is interesting to see from the timing of the turning points is that both the ECB steering rate and the Taylor Rule have been almost simultaneous in their movements during these turning points. Furthermore the results from examining these turning points show no indication that one rule has acted before the other. In the first case the Taylor Rule makes the decline before the ECB steering rate, whereas in the second turning point being examined the Taylor Rule moves first. And the third turning point shows both rules moving at the same time.

### 5.5 Correlation coefficient

Table 2 presents the correlation coefficient for the whole study as well as for the times before and after 2007Q3 to see if there is variation on the figure before the start of the crisis and after it. The correlation coefficients are calculated with Microsoft Excel.

Table 2. The correlation coefficients during the study period

| Timeframe | Correlation coefficient | Rounded values |
|---|---|---|
| 2000 - 2014 | 0,783892748 | 0,78 |
| 2000 - 2007Q2 | 0,717304732 | 0,72 |
| 2007Q3 - 2014 | 0,811145893 | 0,81 |

As can be seen from table 2 the correlation coefficient calculated for the whole timeframe of the study is 0,783892748, which can be rounded to 0,78. This clearly proves that there is not only correlation, but a strong and substantial correlation between the interest rate calculated with the Taylor Rule and the ECB steering rate.

When calculating the correlation for the timeframe before the financial crisis and the timeframe after the beginning of the financial crisis, the correlations vary a little. Most no-

tably for the timeframe of 2000-2007Q2 before the financial crisis, the correlation coefficient is actually smaller, than that of the period after the beginning of the financial crisis 2007Q3-2014. While it can still be said that there has been strong correlation before and after the financial crisis, the correlation is more clear and substantial after it.

### 5.5.1 Lagged correlation coefficients

The apparent effect of the lagged values has been taken into account by calculating the correlations between TR lagged and the ECB steering rate as well as the TR versus the ECB steering rate lagged. The lag was calculated with one quarter and the calculations were done with Microsoft Excel. These are calculated throughout the study period of 2000-2014. These correlations are presented in the table 3 below.

Table 3. Lagged correlation coefficients

| | TR | ECB |
|---|---|---|
| TR lagged | - | 0,73850743 |
| ECB lagged | 0,75059894 | - |

The lagged values show strong correlation, with the Taylor Rule compared to the lagged ECB steering rate being 0,75. The ECB steering rate compared to the lagged Taylor Rule gives to correlation coefficient of 0,74. Both of these results however give a smaller value for the correlation coefficient than that calculated without any lag in the series, which was calculated in chapter 5.5.

## 5.6 Summary of the results

The results show that the Taylor Rule has been accurate in determining the ECB steering rate during the study period of 2000-2014. The correlation has been strong throughout the study, which can be seen both from the calculations and the figures drawn from the results.

Evidence is provided that the correlation between the rates has been stronger after the beginning of the financial crisis in 2007. Turning points examined show that the Taylor Rule and the ECB steering rate move to the same direction nearly at the same time, but there is no clear evidence as to which rule makes the move first in general. The main research question of how the interest rate calculated with the Taylor Rule compare to the ECB steering rate during the recent financial crisis has been answered and the results

show that the TR follows the path of the ECB steering rate and in most parts mimics the fluctuations in the ECB steering rate but the Taylor Rule has been more volatile.

The lagged values show strong positive correlation, but the actual values for the Taylor Rule and the ECB steering rate gave a larger value for the correlation coefficient.

# 6 Discussion

The primary objective of this research was to see how the Taylor Rule compares to the ECB steering rate during the recent financial crisis. From the results it can be seen that the Taylor Rule has mostly been able to follow the steering rule set by the ECB, but the Taylor Rule has been more volatile.

As discussed in the theory part of the research, the policy makers take into account many different factors when making their monetary policy decision, while the Taylor Rule only takes into account the measures of inflation and output (Taylor 1993). This is the main reason for the difference between the European Central Bank's steering rate and the Taylor Rule. However the measures of inflation and output are taken into account when central banks are setting the interest rates, which can be clearly seen from the fact that the Taylor Rule has been able to follow the ECB steering rate. The two have been going in the same direction throughout the time period being researched and while the Taylor Rule has had more substantial differences in quarter-to-quarter movement, both interest rates have shifted at the same times.

The results clearly show that the volatility of the Taylor Rule is stronger than the actual interest rate set by the ECB. If the rule was used in a manner that is strict and follows the calculations completely, the ECB steering rate would have had much more variation. But as discussed in the theory part and discussed by Orphanides (2003) and Carlstrom & Fuerst (2003), it is not ideal for a monetary policy rule to be followed too tightly. As following the rule would have caused more volatility and variation to the steering rate, it would not be in the best interest of the economy and for the consumers for the European Central Bank to use a strict version of the Taylor Rule.

What can be seen from the results of this study is that the TR has been clearly able to follow at least the general direction of the movement of the ECB steering rate and thus could plausibly be used as a guideline for policymakers in regard to future decision-making. In addition to being helpful to policymakers the rule can also be beneficial to individual consumers and companies trying to determine the future values of the ECB steering rate.

The Taylor Rule varies nearly every quarter, whereas ECB steering rate has years of unchanged interest rate. It would not be plausible for the discretion to change the rule this much, but a question of interest is should the ECB change its interest rate more often or is

the keeping of the ECB steering rate on the same level for longer period of time more beneficial for the main goals of price stability.

As of March 2015, the ECB has not introduced a negative value for the interest rate on the main refinancing operations. The Taylor Rule however calculated the interest rate to be negative in two instances during the timeframe examined. It will be interesting to see if the ECB decides to introduce a negative interest rate on the main refinancing operations anytime in the future.

### 6.1 Validity and reliability of the research

Good scientific practice has been used while conducting this research by being thorough and precise with the gathering and handling of the data. The research has been reported according to the guidelines of Haaga-Helia University of Applied Sciences and the sources used have been trustworthy and source criticism is maintained throughout. The primary objective of this thesis was to compare the ECB steering rate to the interest rate calculated by using the Taylor Rule. The research shows validity as the results examine exactly that. The findings represent the phenomenon being researched and thus the research is valid.

The reliability of the research has been established by both being critical in choosing the source materials as well as making sure that the research is repeatable. All the data to make the calculations has been collected from reliable sources that are the European Central Bank website, the Bank of Finland website and the International Monetary Fund website, which makes the data trustworthy. The articles and books used to provide the theoretical framework for the study are also chosen keeping in mind the source criticism. The figures used for the ECB steering rate and the calculations are provided, as well as the sources where they were taken from in order to ensure the possibility of repeating the research.

### 6.2 Future research suggestions

In this research the Taylor Rule is calculated using the most basic version of the rule without any added coefficients as the nature a Bachelor's thesis is not extensively broad. An interesting subject for future research would be that of variations of the Taylor Rule. One interesting subject for a variation would be calculating the Taylor Rule with estimated future values and seeing if the Taylor Rule would have been able to predict any interest rate based on only future values of inflation and the output gap.

Another suggestion for interesting future research would be to repeat the study in 10 years time and see if the Taylor Rule has been still able to follow the ECB steering rate, given whatever economic conditions prevail at that time.

### 6.3 Evaluation of the thesis process

The thesis process has been thorough and educational to me. The process started with the first conversation with the thesis advisor and determining the exact focus of the study, as well as the framework for the theory. The theory follows the originally planned sections very well, with all three theoretical chapters being the same throughout the planning and writing process. This provided to be a good and sufficient framework for the empirical part of the study.

There was a question of which variation of the Taylor Rule would be used, but from the discussion with the thesis advisor and my own decision, the focus was decidedly kept on the original rule, which proved to be a good choice as it was relatively simple to calculate.

Meetings with the thesis advisor were conducted a few times during the thesis process. They were every time informative and provided good discussion, as well as critical help and improvement points for the study.

All in all, the thesis process has been very informative and interesting throughout the whole time. The theory part allowed me to deepen my knowledge on subjects that were of interest to me and had been briefly discussed during my studies. From the empirical part I learned a lot more about data analysis and correlation calculations, which are both tremendously important in the business field.

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# Appendices

### Appendix 1. Figures for the ECB steering rate the Taylor Rule

| Time | ECB steering rate | Taylor Rule |
|---|---|---|
| 2014 Q4 | 0,05 | -0,7205 |
| 2014 Q3 | 0,05 | 0,0295 |
| 2014 Q2 | 0,15 | 0,3295 |
| 2014 Q1 | 0,25 | 0,3295 |
| 2013 Q4 | 0,25 | 0,781 |
| 2013 Q3 | 0,50 | 1,231 |
| 2013 Q2 | 0,50 | 1,981 |
| 2013 Q1 | 0,75 | 2,131 |
| 2012 Q4 | 0,75 | 3,37 |
| 2012 Q3 | 0,75 | 3,97 |
| 2012 Q2 | 1,00 | 3,67 |
| 2012 Q1 | 1,00 | 4,12 |
| 2011 Q4 | 1,00 | 4,644 |
| 2011 Q3 | 1,50 | 5,094 |
| 2011 Q2 | 1,25 | 4,644 |
| 2011 Q1 | 1,00 | 4,644 |
| 2010 Q4 | 1,00 | 3,4085 |
| 2010 Q3 | 1,00 | 2,9585 |
| 2010 Q2 | 1,00 | 2,3585 |
| 2010 Q1 | 1,00 | 2,5085 |
| 2009 Q4 | 1,00 | 0,877 |
| 2009 Q3 | 1,00 | -0,923 |
| 2009 Q2 | 1,00 | -0,623 |
| 2009 Q1 | 1,50 | 0,427 |
| 2008 Q4 | 2,50 | 4,502 |
| 2008 Q3 | 4,25 | 7,502 |
| 2008 Q2 | 4,00 | 8,102 |
| 2008 Q1 | 4,00 | 7,502 |
| 2007 Q4 | 4,00 | 7,2075 |
| 2007 Q3 | 4,00 | 5,7075 |
| 2007 Q2 | 4,00 | 5,4075 |
| 2007 Q1 | 3,75 | 5,4075 |

| | | |
|---|---|---|
| 2006 Q4 | 3,50 | 4,7285 |
| 2006 Q3 | 3,00 | 4,4285 |
| 2006 Q2 | 2,75 | 5,6285 |
| 2006 Q1 | 2,50 | 5,1785 |
| 2005 Q4 | 2,25 | 4,3585 |
| 2005 Q3 | 2,00 | 4,9585 |
| 2005 Q2 | 2,00 | 4,2085 |
| 2005 Q1 | 2,00 | 4,2085 |
| 2004 Q4 | 2,00 | 4,614 |
| 2004 Q3 | 2,00 | 4,614 |
| 2004 Q2 | 2,00 | 4,614 |
| 2004 Q1 | 2,00 | 3,564 |
| 2003 Q4 | 2,00 | 3,7565 |
| 2003 Q3 | 2,00 | 4,0565 |
| 2003 Q2 | 2,00 | 3,6065 |
| 2003 Q1 | 2,50 | 4,5065 |
| 2002 Q4 | 2,75 | 4,666 |
| 2002 Q3 | 3,25 | 4,366 |
| 2002 Q2 | 3,25 | 4,066 |
| 2002 Q1 | 3,25 | 4,966 |
| 2001 Q4 | 3,25 | 4,789 |
| 2001 Q3 | 3,75 | 5,089 |
| 2001 Q2 | 4,50 | 5,989 |
| 2001 Q1 | 4,75 | 5,089 |
| 2000 Q4 | 4,75 | 5,6585 |
| 2000 Q3 | 4,50 | 5,6585 |
| 2000 Q2 | 4,25 | 5,0585 |
| 2000 Q1 | 2,50 | 4,7585 |

## Appendix 2. Figures used for calculating the Taylor Rule

| Time | Inflation (HICP) | Output gap |
|---|---|---|
| 2014 Q4 | -0,2 | -2,841 |
| 2014 Q3 | 0,3 | -2,841 |
| 2014 Q2 | 0,5 | -2,841 |
| 2014 Q1 | 0,5 | -2,841 |
| 2013 Q4 | 0,8 | -2,838 |
| 2013 Q3 | 1,1 | -2,838 |
| 2013 Q2 | 1,6 | -2,838 |
| 2013 Q1 | 1,7 | -2,838 |
| 2012 Q4 | 2,2 | -1,86 |
| 2012 Q3 | 2,6 | -1,86 |
| 2012 Q2 | 2,4 | -1,86 |
| 2012 Q1 | 2,7 | -1,86 |
| 2011 Q4 | 2,7 | -0,812 |
| 2011 Q3 | 3 | -0,812 |
| 2011 Q2 | 2,7 | -0,812 |
| 2011 Q1 | 2,7 | -0,812 |
| 2010 Q4 | 2,2 | -1,783 |
| 2010 Q3 | 1,9 | -1,783 |
| 2010 Q2 | 1,5 | -1,783 |
| 2010 Q1 | 1,6 | -1,783 |
| 2009 Q4 | 0,9 | -2,946 |
| 2009 Q3 | -0,3 | -2,946 |
| 2009 Q2 | -0,1 | -2,946 |
| 2009 Q1 | 0,6 | -2,946 |
| 2008 Q4 | 1,6 | 2,204 |
| 2008 Q3 | 3,6 | 2,204 |
| 2008 Q2 | 4 | 2,204 |
| 2008 Q1 | 3,6 | 2,204 |
| 2007 Q4 | 3,1 | 3,115 |
| 2007 Q3 | 2,1 | 3,115 |
| 2007 Q2 | 1,9 | 3,115 |
| 2007 Q1 | 1,9 | 3,115 |
| 2006 Q4 | 1,9 | 1,757 |
| 2006 Q3 | 1,7 | 1,757 |

| | | |
|---|---|---|
| 2006 Q2 | 2,5 | 1,757 |
| 2006 Q1 | 2,2 | 1,757 |
| 2005 Q4 | 2,2 | 0,117 |
| 2005 Q3 | 2,6 | 0,117 |
| 2005 Q2 | 2,1 | 0,117 |
| 2005 Q1 | 2,1 | 0,117 |
| 2004 Q4 | 2,4 | 0,028 |
| 2004 Q3 | 2,1 | 0,028 |
| 2004 Q2 | 2,4 | 0,028 |
| 2004 Q1 | 1,7 | 0,028 |
| 2003 Q4 | 2 | -0,487 |
| 2003 Q3 | 2,2 | -0,487 |
| 2003 Q2 | 1,9 | -0,487 |
| 2003 Q1 | 2,5 | -0,487 |
| 2002 Q4 | 2,3 | 0,432 |
| 2002 Q3 | 2,1 | 0,432 |
| 2002 Q2 | 1,9 | 0,432 |
| 2002 Q1 | 2,5 | 0,432 |
| 2001 Q4 | 2 | 1,578 |
| 2001 Q3 | 2,2 | 1,578 |
| 2001 Q2 | 2,8 | 1,578 |
| 2001 Q1 | 2,2 | 1,578 |
| 2000 Q4 | 2,5 | 1,817 |
| 2000 Q3 | 2,5 | 1,817 |
| 2000 Q2 | 2,1 | 1,817 |
| 2000 Q1 | 1,9 | 1,817 |