Central Bank Independence and Price Stability
A case study of the Riksbank and the ECB 1999-2009

“Price stability is not everything, but without price stability everything is nothing.”

Otmar Emminger, former President of the Deutsche Bundesbank

Bachelor Thesis in ECONOMICS
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Abstract
The debate concerning the importance of central bank independence on inflation rates has, for several years been ambiguous. Some economists, among which Nobel Prize Laureates Kydland and Prescott (1977) argue that central bank independence is crucial to the achievement of price-stability. Others, such as Daunfeldt and de Luna (2008) could in their studies not find any substantial arguments in favour of central bank independence as the key, explaining the successful achievement and maintenance of a low and stable inflation goal.

In this paper, we use One-Way Analysis of Variance (ANOVA) and Pearson’s correlation test to examine the impact, if any, that central bank independence has on inflation rates. We focus our analysis on a ten year period from 1999 to 2009, looking at the Swedish Central Bank; the Riksbank, and the European Central Bank; the ECB.

The empirical analysis revealed no negative correlation between price-stability and central bank independence. In fact, we found with a 99 % confidence interval that the correlation coefficient between these two variables was only 0.12, a rather weak positive relationship. In Sweden and the Euro-zone we discovered that price stability was achieved years before the concerned central banks were officially declared independent. Also, although the world’s most independent central bank, the ECB did not show the lowest inflation rates.

These indices suggest that the decisive elements behind a state’s low inflation lies beyond the parameters of its central bank. This provides reason to question the belief that institutional reforms granting central banks more independence are necessary for the achievement and upkeep of price-stability.

According to previous research and our own analysis on this topic, a true commitment to sound fiscal policy and a strong inflation adverse social attitude appear to be the variables that most strongly determine the outcome of a low inflation goal. Thereby constituting the backbones without which price-stability can neither be achieved nor maintained.
TABLE OF CONTENTS

1 INTRODUCTION..................................................................................................................1
  1.1 PURPOSE AND METHOD .................................................................................................2
  1.2 DISPOSITION ..................................................................................................................2

2 BACKGROUND OF PRICE-STABILITY ................................................................................3
  2.1 HISTORICAL BACKGROUND OF THE RIKSBank AND THE ECB ........................................3
     2.1.1 The Riksbank ............................................................................................................3
     2.1.2 The ECB ..................................................................................................................3
  2.2 PRECONDITIONS TO PRICE-STABILITY ........................................................................4
     2.2.1 Well-defined nominal anchor ...............................................................................5
     2.2.2 Sound fiscal policy and functioning financial systems .......................................5
     2.2.3 Independent central bank ......................................................................................6
  2.3 ADVANTAGES OF PRICE-STABILITY ............................................................................6
  2.4 PREVIOUS RESEARCH ....................................................................................................7
     2.4.1 Central Bank Independence Atheists: No impact on inflation rates ....................7
     2.4.2 Central Bank Independence believers: Existing impact on inflation rates ............8
  2.5 HYPOTHESIS OF THE STUDY .......................................................................................11

3 THEORETICAL FRAMEWORK .............................................................................................12
  3.1 RULES VERSUS DISCRETION .......................................................................................12
  3.2 TIME-INCONSISTENCY IN MONETARY POLICY............................................................13
  3.3 THE BARRO-GORDON MODEL .....................................................................................13
     3.3.1 Limitations of the Barro-Gordon Model ................................................................14
  3.4 ROGOFF AND THE BARRO-GORDON MODEL ...............................................................14
     3.4.1 Limitations of the Rogoff’s Model ........................................................................15
  3.5 THE THEORETICAL FRAMEWORK AND THE HYPOTHESIS OF THE THESIS ...............15

4 DATA, MEASURES AND METHODS ...................................................................................17
  4.1 MEASURES OF INDEPENDENCE ....................................................................................17
     4.1.1 Goal Independence ................................................................................................17
     4.1.2 Instrument Independence ......................................................................................17
     4.1.3 Personal Independence ........................................................................................18
  4.2 ONE-WAY ANALYSIS OF VARIANCES .........................................................................19
  4.3 THE BONFERRONI TEST ..................................................................................................19
  4.4 THE PEARSON’S CORRELATION TEST ...........................................................................20

5 RESULTS AND ANALYSIS ..................................................................................................21

6 LIMITATIONS .....................................................................................................................24

7 CONCLUSIONS ...................................................................................................................25

8 FUTURE STUDIES ...............................................................................................................27

REFERENCES .........................................................................................................................28

APPENDIX I ............................................................................................................................30
     MORE ON THE TERMINOLOGY .......................................................................................30
     MORE ON THE EURO-ZONE ............................................................................................30

APPENDIX II ..........................................................................................................................31
     MORE ON THE EMPirical ANALYSIS 1 .........................................................................31
     Results .............................................................................................................................31

APPENDIX III ..........................................................................................................................32
     MORE ON THE EMPirical ANALYSIS 2 .........................................................................32

APPENDIX IV ...........................................................................................................................33
     MORE ON THE EMPirical ANALYSIS 3 .........................................................................33

APPENDIX V .............................................................................................................................34
     MORE ON THE EMPirical ANALYSIS 4 .........................................................................34
     More on the Bonferroni test.............................................................................................34
     More on the Pearson’s and Kendall’s correlation statistics .............................................34

APPENDIX VI ...........................................................................................................................35

APPENDIX VII ..........................................................................................................................36

APPENDIX VIII .........................................................................................................................37
1 INTRODUCTION

The maintenance of price-stability \(^1\) is nowadays a broadly accepted doctrine. After decades of experiencing price volatility, devaluations of currencies and the breaking down of fixed exchange rate system, economists and policy-makers have come to realise that the costs of inflation are far too important to be minimized. Monetary policy with low inflation as a goal has thereby become the corner pillar of many functional open economies. Hence, the principal role played by Central Banks, since the mid-1990s formally responsible for ensuring price-stability.

Central Bank Independence often being linked with better price stability has lead to major institutional reforms in Europe in the last 10 years. Some pioneers in central bank independence reforms such as Nobel Prize Laureates Kydland and Prescott (1977) argue that the independence factor adds more credibility to the central bank and thus helps to eliminate the time inconsistency problem and ensure price stability. However, this view has been subject to criticism from other economists. In fact, Daunfeldt and de Luna (2008) could in their case study of the OECD-countries not find any negative relationship between the level of central bank independence and the inflation rates. They conclude that the achievement of price stability could not be explained by the degree of independence of the central banks of OECD-members countries.

Recent research on monetary policy have been controversial, suggesting that there might be valuable evidence supporting these different views on the importance of central bank independence in the implementation and upkeep of price-stability.

In that perspective, Sweden and the Euro-zone, become interesting cases. Sweden, in the front line of inflation targeting, and with the oldest central bank in the world, formally independent since 1999, adopting inflation targeting in 1993 and achieving it since 1994. Moreover, Sweden one of the richest welfare states in the world; becomes even more interesting in the light of its membership in the European Union since 1995. The rejection to adopt the Euro as its currency in the popular referendum of 2003 and let the ECB run the country’s monetary policy makes this region a particular case. The European Monetary union, (EMU) also constitutes an excellent case study, with the most independent central bank in the world (ECB) and heterogeneous economic performance among its members. It provides 10 years of macroeconomic observations that can be useful in the evaluation of monetary policy and the importance of central bank independence.

It is with these indicators that this thesis will analyse the impact if any, that the independence of a central bank has on the price-stability.

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\(^1\)Price-stability refers to a situation of low and stable inflation; both terms will be used interchangeably.
1.1 Purpose and Method

The purpose of this thesis is to analyse if central bank independence affects price stability. The focus is on the Riksbank and the ECB. This plausible relationship is tested running One-way Analysis of Variances (ANOVA) and Pearson’s test statistic. We use an index that shows the level of central bank independence and the inflation rates of Sweden and the Eurozone from January 1999 to April 2009.

1.2 Disposition

The paper is outlined such that, first comes an introductory section with the background of price-stability. In section 2 follows a brief summary of the preconditions behind and advantages of price-stability; a historical background of the Riksbank and the ECB and also previous studies in this area. The third part explains the theoretical framework. The empirical analysis is conducted in the fourth section. The fifth part contains the results and analysis while conclusions and suggestions to future studies are reported in section 6. The last section provides references and appendix.
2 BACKGROUND OF PRICE-STABILITY

2.1 Historical background of the Riksbank and the ECB

2.1.1 The Riksbank

The historical evolution of the Riksbank dates back to 1656 when the Swedish King Karl X Gustav issued privileges for an exchange and loan bank which was named “Stockholm’s Banco” and thus became the first bank in Sweden. The Bank issued banknotes, but when the general public lost confidence in the banknotes the bank folded in 1664. (The Riksbank webpage, 2009)

In 1668 the Riksdag, the Swedish parliament, decided to re-establish Stockholm’s Banco under the name “the Bank of the Estates of the Realm”: the Riksbank was born. During the Age of Liberty, the first economists pointed out that there was a link between the banknote stock, inflation and the exchange rate against other countries. Therefore, the Riksbank started to pay attention to its banknote stock. During the 19th century the demand for credit from the business sector increased as a result of the ongoing industrialization process. The Riksbank became a “real” central bank when it was given the monopoly on issuing banknotes in the 1897 Riksbank Act. The Chairman of the board of directors was to be selected by the King himself. Formally the Riksbank was still an organ under the Swedish parliament, which still remains true. (The Riksbank webpage, 2009)

During the First World War, inflation was very high and was then succeeded by severe deflation in the beginning of the 1920s. The Riksbank faced challenges in coping up with the economic fluctuations. The crisis policy pursued in the 1930s paved the way for stronger coordination of fiscal policy and monetary policy. The global economy was transformed. Cross-border capital flows strongly increased and previously regulated economies were drawn into international trade. Germany gave combating inflation precedence over employment; the United States and Britain performed deregulation on the financial markets. The reassessment reached Sweden later than in many other countries. Deregulation in Sweden did not begin until the mid-1980s, followed by measures to lower inflation in the early 1990s. (The Redshank’s webpage, 2009)

The Riksbank renounced to the fixed exchange rate regime in November 1992 and an inflation target of 2% became the objective of monetary policy after the Riksbank failed to defend the Krona during the traumatic banking crisis Sweden experienced. The new Riksbank Act of 1999 gave the Riksbank a more independent position than before. The Krona (SEK) is still Sweden’s currency after a popular referendum in 2003 when Sweden rejected the adoption of the Euro. In recent years the average inflation in Sweden has been one of the lowest in Europe, mainly due to globalization, increased efficiency and further deregulations. (OECD’s economic survey of Sweden, 2007)

2.1.2 The ECB

The ECB can be seen as a continuation or child of the German Central Bank; the Bundesbank. Because of the successful ability of the Bundesbank to maintain price stability, which, worth emphasizing, may be due to the chaotic inflation fluctuations experienced by Germany in the 20s; it seemed natural to create an European Central Bank in the same spirit that might lead to the same success story. (The ECB’s webpage, 2009)
The ECB, whose objective is price-stability or as the bank claims itself “safeguarding the value of the euro.” was created in June 1998 in Frankfurt am Main. It took over from its predecessor, the European Monetary Institute; EMI. It is a supra-national institution with its own legal personality guaranteed in Article 106 of the European Treaty. However, this legal personality obeys under public international law. The ECB is rather new institutions established by the 11 EU member states and possess responsibility to conduct monetary policy for the Euro zone. The Euro-member countries' national central banks transferred the responsibility of the monetary policy to the ECB, thus sharing the Euro as their common currency. The Euro floats against other major currencies. More and more countries joined the ECB since the inception in 1999. The ECB and the national central banks together constitute the European System Central bank system of the euro area and they perform together the task they have been entrusted with. The Euro-zone has what they call a Convergence Criteria: This means that countries wishing to adopt the Euro as their currency must achieve a high degree of “sustainable convergence”. The degree of convergence is assessed on the basis of several criteria in the Maastricht Treaty, which require a country to have a high degree of price stability, sound public finances, a stable exchange rate, low and stable long-term interest rates and an independent central bank. (ECB webpage 2009)

The criteria are designed to ensure that only countries with stability oriented economic policies and a track record in price stability are admitted to use Euro as their currency. The Treaty also requires the central bank of each country to be independent. After almost ten years of existence, the ECB has been praised and criticized by policy-makers and the public. What is true about the ECB performance is that since 1999, inflation, even though still fluctuating, has been relatively low and stable compared to the period before the ECB. This was of course true before the beginning of the actual worldwide financial crisis.

Table 2.1 shows a data chart displaying inflation for the last ten years. On the vertical axes is the level of inflation and the horizontal axes the time horizon.

Table 2.1 Inflation in the Euro-zone before and after the ECB

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>5.0%</td>
</tr>
<tr>
<td>1996</td>
<td>4.8%</td>
</tr>
<tr>
<td>1997</td>
<td>4.3%</td>
</tr>
<tr>
<td>1998</td>
<td>3.5%</td>
</tr>
<tr>
<td>1999</td>
<td>2.0%</td>
</tr>
<tr>
<td>2000</td>
<td>1.5%</td>
</tr>
<tr>
<td>2001</td>
<td>1.1%</td>
</tr>
<tr>
<td>2002</td>
<td>1.0%</td>
</tr>
<tr>
<td>2003</td>
<td>0.7%</td>
</tr>
<tr>
<td>2004</td>
<td>0.5%</td>
</tr>
<tr>
<td>2005</td>
<td>0.3%</td>
</tr>
<tr>
<td>2006</td>
<td>0.2%</td>
</tr>
<tr>
<td>2007</td>
<td>0.1%</td>
</tr>
<tr>
<td>2008</td>
<td>0.0%</td>
</tr>
<tr>
<td>2009</td>
<td>0.1%</td>
</tr>
<tr>
<td>2010</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Source: Eurostat

2.2 Preconditions to Price-Stability

There is a widely accepted consensus among economists among which Giavazzi and Mishkin (2006) that the way to low inflation must be preceded by some well-established criteria. The debate has thus not been on which these preconditions are but on which of them are unavoidably decisive for the outcome of a low inflation goal.
Mishkin and Giavazzi (2006) regarded by some economists as the “fathers of low inflation targeting” propose three main conditions without which it will be impossible for a central bank to conduct a low inflation oriented monetary policy. The requirements presented by Mishkin and Giavazzi (2006) are the following: a well-defined nominal anchor, a sound fiscal and financial system and an independent central bank.

2.2.1 Well-defined nominal anchor

A nominal anchor can be viewed as the compass of monetary policy. Having a well-defined nominal anchor significantly reduces the time-inconsistency dilemma by reducing the central bank’s or government’s temptation to expand the money supply. As we will discuss later in this paper, the time-inconsistency problem arises because the central bank and politicians tend to have an incentive to renege on their commitments to price-stability in an attempt to reduce unemployment. According to the Phillips curve, unemployment affects inflation through the expected inflation. By announcing that it pursues a low inflation goal, the central bank aims to have people expecting low inflation, so that the trade-off inflation-unemployment will be advantageous for everyone. However, these attempts are often unsuccessful since the public understands that the central bank will tend to renege on its announcement, hence the distrust. (Mankiw, 2006)

With this background, it has been argued, notably by M. Friedman (1968) that central banks and policy-makers can better achieve their goals if their discretion is taken away from them. Inflation will be low without the cost of high unemployment if the central bank and politicians are committed to a fixed rule policy, consequently, the need for a credible well-defined nominal anchor.

2.2.2 Sound fiscal policy and functioning financial systems

When a government runs unsound fiscal policy, that is, the government has huge budget deficits; it may be tempted to expand the money supply by directly printing more money or force the central bank to buy government bonds to finance those deficits. Sweden and the Euro-zone have both adopted The Maastricht Treaty, hence banning out the possibility of printing money to finance budget deficits. Nevertheless, financial prudence is still an unavoidable criterion to be in a situation of low and stable inflation. (Chang, 2008)

Giavazzi and Mishkin (2006) found that, for Sweden, the last ten years have been outstanding. The results is that, there is in Sweden since 1996, a new budget law (Law SFS 1996:1059) that has lead to average annual budget surpluses. Today, Sweden has a budget surplus that is around 1% of the country's GDP, a performance still rare in the Euro-zone, where on average budget deficits have been more than 3% of GDP.

Likewise, good supervision of the financial system is crucial for price-stability. If the financial system is not well functioning and regulated, the scenario will be that banks will perform badly. This makes it impossible for the central bank to use interest rates as the instrument to control inflation. The rise in interest rates would cause further losses and maybe even leading to a total breakdown of the financial system. (Giavazzi and Mishkin, 2006)

Also, as today's ongoing financial crisis clearly points out, major losses in bank’s balance sheets lead to increased government spending since the government will pay large sums to bail out banks. These large payments will in turn lead to budget deficits, and huge budget deficits can as previously stated; cause growth of money supply and thus high inflation. (Mankiw, 2006)
In Sweden, the previous cited budget law (Law SFS 1996:1059) has more than only lead to budget surpluses, it also puts in place "a prudential regulatory and supervisory system that has promoted the safety and soundness of the financial system." (Giavazzi and Mishkin 2006, p. 56)

2.2.3 Independent central bank

As far as the third precondition, central bank independence is concerned, Giavazzi and Mishkin (2006), Barro and Gordon (1983) and Kydland and Prescott (1977) before them, have placed it as a prerequisite for a successful low inflationary monetary policy. Giavazzi and Mishkin (2006) however, clearly specify that a central bank should only be independent in setting its’ policy tools but not when setting the long-run monetary goals of the economy. A deeper elaboration on this matter is given later in this paper. Nevertheless, it can be pointed out that the Riksbank is goal independent and as mentioned in the introduction, the ECB is the highest independent bank in the world.

The conclusion of this section is that both the Riksbank and the ECB fulfill all the requirements for the achievement and the maintenance of price-stability suggested by Giavazzi and Mishkin.(2006) They have well-defined nominal anchors, functional financial systems, responsible fiscal policies and highly independent central banks.

2.3 Advantages of Price-Stability

The idea of focusing monetary policy on low and stable inflation is by no means new. The current international tendency to concentrate monetary policy on long-term price stability reflects a growing consensus on three issues.

First, there seems to be awareness that there is no long-term stable trade-off between inflation and real factors like production and employment. It follows that in the long run, the influence of monetary policy is confined to the level of inflation. Second, there is a widespread agreement that to the extent that monetary policy has any influence on the real economy at all; it seems to be the case that price stability as such can contribute to long-term productivity growth. Third, excessive short-term thinking in economic policy is considered to be conducive to a higher inflation trend. (Giavazzi and Mishkin, 2006)

A good but extreme example of how high inflation can harm the economy is the on-going crisis in Zimbabwe. Zimbabwe's hyperinflation, 79,600,000,000% in November 2008 is not only disastrous for the economy; it pushes more of its population into poverty, and forces millions of Zimbabweans to emigrate. In an attempt to control the intense growing dissatisfaction among its inhabitants, the government faces even more troubles with capital outflow, many black markets and an increased incentive to criminality. (International Monetary Fund webpage 2009)

As claimed by Giavazzi and Mishkin (2006), from price-stability derives many positives effects; increased economic growth, better market efficiency and improved long-term planning. Also, low and stable inflation reduce speculative buying and the distortion that may arise between inflation and the tax system, hence avoiding a missal-location of resources and unfair distribution of income. Furthermore, by lowering the uncertainty in future price levels, price-stability allows financial contracts based on correct assumptions to take place. (Prescott, 2004) The underlying assumption in Giavazzi and Mishkin statements is that economic prosperity and growth are strongly dependent on investment. When prices rise very fast; inflation is high and unstable, rational economic calculation is difficult and therefore long-run planning impossible. The argument goes, for robust investment to take place,
investors need to have a long time-horizon to be able to plan and make rational decisions. Hence, the crucial role played by inflation levels for a country’s economical growth. (Chang, 2008)

Because of all these economic and social benefits, many countries are today aiming at low and stable inflation. In fact, since the 1990s, inflation has dropped sharply in most European countries and employment fluctuations have significantly fallen (Giavazzi and Mishkin, 2006).

2.4 Previous research
As stated in the introduction, research findings on central bank independence and inflation rates have been mixed and controversial. In this section, we give a summary of some of the past research studies on the area.

2.4.1 Central Bank Independence Atheists: No impact on inflation rates
Bofinger (2001) and later Daunfeltd and de Luna (2008) could in their respective studies not find any correlation between central bank independence and inflation rates. For instance, Daunfeltd and de Luna (2008) who use an index with the implementation dates of central bank independence reforms and whose study cover 29 OECD-member countries show that price-stability was achieved in most countries, Germany and Sweden included, years before the central banks became officially independent. Thus, their suggestion is that price-stability can be fulfilled without institutional reforms that grant central bank more independence.

In fact, as can be seen from Table 1, the Swiss National Bank, the Central Bank of Switzerland, has had a long history of being credible and achieved price-stability already in 1984 while it was first in 2000, 16 years later that it became constitutionally independent. The same holds for Sweden with price-stability achievement prior to central bank independence. The Slovakian central bank on the other hand, was made independent in 1992 but 13 years later it still has not achieved price stability.
Two points can thus be derived from their study: primarily, it should be emphasized that, because a central bank is not legislatively independent, it does not imply that it lacks credibility or vice-versa. Secondly, the cornerstone to low inflation is not that the central bank is independent but rather that it is credible. Hence, credibility is the most important quality of a central bank, because if the credibility of the central bank to pursue price stability is weakened, inflation expectations will rise. (Giavazzi and Mishkin, 2006)

### 2.4.2 Central Bank Independence believers: Existing impact on inflation rates

The Daunfeldt and de Luna's view is however not shared by all economists. The theorists Kydland and Prescott (1977), Barro and Gordon (1983) and Rogoff (1985) who worked centrally on the problem of time inconsistency in monetary policy, mean that central banks must be independent of political instructions in order to pursue the objective of price stability effectively. Empirical evidences have been provided to support this standpoint.

By applying an index that illustrates the level of central bank independence, Grilli et al. (1991), Alesina and Summers (1993) and Jonsson (1995) found a negative relationship between central bank independence and average inflation. They conclude that by being independent, the central bank increased the chances of fulfilling price stability without causing distortion in unemployment, economic growth and interest rates. Worth mentioning is that, Sweden and Germany, were part of the study from 1955 to 1988 by Alesina and Summers. Consistent with their theory, the Bundesbank, this later became the ECB achieved...
indeed lowest inflation rates because it had the highest degree of independence. The graphical illustrations of these findings are displaying in Figure 2.1. Moreover, Grilli et al (1991) whose study period was between 1996 and 2000 went further and proved that political and economic independence were negatively related with inflation rates.

Figure 2.1 shows two types of measurement of central bank independence according to Alesina and Summers. The second column, the BP index, gives a measure of central bank independence based on the bank ability to select by itself the policy objectives it must follow without any influence from the government. In other words, the BP-index is a measure of "political independence". (Compare with goal and personal independence later in this paper) It ranges between 1 and 4 where 4 is the highest level. Even here (see Daunfeldt and de Luna) the Bundesbank, together with the central bank of Switzerland gets the highest value. The Riksbank ends up in the middle with 2 in the scale. The GMT-index in the third column measures both political and economical independence where economic independence should be understood as the central bank ability to use free from influence, instruments of monetary policy the bank found appropriate. (This could be compared with the instrument independence in the section concerning measurement of independence)

In the fourth column, the GMT-index has been converted to a 1 to 4 scale. Also in this case, the Bundesbank and the Central Bank of Switzerland remain the leading players with greatest political and economical independence while New-Zealand and Spain seems to be the least independent.

Figure 2.2 shows a clear negative relationship between average inflation and central bank independence. Notice that the index for central bank independence used in this graph is the BP/GMT presented earlier. Not surprising, Spain and New-Zealand are performing worse while Germany and Switzerland show the lowest level of inflation and Sweden gets caught somewhere in the middle. So, the less independent the central bank, the higher is the inflation rate.

![Central bank independence 1955-1988](image-url)
This belief has been accused to disregard major aspects of importance. First of all, it has been argued by Posen (1993), Forder (1996) and Hayo (1998) that central bank do not automatically gain credibility from the public by being independent. Instead, they claim that central bank credibility is principally depending on social attitude. An inflation adverse social attitude, like the one common in pre and post war Germany, is more likely to give credibility to the central bank as a price-stabilizer than a nation with no or low preference for price-stability. Therefore, one needs to seek in the economic and political history of each nation since it paves the way to the attitude the public will have towards the central bank. Hence, in the German case, the high credibility the Bundesbank was accredited from both policymakers and the public arose from the severe inflation fluctuations this nation had experienced before. These conditions however, do not apply to all countries. Also, through the years, the Bundesbank had proved, to the policymakers and the public, its competence in pursuing a low and stable rate of inflation. As encapsulated so well by Jacques Delors in the 1990s “Not all Germans believe in God, but they all believe in the Bundesbank”. Secondly, by not considering the role played by fiscal policy and not taking into account other factors that may influence economic performance (see Pollard, 1993); Grilli et al. (1991), Alesina and Summers (1993) and Jonsson (1995) make conclusions based on incomplete assumptions. As emphasized by Mishkin and Giavazzi (2006) and Blake and Weale (1998), and already mentioned in the section about preconditions, a central bank that is independent may still lack credibility because of irresponsible fiscal policy. Therefore, a commitment to sound fiscal policy is the inevitable precondition that promotes faith in the central bank and its ability to resist political pressures. As well summarized by Professor Axel A Weber, the president of the Deutsche Bundesbank in a speech held at the Narodowy Bank Polski, the National Bank of Poland, in Warsaw in October 2006: “As a general principle, a stability-oriented monetary policy must be accompanied by a stability-oriented fiscal policy. The reason for this nexus is that unsound fiscal policies generally entail the risk of a conflict between monetary and budget policy”
Furthermore, the study by Grill et al (1991) has been described by Bofinger (2001) as unreliable; partly because of the short period of four years it focuses on, and also for the fact that 1996 to 2000 was a period of general low and stable inflation in OECD-countries. Finally, one should keep in mind that the research by Alesina and Summers (1993) is focused on a period (1955-1988) prior to the institutional reforms that made many central banks formally independent.

2.5 Hypothesis of the study

In the light of the above mentioned previous studies, the hypothesis of this thesis is that there is no negative correlation between the degree of central bank independence and inflation rates. By analyzing the above relationship, we want to show that central bank independency should not be overrated at the expense of other more important explanatory variables such as financial prudence and social attitude.
3 THEORETICAL FRAMEWORK

3.1 Rules versus Discretion

*Rules* are an outside procedural rule laid down in the central bank’s statutes as a guideline for action. Whereas, *Discretion* implies that the central bank has the absolute right of deciding on its issues without any interference from other actors. The *Rules versus Discretion* problem is closely related to the time-inconsistency dilemma and different types of central bank independence, but for structural purposes, those topics will be broached later in this paper.

There has been much debate on *rules versus discretion* and one of the more traditional views is the so called Friedman’s argument. For Friedman (1968), the important step in avoiding the central bank as a source of instability was to get it to give up discretionary power in policymaking.

A better alternative is that the central bank should commit itself—publicly and in advance— to following some simple rule. The exact rule to follow is not crucial, but Friedman thought that a good choice would be a constant—money—growth rule. First, the central bank should have considerable control, though not complete, over the rate of money growth. His argument is based on the following two major presumptions:

— Our knowledge of the detailed workings of the macro economy is far from perfect; and there are long lags between policy actions and changes in prices, output, and employment.
— The government in general and the central bank in particular are often motivated by political considerations. Individual policymakers can be motivated by personal gains and advancement. In this environment it would be foolhardy to entrust the government with policy tools that can have significant adverse welfare effects on the public.

Finally, Friedman (1968) concludes that central bank knowledge of the economy is too limited and that the central bank is often not interested in maximizing the social welfare and hence he advocates for introducing an outside policy rule which is less harmful.

In modern debate, Kydland and Prescott (1977), Barro and Gordon (1983) argue that our knowledge of the macroeconomy has improved dramatically since Friedman’s time. Nowadays, everybody, including the central bank, knows how the economy works. The central bank maximizes social welfare; there are rational expectations and there is still a high inflation rate because of *time inconsistency* problems. Hence, they suggestion that the central bank should continuously monitor the economy and, using the advice of economic experts, change the money supply as needed. In other words, the central bank should be given a rather high level of discretion.

However, not all economists want to accredit so much discretion to the central bank. For instance, Simons (1936) and Eucken (1952) argue that central bankers, just as normal people can lack of knowledge or fall under the influence of the public opinion or misleading theories, and thereby make inappropriate decisions which will result to price-instability.

Equation 1 and 2 in the appendix summarizes the implications of rules and discretion in the existence of economic shocks.
3.2 Time-inconsistency in monetary policy

Time-inconsistency is, as mentioned above, an issue closely linked to the rules versus discretion dilemma.

The term time inconsistency of optimal monetary policy strategies has been a subject of debate throughout the 80s. A strategy is time inconsistent if it is optimal at a point of time but no longer optimal at a point of time in future. Time inconsistency of optimal strategies does not appear to be a particularly significant phenomenon, since it is clear at once that a strategy which is optimal at one time and not optimal at different time if the bases on which the parties involved their decisions has changed. Similarly time inconsistent strategic choice will also occur when new information becomes available. (Bofinger, 2001)

Nobel Prize winner Edward C. Prescott described why the price stability policy rule is time-inconsistent in the following way: considering an economy in which the nominal wage rate is set above the market clearing level in some sectors, given the inflation rate specified by the rule. This outcome could be the result of industry insiders in each of a number of industries finding this action in their best interest, given the wages chosen by the insiders in other industries and the expected inflation rate. If the price stability policy rule is followed, ex post a distortion occurs that results in low employment. This distortion can be reduced by having inflation in excess of the amount specified by the rule. With the time-consistent monetary policy rule, inflation will be at that level where the marginal value of higher inflation in reducing the distortion will just equal the marginal cost of the higher inflation. The equilibrium outcome is high inflation and no reduction in the distortion. Commitment to the best rule will not result in high inflation, just the labor market distortion. (Prescott, 2004)

Another important example in the field of monetary economics is the possibility of increasing seigniorage in the short term beyond the maximum by means of surprise inflation. Thus, the conclusion is that, being able to commit has value and that having discretion has costs. The only method of commitment is to follow rules. That is why we concluded that the time inconsistency of optimal plans necessitates following rules. (Prescott, 2004)

3.3 The Barro-Gordon Model

The cornerstone of the BGM is that the government must be institutionally committed to low and stable inflation. Every economy has a positive equilibrium inflation level. Assume that the policymakers' utility decreases with the level of inflation and the rate of unemployment and that this is known to the public. Assume further that the policymakers maximize a social welfare function, taking into account the relationship between inflation and unemployment as revealed by an expectations-augmented Phillips curve. Equation 3 in the appendix provides a good summary Barro and Gordon’s idea.

Barro and Gordon showed that under these assumptions, a policy of zero inflation is not sustainable because such a policy is incredible in the eyes of the public because it is time-inconsistent (Kydland and Prescott, 1977). As soon as the inflationary expectations of the economic agents have adjusted to price stability, the policymakers have an incentive to renounce this policy and replace it by a policy of positive (surprise) inflation, which yields a rate of unemployment below the natural one. The consequential mixture of inflation and unemployment provides a higher level of utility than the combination of zero inflation and unemployment equal to the natural rate. Knowing the policymakers' interest in surprise inflation, the rational public will hold positive inflation expectations, forcing the monetary policymakers either to inflate or to drive the economy into a recession. The policymakers will prefer the former option which implies that in the end the economy will be characterized by
positive preference-related equilibrium inflation (cf. Backus and Drifill, 1985). This equilibrium inflation rate relates to a situation where (1) the public’s expectations are realized and the actual unemployment rate equals the natural rate; and (2) the policymakers no longer have any interest in creating surprise inflation. The social costs are minimal when central bank calculates the optimal inflation rate as given in equation 4 in the appendix.

3.3.1 Limitations of the Barro-Gordon Model

However, the reader should be aware that the above presented Barro-Gordon model suffers from several limitations. The model ignores time dimension and multi period games. Central bank has to compare short run gains of surprise inflation to long run costs of inflation bias. Inflation bias under rational expectations is the result of $K \neq 1$, whereas when $K = 1$ under discretion optimal inflation is zero and the size of the inflation bias depends on preference parameter $\beta$.

This model also lacks sufficient information about the non existence of incentives to generate surprise inflation. Moreover, there is a lagged effect of monetary policy on the economy and policy rules do not allow central banks to react to shocks. To be flexible to react to shocks in the economy and to be prepared to suffer higher unemployment could be some solutions to reduce inflation bias.

Another critic against the framework used in this paper is that of the short sighted temptation of the policy makers, a factor which is not considered in the Barro-Gordon Model. The influence of the political sphere on central bank independence can be attributed to the objectives or instruments of central bank policy, an aspect excluded in the Barro-Gordon Model as emphasized by Debelle and Fischer (1994).

It is well-established that during economic boom, elections will be in favor of the mandated politicians who are behind the boom and hence the policy makers will override the central banks to maximize the probability of the re-election. Ignoring these facts in the Barro-Gordon model limits the usefulness of the model.

3.4 Rogoff and the Barro-Gordon Model

The result of Rogoff’s (1985) study shows that delegation of the monetary policy to an independent central bank could lead to higher credibility and stabilization. Based on Rogoff’s analysis, as a result of conservativeness of central bankers, there is a close link between central independence and welfare outcomes.

If an independent central bank is managed by a “conservative” central banker, that is, an agent who is more inflation adverse than citizens in general, better welfare outcomes can be achieved. His results suggest that central bank independence from direct government influence is necessary. The theoretical supposition, that it should be possible to decrease inflation through such institutional modification without any cost in terms of increased average unemployment over the business cycle, has gained support from empirical research examining the effects of monetary policy institutions on macroeconomic outcomes both across countries and over time.

In practice, the Rogoff model can be seen as an extension of the Barro-Gordon Model. In the Barro-Gordon Model, it was shown that the cost of discretion trims up with the value of the unemployment weighting factor $b$. The new variable introduced by Rogoff (1985) was the target function of the previously mentioned “more-conservative” central banker where he reduced $b$ by $\xi$. A variable that weights unemployment less than a less-conservative central
banker would do. The target function of a conservative central banker can thus be written as following:

\[ Z^{Kkb} = (b - \xi) \left[ (1 - k) U^n - a (\pi - \pi^e) \right]^2 + \pi^2 \quad \text{with} \quad 0 \leq \xi \leq b \]  

Equation 5

In this solution, that is considered to be the theoretical explanation to central bank independence, the conservative central banker presumes that there is total price-stability and ignores the level on unemployment when \( \xi \) assumes the same value as \( b \).

For instance, the function shows how social welfare is being optimized.

3.4.1 Limitations of the Rogoff's Model

The Rogoff’s extension of the Barro-Gordon Model has nevertheless been criticized for only taking into account a single-period market, which it has been argued is far from being realistic. According to the criticizers, the decision-making in monetary policy should be perceived as a repeated game. Logically it is only under a repeated game that central banks can be assumed to have the incentive to operate with long-term goals rather than solely put their focus on the weighting factor of price-stability in the short-run. With a repeated game, it is possible to model how the central bank will seek for low and stable inflation rates for a longer period of time.

The independence factor is not only designed to protect the conservative central banker from governmental influence but rather to also ensure that short-run governmental ambitions do not interfere with central bank long-term goals. Hence, only when the independent central bank has a longer time-horizon, can it be willing to achieve the same goals as the government. It is therefore feasible for the independent central bank to counter shock-term shocks as long as those shocks do not prevent the central bank for achieving its long term goal of low and stable inflation. Central bank independence justification is thus provided in order to make it possible for central banks to focus on their long-term goal without governmental demands and pressures for short-term results.

3.5 The theoretical framework and the hypothesis of the thesis

To begin with, the first part of the theoretical framework presented in this paper, rules versus discretion together with the time-inconsistency dilemma are laying the ground for the hypothesis of this paper. As the reader recall, the genesis of the desire to have an independent central bank was the time-inconsistency problems. The firsts to be characterized for being time-inconsistent were (not so surprising), politicians, and in an attempt to protect the public from politicians time-inconsistency in monetary policy, the central bank had to be made independent, that was the idea. As the mathematically minded reader can easily derive from equation 2, rules versus discretion, showed that discretion, that is, the central bank should be given the absolute right of deciding on its issues without any interference from other actors, actors being politicians and government, that discretion was always better, better than rules. (Rules are regulations guiding the central bank actions).

In other words, the implication of the first section of the theoretical framework is quite straightforward, the higher discretion has the central bank, and the better inflation outcome is it for the nation. Or as we would have formulated it “the higher independence level, the lower inflation rates.” This is, what this thesis is about, a negative correlation between independence level and inflations rates, except from the fact that we suspect such a dependence unlikely to be true, at least not for Sweden and the Euro-zone. Besides, as we have mentioned earlier, central banks are not free from time-inconsistency problems either.
The second part of the theoretical framework, the Barro-Gordon Model shares the same corner pillar as of the hypothesis of this thesis, that central bank by itself cannot achieve price-stability, hence, only increasing central bank independence will not lead automatically to low and stable inflation. In Barro and Gordon’s terminology, it is called that the government must be institutionally committed to low and stable inflation, we say “sound fiscal and financial systems” are requirements that must be fulfilled for a nation to achieve and maintain price-stability”, so far no disagreements. Unfortunately, because the BGM ignores politicians short-term time-inconsistency, it is vague how they define central bank independence.

In short, our views may diverge significantly from rules versus discretion and time-inconsistency models, but it is backed up to some extend by the BGM.
4 DATA, MEASURES AND METHODS

The paper will focus its analysis on Sweden and the Euro-zone. The inflationary pattern monthly registered for these two areas for the period 1999M1-2009M4 will be examined against an index showing the degree of central bank independence. One-way analysis of variance (ANOVA) and Pearson product-moment correlation test constitute the methods behind this investigation. To measure inflation, we will use harmonized consumer price index from the ECB and statistics Sweden. (Scb)

4.1 Measures of Independence

Although there is a widely spread concept that the autonomy of a central bank promotes an efficient low inflation monetary policy, it is still questionable what will be included in this “independent status”. What should the central bank, independently be allowed to decide? Can an efficient central bank be free without being to free?

We distinguish three different angles from which central bank independence can be viewed: Goal, instrument and personal independence.

4.1.1 Goal Independence

Goal independence (Grilli et al. 1993) implies that the central bank should freely sets the goals for the monetary policy. In other words, the central bank should by itself choose between price-stability and nominal GDP growth, decide the inflation target (2% in Sweden) and the time horizon during which this goal should be achieved. Moreover, the bank should be permitted to define the concretes indices, their numerical target values and the definition of escape clauses. (Bofinger, 2001)

Giavazzi and Mikshin (2006) find it adequate that a central bank is goal dependent. They argue that by letting the government set the long-run goal for monetary policy, it will increase” the likelihood that it will pursue fiscal policies that facilitates achievement of the inflation target by the central bank.” (Giavazzi and Mishkin 2006 p. 57)

In Sweden however, it was the Riksbank and not the government that in 1993 decided to go over to inflation targeting and that the target should be 2% with a tolerance of +/-1 percentage point for deviations. Nevertheless, since 1996, in the yearly budget statement, the government gives support to the monetary policy set by the Riksbank, and thus takes officially ownership of the inflation targeting policy.

For the ECB, the Article 105 of the EC Treaty, states that the principal task of the ECB is to achieve price-stability. However, it is in the EC Treaty not specified any time period during which this goal must be achieved. Hence, it gives room to the ECB to follow other goals in the short run.

4.1.2 Instrument Independence

Apart from being goal independent, central bank independence can be perceived from a second aspect; it can be Instrument Independent.

Instrument independent refers to the ability of the central bank to independently from the government to set the instruments to achieve its monetary goals, e.g. the level of interest rates. (Recall the rules versus discretion discussion earlier in this paper)The idea behind an instrument independent central bank is that, monetary policy must be conducted with a long-run perspective while governments and politicians often suffer from only having short-term effects in mind. (Recall the time-inconsistency dilemma) It is thus, strongly advised that
central bank should be given the freedom to set the instruments they judge appropriate to pursue a successful monetary policy. Both the Riksbank and the ECB, even though at different levels, are instrument independents. (Giavazzi and Mishkin, 2006)

4.1.3 Personal Independence

Pursuant to Bofinger (2001), personal independence reduces the risk for informal influence from politicians towards central bankers’ e.g. central bank governor, executive board officials etc... Moreover, by deciding on the number of members in the decision-making organ of the central bank or the terms of office, politicians could indirectly try to inflict some influence on central bankers, this, even though the central bank is officially goal and instrument independent. It is therefore desirable that the legislation has a constitutional status, that the parliament rather than the government chooses members of the decision-making body and that the number of the members of the board is more than six.

In the Swedish Instrument of Government, a part of the Swedish Constitution, it is stated that “The Riksbank shall have a General Council comprising eleven members, who shall be elected by the Riksdag. The Riksbank shall be managed by an Executive Board appointed by the General Council.” (Executive Board 6 members) The Riksbank Act of 1999 extended the independent status of the Executive Board granting its members long-term appointments that protect them from severance from unemployment. (Giavazzi and Mishkin, 2006)

The same goes for the ECB. The Article 106 of the Treaty establishing the European Community says that” The ECB shall have legal personality. The ESCB shall be governed by the decision-making bodies of the ECB which shall be the Governing Council and the Executive Board.” (Executive Board 6 members; 16 governors of the national central banks of the 16 euro area countries.)

However, when it comes to being independent from political instructions, both the Riksbank and the ECB are granted full independence. According to the Riksbank Act (1988:1385), in the second article of the third chapter: “members of the Executive Board may neither seek nor take instructions when fulfilling their monetary policy duties.” The Instrument of Government also protects the Riksbank independence against influence from politicians by emphasizing in the thirteen article of the ninth chapter that: “No public authority may determine how the Riksbank shall decide in matters of monetary policy.”

For the ECB, the Article 108 of the Treaty says: “When exercising the powers and carrying out the tasks and duties conferred upon them by this Treaty and the Statute of the ESCB, neither the ECB, nor a national central bank, nor any member of their decision-making bodies shall seek or take instructions from Community institutions or bodies, from any government of a Member State or from any other body. The Community institutions and bodies and the governments of the Member States undertake to respect this principle and not to seek to influence the members of the decision-making bodies of the ECB or of the national central banks in the performance of their tasks.”

Consequently, the Riksbank and the ECB can be considered to some extend to be goal, instrument and personal independent or as Alesina and Summers would have said: political and economical independent.

In table 4.1, an index of central bank independence, CBI, has been divided into the sub-categories, goal, instrument and personal independence. The value varies between zero and
two. The higher the index, the greater is the degree of central bank independence. According to this table, the ECB is the central bank with the highest level of independence in the whole world, followed by the Fed and the Bank of Japan while again the Central Bank of New Zealand is the least independent. Sweden comes somewhere in the upper-bound with an index of 1.1 central independence.

In short, this table is only confirming what Alesina and Summers already made clear: the Bundesbank (which later became the ECB) closely followed by the FED are the most independent central banks; Sweden is in the middle and The Central Bank of New Zealand is the least independent.

Table 4.1 Index of Central Bank Independence

<table>
<thead>
<tr>
<th>Central Bank → Type of Independence ↓</th>
<th>ECB Eurozone</th>
<th>RIKSBANKEN Sweden</th>
<th>FED USA</th>
<th>BOJ Japan</th>
<th>BOC Canada</th>
<th>BoE England</th>
<th>RBNZ New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Instrument</td>
<td>1.33</td>
<td>0.66</td>
<td>0.66</td>
<td>0.66</td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Personal</td>
<td>1.8</td>
<td>0.6</td>
<td>1.2</td>
<td>0.8</td>
<td>1.1</td>
<td>0.26</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>1.7</td>
<td>1.1</td>
<td>1.3</td>
<td>1.2</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source: Bofinger (2001:219)

All the same, when drawing conclusions, one should keep in mind, as Bofinger, the original designer of this table summarized, that the construction of such an index implies problems of “...choosing the criteria that includes and of weighting the different elements of independence and the different criteria with each category” (Bofinger 2001 p. 219). To avoid these weighting issues, in the following index, each of the different variables has been given the same value.

4.2 One-Way Analysis of Variances

The analysis used in this paper is One-Way Analysis of Variances (ANOVA). Because we want in this thesis to identify the correlation between central bank independence and inflation rate by using an index as an independent variable; it is suitable to analyse mean values of different countries to check if they are significantly different from one another; that is to see if inflation rates are a result of central bank independence. Since the period analysed is relatively short (ten years) and the index does not vary over time, central bank independence level for Sweden is assumed to be constantly 1.1 and 1.7 for the ECB, the One-Way ANOVA is more appropriate than an ordinary least squares regression.

We make two principal assumptions in using the One-Way ANOVA: first, each cluster must be an independent random sample from a normally distributed population. Second, the clusters must have same and equal variance. To test if the second requirement of equal variance is fulfilled, a Levene Test, a test within the One-Way ANOVA will be performed.

The analysis is divided into two separate parts: an analysis within and between the clusters. If the mean values turn out to be equal, the null hypothesis will not be rejected and the samples will be assumed to belong to the same population.

4.3 The Bonferroni test

Even if a significant F-value from the One-Way ANOVA shows that the mean values are not equal, it still cannot tell which of the values differ. Thus, the need to conduct a test that adjusts the observed level of significance to the number of comparisons made. This is the reason why in addition to One-Way ANOVA, we also conduct a Bonferroni test.

For more details on the Bonferroni test, see the appendix at the end of this paper.
4.4 The Pearson's correlation test

Since we are in this thesis, trying to find a potential correlation between variables, central bank independence and inflation rates, it was accurate, in combination to the One-Way ANOVA, to also run a regular correlation test. The choice fall on the Pearson's test statistics simply because it is the most common.

A deeper description of the Pearson's correlation test is found in the appendix.
5 RESULTS AND ANALYSIS

Having conducted the Levene test that showed that the variances of the two groups were indeed equal, we went on for the One-Way ANOVA and Bonferroni test.

The results are summarized in Table 5.2 where inflation rates are tested against levels of central bank independence, 1.1 for Sweden and 1.7 the Euro-zone respectively.

Table 5.2 One-Way ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>245,208</td>
<td>1</td>
<td>245,208</td>
<td>809,338</td>
<td>.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>74,531</td>
<td>246</td>
<td>303</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>319,739</td>
<td>247</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since the variance between the groups is very much larger than the variance within the group, showed by the high F-value, it is obvious that Sweden differs from the Euro-zone. The significance level alpha is 0.01 and the recorded P-value (2.2e-16~0) is lower, the mean values between those two areas, Sweden and the Euro-zone are obviously not equal.

The conclusion is hence that the Bonferroni test between inflation rates in the Euro-zone and Sweden and the respective central bank independence level shows that the mean values are different (see table 5.2 and appendix.) The box plot 5.4 in the appendix shows graphically how the two groups differ.

This conclusion is in line with the theoretical framework of the thesis (recall rules versus discretion and time-inconsistency dilemma); there are differences in the level of inflation rates depending on the level of central bank independence.

In the comparison between Sweden and the Euro-zone, we also found that Sweden, with less central independence showed lower inflation compared to the Euro-zone as graph 3 clearly displays. A finding that is totally in opposition to earlier studies notably the work by Alesina and Summers, who found that less independent central banks higher inflation rates. According to the rules versus discretion model, we will expect the inflation rates of Sweden to be higher due to the lower degree of independence of its central bank. However, as the hypothesis of this thesis goes, the Swedish lower inflation rates are indeed supporting the suspicions that higher central bank independence does not automatically lead to lower inflation.
Moreover, we tested for correlation between central bank independence level and inflation rates. The result of the Pearson's correlation test showed there was no negative correlation between central bank independence and inflation. Furthermore, Pearson's correlation coefficient was found to be 0.117 (see table 5.5), a very weak positive relationship. Again, this outcome is in accordance with the conviction of this testis: that central bank independence can neither achieve nor maintain price-stability as some previous studies, such as the Daunfeldt and de Luna research paper also revealed. Paraphrased, the Daunfeldt and de Luna’s argument is that the central bank independence is most unlikely to be able to explain the achievement of a low and stable inflation goal. As the reader recall, Daunfeldt and de Luna found that for most European countries, Sweden and the majority of EMU members included, price-stability was achieved years before the institutional reforms that made central banks more independent. Of course, one can argue that Daunfeldt and de Luna’s study only indicates that central bank independence does not lie behind the achievement of low and stable inflation but says nothing about the maintenance of that price-stability once achieved. Perhaps, central bank independence is not the key to the achievement of price-stability but fundamental to keep it that way, low and stable can the reader argue. It is tempting to accept such an elegant justification. However, the time-horizon in focus in this paper is 1999-2009, a post-low inflation achievement period. The point is, if central bank independence was the explanation behind the maintenance of price-stability, we will expect the ECB to perform better than the Riksbank, since it is more independent and should hence maintain price-stability better than the Riksbank, which it does not. (see graph 3) Hence, the weak 0.117 correlation found in this paper is therefore confirming our and Daunfeldt and de Luna suspicions: central bank independence is weakly correlated to inflation rates and cannot be accredited the responsibility of neither achieve nor maintain price-stability.

There is a widespread idea that countries with an independent central bank perform better on price stability. This idea has even been confirmed by many empirical studies. Yet, using One-Way ANOVA together with other Pearson's correlation test and looking at Sweden and the Euro-zone, we could in this paper not find any support for this concept. In contrast to some earlier studies such as the study by Alesina and Summers but in line with the hypothesis of this thesis; there was no sign of negative linear correlation between central independence and inflation rates. In fact, as displayed in graph.3, there was higher inflation in the Euro-zone, suggesting that in these two cases, with Sweden and the Euro-zone, central bank independence is not leading to lower inflation and at the limit there could be some weak positive relationship between the two variables. These results are in accordance with previous studies mentioned in the beginning of this paper both by Bofinger (2001) and Daunfeldt and
de Luna (2008). Indeed, neither could Bofinger (2001) in Table 5.7 in the appendix find any negative relationship between these variables even though, it should be mentioned, he, just as he criticised Grill, also only looked at 4 (inflation stable) years.

**Graph 3** Inflation rates Sweden versus Euro-zone

![Graph showing inflation rates for Sweden and Euro-zone with red and blue lines representing different years.](image)
6 LIMITATIONS

Because of limited disposal time and the tremendous supply of books and articles about this topic, it would have been impossible to cover all the literature in the area.

The results and conclusions from this paper are therefore limited by the material we could access and gather. Also, this paper should be read, set and understood in its context. One should keep in mind that reality is much more complicated than any theoretical model.

Since this is a relatively new area of research, it could of course, be that other very significant factors affecting price stability have been omitted in this paper. Covering every possible aspect of a low inflation goal was never the ambition of this paper. There are as the reader understands a selection of factors, and within that group we have selected what we think are decisive factors. The conclusions mentioned above should thus be taken with caution, the reader being aware that this paper is far from being flawless.

Of course, these results should be treated with great caution, even 10 years is a rather short time period. Even more important is that we are here only looking at two specific areas with very specific financial, political and social background and environments. For instance, Sweden has had the last 10 years some advantageous features such as low rates of natural unemployment, steep short-term Phillips curves and stable government with a strong commitment to price-stability, features which not all countries have. It would be naive to apply these conclusions to other nations or areas with different conditions and outcomes. Also, economical and inflation wise, Sweden is an outlier, hence comparing the Euro-zone with a country whose performance as been qualified to be outstanding, does not leave room for general applications standards.

The reader should also remember that, this thesis is only testing for linear correlation, that is, we assume that the rate of change of the variables is constant; hence when we conclude that there is no negative correlation, we are only referring to a lack of negative linear dependence between central bank independence and inflation rates.

There could however, be nonlinear interactions between central bank independence and inflation rates.

Moreover, the last decades has been a period with many particular events, 9/11, the current worldwide financial crisis to mention some; and it is still too early to draw definite conclusions on the repercussions of these instabilities in an inflation perspective.

Nevertheless, these findings are interesting because they somehow question the established role played by independent central banks in the achievement and the maintenance of price-stability. There are no miracle pills, and increasing central bank independence is definitely not one of them.
7 CONCLUSIONS

The purpose of this paper was to analyse if central bank independence affects price-stability, looking at the Riksbank and the ECB.

Our theoretical and empirical analysis could not detect any direct causality correlation between central bank independence and inflation rates. There was no clear evidence that greater central bank independence lowers the rate of inflation. Our point of view is that, the potential positive effects central bank independence could have on inflation levels can only be considered together with other social, political and structural factors, which determine the inflation outcome of a nation.

At the light of the Riksbank and the ECB journey, our suggestion is that by positively affecting the credibility of the central bank, the independence factor can indeed promote price-stability. Thereby, a possibility could be that an independent central bank even though not essential for achieving price-stability, can be advantageous in maintaining it. Besides, as proved by earlier studies, in Sweden and the Euro-zone, price-stability was achieved years before the respective central banks were made officially and legally independent.

However, if central bank independence cannot explain the low and stable inflation in Sweden and the Euro-zone, the natural question is: "what other factors lie behind the price-stability experienced in these two areas for the last decades?"

According to previous studies and our own analysis on this topic, we find a true commitment to sound fiscal policy and a strong inflation adverse social attitude to be the variables that most strongly will determine the outcome of a low and stable inflation goal. This leads to one conclusion, that decisive for a successful price-stability oriented monetary policy is and has always been a credible central bank, independent or not. Thus, a government that runs a responsible fiscal policy and a public that has a strong aversion against inflation will most likely pave the way for a credible central bank and hence to price-stability.

This point of view is strengthened by Sweden and the Euro-area economic background. Both zones have signed the Maastricht Treaty that bans out the possibility of printing money to finance budget deficit. In other words, with the adoption of the Maastricht Treaty, Sweden and all the countries of the Euro-area committed to sound public finances. Moreover, because of the traumatic inflation history of Germany (recall the great German hyperinflation of the 1920s), its central bank, the Bundesbank, which will later become the ECB, had very high credibility in the eyes of the public. Well-known is the quote from Jacques Delors, President of the European Commission in 1992: “Not all Germans believe in God, but they all believe in the Bundesbank.” summarizing well the close trusting relationship Germans had with their central bank.

Sweden may not have experienced what Germany did in terms of tremendous inflation fluctuations but still, in the 70 and 80s, Sweden went through huge changes and tested once for all the consequences of high and unstable inflation. The banking crisis of the early 90s when the government chose the higher path and did not pressure the Riksbank to buy government bonds to finance the then current budget deficit, showed the government willingness to run responsible fiscal policy. Of course, with lower demand due the 90s crisis followed lower expected inflation and as the reader understands, the inflation trend principally depends on expectations, and when those are low, the trend will most likely also be downsloping. As much as Germany is known for its after-war inflation fluctuations, is
Sweden known for its egalitarian system where the worker is the central actor. Thus, by claiming that: “The Riksbank is the worker’s best friend”, the LO\textsuperscript{1}-economist Dan Andersson in the same way as Jacques Delors, emphasized the crucial role played by the central bank in the life of every worker, of every Swedish. Hence, although though to different extends, Sweden and the Euro-zone, having stable governments, sound fiscal policies, high preference for price-stability among their populations and thereby credible central banks, reached low and stable inflation, disregarding in our opinion, of the degree of formal\textsuperscript{2} independence of their central banks. The presumptions, are of course, not true for all other countries of the globe.

Therefore, this paper suggests that the role of central bank independence should not be overrated and shadow the adequate means that need to be improved in order to achieve price-stability. In advising other nations which seek this same goal, economists should rather focus on relevant factors, adapting solutions to the reality in place instead of applying general after-hand made rules which in fact are far from deserving the credit they are given.
8 FUTURE STUDIES

The limitations of this thesis and the scope for which it has been analysed, leaves great room for further studies on the topic.

For instance, one could, more explicitly study the real effects of central bank independence on inflation rates in western open economies versus developing ones, to see if these effects are strongly dependent on other economical and political variables such as unemployment, growth, political regimes etc.

Also, a period of ten years (1999-2009) is relatively short; the same study could be done for a longer time period to see if the pattern gets different. Further empirical testing is recommended, perhaps including further variables and other European countries.

In this paper, we claim that the most important criteria for a successful price-stability oriented central bank, is for it to be credible. Further studies could extensively analyse this correlation, credibility and central banks. One could also test for other factors other than those mentioned in this paper (sound fiscal policy, stable and responsible government, inflation adverse attitude ect.) that could also affects the credibility of the central bank.

Even more interesting, in a price-stability oriented monetary point of view is, the current worldwide financial crisis. Are the more independent central banks performing better than the less independent in these crisis time? Is the central bank long-run price-stability goal being overlooked in favour of short-term governmental goals? How governments are with dependent respective independent central banks facing the time-inconsistency dilemma in today’s almost text book financial crisis example?
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APPENDIX I

More on the terminology
Inflation is the percentage change in prices often measured as the percentage change in consumer price index CPI. Inflation is reported yearly.

Hyperinflation is a situation of very high and unstable inflation. Inflation exceeding 50% per month is considered “hyper”.

Formal independence refers to the implementation date of the institutional reforms granting central banks more independence according to Daunfelt and de Luna.

LO is the central organisation in Sweden for 15 affiliates which organise workers within both the private and the public sectors.

More on the Euro-zone
The Euro (€) is the official currency of 16 of the 27 member states of the European Union (EU). Sweden is since 1995 member of the EU.

The Euro-zone countries

1. Austria
2. Belgium
3. Cyprus
4. Finland
5. France
6. Germany
7. Greece
8. Ireland
9. Italy
10. Luxembourg
11. Malta
12. Netherlands
13. Portugal
14. Slovakia
15. Slovenia
16. Spain

Source: http://en.wikipedia.org/wiki/EU_(disambiguation)
APPENDIX II

More on the empirical analysis

Results
Terms and abbreviations used in this section
CBI = central bank independence
IR = inflation rates
DF = degree of freedom
CF = confidence interval
Alpha = α = 0.01
Number of groups K = 2
Number of observations N = 248

Result from the Levene test
We started by running a Levene test with the following hypotheses:
Null hypothesis H₀: the variances are equal: σ₁ = σ₂
Alternative hypothesis H₁: the variances are not equal: σ₁ ≠ σ₂
Since the p-value = 0.047 > alpha = 0.01 we cannot reject the null hypothesis of equal means.

Table 5.1 Levene

**Test of Homogeneity of Variances**

<table>
<thead>
<tr>
<th>inflations</th>
<th>weu</th>
<th>euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levene Statistic</td>
<td>df 1</td>
<td>df 2</td>
</tr>
<tr>
<td>3.979</td>
<td>1</td>
<td>246</td>
</tr>
</tbody>
</table>
APPENDIX III

More on the empirical analysis

We went on for the One-Way ANOVA testing the following hypotheses

Null hypothesis $H_0$: the means are equal: $\mu_1 = \mu_2$

Alternative hypothesis $H_a$: the means are not equal. $\mu_1 \neq \mu_2$

Result from the One-way-ANOVA

Table 5.2 One-Way ANOVA

<table>
<thead>
<tr>
<th>inflation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>in</td>
<td>245,208</td>
<td>1</td>
<td>245,208</td>
<td>809,338</td>
<td>.000</td>
</tr>
<tr>
<td>s</td>
<td>74,531</td>
<td>246</td>
<td>.303</td>
<td></td>
<td></td>
</tr>
<tr>
<td>euro</td>
<td>319,739</td>
<td>247</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$p$-value $= 2.22^{-16}$ which is very close to zero

Since the $p$-value $=2.2e-16 < \alpha =0.01$ we can reject the null hypothesis of equal means.

Conclusion: The means are not equal
APPENDIX IV

More on the empirical analysis 3

Result from the Bonferroni test

Table 5.3 Bonferroni test

<table>
<thead>
<tr>
<th></th>
<th>Mean value</th>
<th>Variance</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro-zone (1.7)</td>
<td>2.1427419</td>
<td>0.4128737</td>
<td>0.6425525</td>
</tr>
<tr>
<td>Sweden (1.1)</td>
<td>0.1540323</td>
<td>0.1930730</td>
<td>0.4394008</td>
</tr>
</tbody>
</table>

The Bonferroni test between inflation rates in the Euro-zone and Sweden and the respective central bank independence level shows that the mean values are different as shown in the box plot below.

Table 5.4 Box Plot of the Bonferroni

Result from Pearson’s product-moment correlation r

Table 5.5 Pearson’s correlation test

<table>
<thead>
<tr>
<th></th>
<th>inflationswe Pearson Correlation</th>
<th>inflationswe Sig. (2-tailed)</th>
<th>inflationswe N</th>
<th>inflationeuro Pearson Correlation</th>
<th>inflationeuro Sig. (2-tailed)</th>
<th>inflationeuro N</th>
</tr>
</thead>
<tbody>
<tr>
<td>inflationswe</td>
<td>1,000</td>
<td>.117</td>
<td>124</td>
<td>1,117</td>
<td>.197</td>
<td>124</td>
</tr>
<tr>
<td>inflationeuro</td>
<td>.117</td>
<td>1,000</td>
<td>124</td>
<td></td>
<td>.197</td>
<td>124</td>
</tr>
</tbody>
</table>

Correlation coefficient $r = 0.117$ (weak but yet existing positive correlation)

Conclusion: We cannot reject the null hypothesis of no correlation. In other words, we can reject the alternative claiming that there is negative correlation.
APPENDIX V

More on the empirical analysis

Result from Kendall’s rank correlation tau

Table 5.6 Kendall's correlation test

<table>
<thead>
<tr>
<th>Correlations</th>
<th>inflationsw</th>
<th>Inflationuro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kendall's tau_b</td>
<td>Correlation Coefficient</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.</td>
</tr>
<tr>
<td>N</td>
<td>124</td>
<td>124</td>
</tr>
<tr>
<td>inflationsuro</td>
<td>Correlation Coefficient</td>
<td>0.098</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.128</td>
</tr>
<tr>
<td>N</td>
<td>124</td>
<td>124</td>
</tr>
</tbody>
</table>

**Tau, the correlation coefficient = 0.098 (again, extremely weak correlation)**

**Conclusion:** We cannot reject the null hypothesis of no correlation. In other words, we can reject the alternative claiming that there is negative correlation.

More on the Bonferroni test

The Bonferroni test is a multiple-comparison procedure used to determine the significant differences between cluster means in an analysis of variance. It is a safeguard against multiple tests of statistical significance on the same data wrongly giving the appearance of significance. (Shaffer, 1995)

The Bonferroni test procedure has been criticized for being too conservative for highly correlated test statistics, hence resulting in a high probability of Type II errors, i.e. failure to reject a false null hypothesis. (Simes, 1986)

However, in this paper the correlation between the variables was almost non-existing, therefore, one needs not to worry about the probability of failing to reject a false null hypothesis.

More on the Pearson's and Kendall's correlation statistics

The two methods estimate each the association between paired samples and compute a test of the value being zero. They use different measures of association, all in the range [-1, 1] with 0 indicating no association. These are sometimes referred to as tests of no correlation, but that term is often confined to the default method.

The Pearson’s test statistic is based on Pearson's product moment correlation coefficient \( r(x, y) \) and follows a t- distribution with \( \text{length}(x) - 2 \) degrees of freedom if the samples follow independent normal distributions. It is the usual measure of correlation, varying from -1 to +1, with 0 indicating no relationship and 1 indicating perfect relationship and a value of -1 is a perfect negative relationship.

The Kendall's tau or Spearman's rho statistic is used to estimate a rank-based measure of association. For Kendall's test, an exact p-value is computed if there are less than 50 paired samples containing finite values and there are no ties. Otherwise, the test statistic is the estimate scaled to zero mean and unit variance, and is approximately normally distributed.
APPENDIX VI

More on IR and CBI

Table 5.7 Inflation and central bank independence 1996-2000

<table>
<thead>
<tr>
<th>Central Banks</th>
<th>CB-Independence</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECB</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>FED</td>
<td>1.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Bank of Japan</td>
<td>1.2</td>
<td>-0.4</td>
</tr>
<tr>
<td>Swedish Central Riksbank</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Bank of Canada</td>
<td>0.81</td>
<td>1.0</td>
</tr>
<tr>
<td>Bank of England</td>
<td>0.53</td>
<td>2.7</td>
</tr>
<tr>
<td>Reserve Bank New Zealand</td>
<td>0.51</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Source: Bofinger (2001: p. 220)

Graph 1 Inflation rates in Sweden Jan 1999-April 2009

Graph 2 Inflation rates in Eurozone Jan 1999-April 2009
Appendix VII

Equation 1

- Policy rules and the existence of shocks in the economy
  - Result under rational expectations (discretion)
    \[ \Delta m = \Delta m^* = \frac{\alpha \beta (1 - k) u^n}{1 + \alpha^2 \beta} + \frac{\alpha^2 \beta}{1 + \alpha^2 \beta} \pi^e + \frac{\alpha \beta}{1 + \alpha^2 \beta} \varepsilon \]
    \[ \pi^e = E[\pi^*] = \alpha \beta (1 - k) u^n \]
    \[ \Delta m_{rol} = \pi_{rol} = \alpha \beta (1 - k) u^n + \frac{\alpha \beta}{1 + \alpha^2 \beta} \varepsilon \]
    \[ u_{rol} = u^n + \frac{1}{1 + \alpha^2 \beta} \varepsilon \]
    \[ E[Z_{rol}] = \beta (1 + \alpha^2 \beta) \left[ (1 - k) u^n \right]^2 + \frac{\beta}{1 + \alpha^2 \beta} \sigma_e^2 \]

Where \( \pi^* \) = optimal inflation rate, \( \pi^e \) = expected inflation, \( U^n \) = natural rate of unemployment

- Policy rules and the existence of shocks in the economy
  - Result under a policy rule (strict targeting rule)
    \[ \Delta m_{rule} = \pi_{rule} = \pi^e = 0 \]
    \[ u_{rule} = u^n + \varepsilon \]
    \[ E[Z_{rule}] = \beta \left[ (1 - k) u^n \right]^2 + \beta \sigma_e^2 \]
  - Policy rule is superior only if:
    \[ \frac{1}{1 + \alpha^2 \beta} \sigma_e^2 < \left[ (1 - k) u^n \right]^2 \]
    \[ \Rightarrow \alpha \uparrow \beta \uparrow u^n \uparrow \sigma_e^2 \downarrow k \downarrow \]
    \[ \Rightarrow \text{if } k = 1: \text{ discretion is always better} \]
APPENDIX VIII

Barro-Gordon model
- Social welfare function = target of central bank
  \[ Z = \beta (u - u^*)^2 + \pi^2 \]
  \[ \beta > 0 \]
- Expectations augmented Phillips curve
  \[ u = u^* - \alpha (\pi - \pi^*) \]
  \[ u^* < u^e \]
  \[ u^* = k u^e \]
  \[ 0 < k < 1 \]
- Central bank fully controls inflation
  \[ \pi = \Delta m \]
- Solve for optimal inflation
  \[ \Delta m = \pi^* = \frac{\alpha \beta (1 - k) u^e}{1 + \alpha^2 \beta} + \frac{\alpha^2 \beta}{1 + \alpha^2 \beta} \pi^e = \phi(\pi^*) \]
- If \( \pi^e = 0 \): surprise inflation
  \[ \Delta m = \pi^e = \frac{\alpha \beta (1 - k) u^e}{1 + \alpha^2 \beta} > 0 \]
  \[ u^e = u^e - \frac{\alpha^2 \beta (1 - k) u^e}{1 + \alpha^2 \beta} < u^e \]
  \[ Z = \frac{\beta}{1 + \alpha^2 \beta} \left( 1 - k \right) u^e \]
- Rational expectations: \( \pi^e = \pi^* \)
  \[ \Delta m_{net} = \pi^e = \alpha \beta (1 - k) u^e > \pi_S \]
  \[ u^e > u^* \]
  \[ Z_{net} = \beta \left( 1 + \alpha^2 \beta \right) \left( 1 - k \right) u^e > Z_S \]

Equation 3

Where \( \pi^* \) = optimal inflation rate, \( \pi^e \) = expected inflation, \( U^n = \) natural rate of unemployment, \( \beta \) = preference parameter

\[ \pi^* = \left[ ab \left( 1 - k \right) U^n / 1 - a^2 b \right] + \left[ a^2 b / 1 + a^2 b \right] \pi^e = \Phi(\pi^e) \]  
Equation 4

\( U^n = \) natural rate of unemployment
\( U^n, a, b \) and \( k (0 < k < 1) \) = positive

K = efficiency criterion for the entire economy

Optimal inflation depends on expected inflation

Inflation will be above zero even if the public expects it to be zero (and the central acts along)
\( \rightarrow \) by positive inflation the central bank will aim to achieve positive employment.