Optimal Central Bank Transparency – Assessing the Holy Grail of Monetary Policy

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Preface

Although I am the sole author of this thesis – and it should be emphasized that the remaining mistakes are my responsibility – there are some who deserve to be mentioned.

First, I wish to thank my enthusiastic supervisor, Nina Larsson Midthjell. After attending a few of her lectures on monetary policy, the question was not whether I wanted to write about monetary policy, but rather which topic within monetary policy I wanted to go for. The guidance in the process of writing this thesis, as well as the discussions of current monetary policy events, have been invaluable.

Second, my significant other, Caroline, should be praised for her patience throughout the years. Hopefully she will forgive me for being, on average, three months late with birthday presents. Third, Henriette, my sister, and her husband Henrik, deserve to be mentioned. The timing of their child leave was perfect as it coincided with the opening of a vacancy as IT-support for me and my LaTeX-problems. I also wish to thank Henriette for proofreading the thesis.

Finally, I wish to thank the committee of the *Professorship in Macro and Monetary Policy Issues* for the scholarship granted.

Abstract

Although central bank transparency has increased rapidly in recent time, the empirical documentation of its effects remains scarce. In addition, the literature on the topic is fragmented. This thesis seeks to shed light on the discussion of the optimal degree of central bank transparency by reviewing the literature on the topic and providing an analysis of the current degree of central bank transparency and its effects.

First, by providing a theoretical framework for the analysis of monetary policy, the relevance of transparency as a solution to the time-inconsistency problem is highlighted. Being clear about its incentives might result in more credibility for the central bank, making it less costly to reach the targets set. Furthermore, central bank credibility is at the center of attention when analyzing the trade-offs central banks face when introducing forward guidance. Clearer communication in the form of a promise of future monetary policy stance might be more effective in affecting the private agents' expecations, but this benefit must be weighted against the risk of ending up in a sub-optimal state in the future time period. The central bank's information, both in the sense of being able to distinguish cost shocks from demand shocks and to forecast future values of macroconomic variables accurately, should be a major part of the discussion prior to an introduction of forward guidance. Precise communication can to some degree solve this problem, but, as my analysis of the Bank of England's revision of forward guidance in 2014 shows, it is challenging for the central bank to communicate its intentions accurately to the markets.

In order to analyze transparency and its effects, a notion of what central bank transparency is, is needed. Geraats' five transparency categories establish a taxonomy for measuring transparency. She distinguishes between political, economic, procedural, policy and operational transparency. The central banks of OECD-countries included in the analysis receive high scores for their political – the institutional arrangements – and economic – openess about models, forecasts and data – transparency. The same central banks score lower on procedural transparency – transparency about the decision-making process. Procedural transparency is particularly important for the accountability of the independent central banks, and its low level is therefore raising democratic concerns.

Documented by for instance Dincer and Eichengreen (2013), central bank transparency has increased in recent time. The authors find that the degree of central bank transparency almost doubled from 1998 to 2010. An update of 10 central banks' transparency policies shows that the development of transparency has

continued since 2010. Bank of Japan and the Federal Reserve have both implemented inflation targets, and have, along with Bank of England and the ECB, introduced forward guidance to monetary policy. Furthermore, it is interesting to note that the transparency policies adopted by central banks small economies, such as the Reserve Bank of New Zealand and Sveriges Riksbank, have been followed by increased transparency among the central banks of more important economies.

Having quantified the evolution of central bank transparency, an empirical analysis of its impacts on the economy is the natural next step. There exists a large literature on risk-aversion, and a reduction of uncertainty is seen as beneficial. I will therefore not discuss the benefits of reduced volatility in great detail. Dincer and Eichengreen (2013) use panel data methods to conclude that transparency reduces inflation volatility and the level of inflation, while Crowe and Meade (2008) find that the variance of the private actors' forecast is reduced by increasing transparency. I follow Dincer and Eichengreen (2013) in examining whether transparency reduces inflation volatility and the inflation level, but I expand my analysis as I include output volatility in the analysis. In addition, I include the values of the lagged dependent variables in the analysis, thereby providing an arguably more robust framework. Furthermore, I isolate the effect of the various transparency categories. I use Stata as the statistical software package for analyzing a panel data set consisting of OECD-countries observed from 1998 to 2010. Depending on the outcome of the Hausman test and the Breusch-Pagan test, I use either the random effect or the fixed effect model.[1] I find that increased central bank transparency over time statistically significantly reduces the level of inflation, and weaker evidence of transparency reducing the volatility of inflation. The analysis also suggests that the marginal effect of transparency is diminishing as transparency increases, and that economic transparency is the only category with a statistically significant negative effect on inflation volatility when the analysis isolates the various categories. Furthermore, although not statistically significant, policy transparency seems to reduce the volatility of both inflation and output, as well as the level of inflation. The effect of transparency on output volatility is less conclusive.

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[1] Further specification of the model includes tests for autocorrelation, heteroscedasticity and cross-sectional dependence. In addition, I use an F-test to test time effects.

Contents

1 Introduction

Monetary policy has in recent years undergone remarkable changes in how it is communicated. Historically, central bank communication has been characterized by its lack of clarity, which stands in great contrast to the degree of transparency adopted by many central banks today. Once renowned for its secrecy, the Federal Reserve of the United States (henceforth Fed) serves as an example of this development. In 1993, the first step toward more transparency was taken when the Fed decided to publish minutes, which since 2004 have been made available with a shorter time lag.[2] The introduction of press conferences in 2011, the implementation of a 2 percent inflation target in 2012 along with an increasing use of forward guidance in recent years, are further examples of more transparency; the Fed has moved from mumbling to clarity:

> *Since I've become a central banker, I've learned to mumble with great incoherence.* - Alan Greenspan (1987)[3]

> *In particular, the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 % and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 %...* - Federal Open Market Committee (2012)[4]

The development toward higher degree of transparency is not unique to the Fed. Bank of Japan introduced an explicit inflation target in February 2012 and has recently begun publishing quarterly projections on inflation and output. Bank of England (henceforth BoE), along with the Bank of Japan and the Fed, has introduced forward guidance to its monetary policy. Furthermore, the central banks that were already quite transparent at the beginning of this millenium have continued to adopt new transparency measures. Sveriges Riksbank, for instance, has followed the Reserve Bank of New Zealand (henceforth RBNZ) in publishing its forecast on the key policy rates, and has also disclosed Ramses II, its macroeconomic model used for policy analysis.

To understand the possible economic benefits of central bank transparency, we need to look at how monetary policy impacts economic activity. The response following the financial crisis of 2008 was based on the belief that monetary policy actions impacts the real economy. By lowering interest rates, increasing money supply and signalling

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[2]From 1993 to 2004, the minutes were published six weeks after the monetary policy meeting. Since 2004, this lag has been reduced to three weeks.

[3]As quoted in the Wall Street Journal, September 22. See (Geraats, 2007, p.1).

[4]See: http://www.federalreserve.gov/newsevents/press/monetary/20121212a.htm

future expansionary monetary policy, the central banks sought to stimulate to more investments and consumption. Through more transparency, the central banks might increase the private agents' understanding of the conduction of monetary policy, resulting in these measures being more effective. Today's extensive use of forward guidance by major central banks is a clear sign of the emphasis on affecting private expectations.

Reflected in the various inflation targets introduced by central banks over the last 20 years, stable inflation is among the most important promised result of transparent monetary policy actions. The communication of an inflation target reduces the uncertainty under which the agents of the economy operate, making them better equipped to make decisions regarding consumption, investments and future monetary policy actions. Through the focus on *flexible* inflation targeting, reduced output fluctuations is also a possible consequence of more transparent central banks.[5] Reducing the volatility of output is favorable since it reduces employment volatility, resulting in reduced economic uncertainty for the agents.

The trend toward higher degree of transparency is accompanied by challenges. In particular, the more explicit the forward guidance is, the more likely it is that there will be a future trade-off between flexibility and credibility. The BoE's recent revision of its forward guidance serves as an example. In August 2013, the BoE announced that it would not revise its monetary policy at least until unemployment fell below a 7 % threshold – a number that was not expected to be reached until 2016. Although this forward guidance was not explicitly time-contingent, it was perceived as so implicitly through the forecasts made. The unemployment rate fell sharply in the six months following the August meeting, ending up at 7.1 % in February 2014, just before the monetary policy meeting. As a result, the BoE revised its forward guidance to include 18 different indicators to monitor, and claimed that this information will provide better clarity of the MPC's judgements. Nevertheless, the unemployment rate, although it was easily communicated, failed to serve as an appropriate indicator for the economic recovery. Whether or not this early and drastic change in its forward guidance affects the central bank credibility, remains to be seen.

The literature on transparency practices is small but influential (Geraats, 2009, p. 236). Dincer and Eichengreen (2013) have in a series of articles built a data set covering 120 central banks' transparency from 1998 to 2010. They find that almost every central

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[5]As opposed to strict inflation targeting, flexible targeting allows for inflation to deviate from target in order to stabilize other targets such as output growth.

bank has become more transparent over the time period, which is a stronger conclusion than the one presented by Crowe and Meade (2008), who find that the increase in transparency only is significant for the developed countries. Dincer and Eichengreen (2013) find that increased transparency reduces inflation volatility, while Crowe and Meade (2008) conclude that a higher degree of transparency lowers the volatility of the market agents' forecasts. Since the literature on central bank transparency is quite limited, the effect of transparency on the various macroeconomic variables is also scarcely documented. Chapter 4 discusses two different approaches used to examine the effect central bank transparency has on macroeconomic variables, and briefly presents the results from the analyses utilizing those.

In this thesis, I assess the optimal degree of central bank transparency. As I view the literature on the topic as fragmented, I provide a thorough review of the literature on the topic. To highlight the relevance of the theoretical contribution, I present an in-depth analysis of the BoE's introduction and revision of forward guidance. Furthermore, to get a solid understanding of how central bank transparency has evolved in recent time, one needs to know both the descriptive statistics and how transparency is measured. Therefore, I provide both a quantitative and a qualitative approach to central bank transparency: First, descriptive statistics of a sample counting 120 central banks; second, an in-depth analysis of the various measures taken by a sub-sample of these central banks. It is evident that central bank transparency has increased over the last 16 years, and that there is great heterogeniety among central banks. This variation across years is valuable for my empirical analysis of central bank transparency.[6] The panel data set covering 22 central banks in OECD-countries from 1998 to 2010 suggests that a higher degree of central bank transparency over time reduces the level of inflation. Transparency might also reduce inflation volatility, but the findings are not equally robust. Its effect on output volatility is less convincing.

The remaining of the paper is organized in the following way: Chapter 2 provides a theoretical framework for the analysis of central bank transparency. Chapter 3 provides the theoretical arguments in the analysis of the optimal degree of transparency, as well as a detailed analysis of the BoE's forward guidance which serves as a reminder of the challenges related to central bank transparency. Chapter 4 provides an empirical framework for central bank transparency, how this transparency has evolved and a qualitative analysis of today's transparency of major central banks . Chapter 5 presents the empirical approach and the results from the analysis. Chapter 6 concludes.

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[6]I have used Stata to perform the analyses.

2 Central Bank Transparency - a Theoretical Framework

One of the most embraced ideas in today's macroeconomic theory is the notion about private agents being forward-looking. Instead of just taking tomorrow's state as given, the private agents form expectations about future prices and output level, which in turn results in beliefs about how future economic factors, such as real wages, will evolve. Agents operating in an uncertain environment will find that economic stability make them better equipped to make decisions. Low and stable inflation is beneficial both for the households and the firms of the economy. The households are able to make better decisions concerning both present and future consumption, while the firms find that their investment decisions are based on a more complete information set. An entreprenuer planning an investment today will typically have a potential cash flow in future time periods. If inflation is fairly stable, the entrepreneur knows the value of future revenues, making her better equipped to make the investment decision. Furthermore, lower output volatility is desirable for the private agents when forming expectations. By reducing output fluctuations, the employment rate will be more stable, resulting in reduced uncertainty for the private agents. This latter source of uncertainty is particularly important if much of the change in labor demand is on the extensive margin.[7] The opposite is true if firms hoard labor following a drop in demand, as Leitner and Stehrer (2012) find for a sample of EU-countries following the financial crisis. Nevertheless, from an individual's percpective, whether or not she is employed in the future is crucial for her expectations and thus also for today's consumption decisions.

Having briefly argued that a reduction in the volatility of different macroeconomic variables is beneficial for private agents forming expectations, the rest of this thesis seeks to explain and examine how central bank transparency can result in more easily achieving such stability. In this chapter, I will first briefly present the time-inconsistency problem raised by Kydland and Prescott (1977), which can be seen as a starting point for the analysis of the role of transparency in central banking. Second, I provide a thorough description of the concept of transparency. Third, I explain the concept of forward guidance since this has been a very central part of the recent transparency policy by today's most important central banks.

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[7]Changes on the extensive margin is equivalent to changes in the employment rate, while changes in the intensive margin measures the change in hours worked among the employed.

2.1 The Time-Inconsistency Problem

Although it is hard to pin down exactly when transparency became increasingly debated, a natural starting point is the time-inconsistency problem raised by Kydland and Prescott (1977) in their Nobel Prize winning paper "Rules Rather Than Discretion: The Inconsistency of Optimal Plans". Along with Barro and Gordon (1983), this paper has laid the foundation for much of the modern analysis of central bank behaviour.

Barro and Gordon (1983) model a central bank which minimizes a loss function dependent on two variables: inflation and output.[8] In the model, the monetary policy authorities have control over money supply, and therefore also control inflation. Analytically, the loss function can be presented in the following way:

$$L_t = \frac{1}{2}[(\pi_t - \pi^*)^2 + \lambda(y_t - y^*)^2]$$

(1)

Distortions in the economy, such as the ones following from monopolistic competition, political pressure and inefficient labor markets, affect the economy negatively, making the natural level of output sub-optimal. Therefore, the central bank seeks to reach the socially optimal level y^*, which is higher than the natural level of output. Deviations from the inflation target, π^*, and from the socially optimal output level, y^*, are seen as welfare losses. The gaps are quadratic, that is, the marginal loss of additional deviation is greater when the absolute level of this deviation already is high.[9] Furthermore, λ measures the relative weight the central bank puts on output stabilization. In the model, the dynamics of the economy is governed by the Lucas supply equation and the inflation expectations formed by the private agents:

$$y_t = y_t^{natural} + \gamma(\pi_t - \pi_t^e) + \epsilon_t$$

(2)

$$\pi_t^e = E_{t-1}[\pi_t]$$

(3)

Where ϵ_t is an i.i.d. supply shock, while γ measures how sensitive the level of output is to an "inflation surprise", that is, to inflation deviating from the private expectations. From equation (2) we see that output will be higher (for any positive non-zero value

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[8]Although few central banks uncritically will follow the outcomes derived from minimizing the loss function, it is useful as an analytical tool.

[9]The mathematical reason for the deviations being quadratic is to ensure that two deviations of opposite signs will not cancel each other out.

of γ) than its natural level, and by that closer to the socially optimal level of output, when actual inflation is above the expected level of inflation. If actual inflation is higher than the expected level, firms will have lower real costs and can increase production, resulting in higher economic activity.[10]

The time-inconsistency problem arises because the central bank optimizes its objective function *after* the private agents have formed their inflation expectations. The central bank communicates its inflation target, π^*, in an attempt to form the private agents' expectations. After the shock, ϵ_t, is realized, the central bank optimizes its objective function, resulting in a different inflation level. In an attempt to reach the socially optimal level, the central bank increases the money supply growth, which in the model results in a one-to-one increase in inflation. In other words, in order to reach its optimal output target, the central bank must create unexpected inflation. However, rational agents form expectations on the basis of what is rational for the central bank to do in its optimization. Knowing that it is optimal for the central bank to increase money supply, the private sector will form expectations accordingly, revising them upwards. Facing higher inflation expectations when the optimization problem is solved, the central bank fails to surprise the market when it increases money supply. As a result, if the agents have rational expectations, the optimizing central bank creates an inflation bias without reaping the gains from boosting output.

There have been proposed many solutions to this time-inconsistency problem. Rogoff (1985) suggests an independent central bank with a conservative governor who puts great emphasis on fighting inflation and who, through the central bank's independence, is less affected by political pressure to the monetary policy to boost output. Introduction of a conservative inflation target, advocated by Svensson (1997), should lead to a lower level of inflation as the central bank is reluctant to give up its credibility in order to boost output when needed. Focusing more on the individuals executing monetary policy, Walsh (1995) shows that a contract which penalizes the central banker for missing the inflation target will be sufficient. Transparency that successfully clarifies the incentives and motives of the central bank seems crucial. In what follows, I will examine the concept of transparency, and highlight the challenges today's central banks face when adopting new measures to increase transparency.

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[10]In the model, the economy is driven by the supply side.

2.2   The Concept of Transparency

An object's degree of transparency can be defined as its ability to transmit light so that images can be seen clearly. In this thesis' context, the object is the central bank and the images are its actions. However, it is not straight forward to measure the central bank's degree of transparency due to the many different aspects of monetary policy combined with their complexity. There is no consensus in the literature on what a good measure of central bank transparency is. On the one side, papers like Issing (1999) refer to it solely as the explanation of monetary policy to the public; the central bank's actions themselves. On the other side one finds, for instance, Buiter (1999) who argues that transparency as a notion should be expanded to include the policy *outcomes.* I will argue that the approach Issing (1999) uses is more purposeful in the analysis of central bank transparency since it is is easier to isolate the effects of the different transparency measures taken by the central banks. Furthermore, by analyzing transparency following Issing's (1999) notion of it, it is possible to examine how well it performs in the sense Buiter (1999) defines transparency. This will be elaborated further in section 5. A solution to the challenge of measuring central bank transparency, is to create an index based on quantifiable categories. One of these indices is the Geraats-Eijffinger index, which will be the benchmark index utilized in this paper. Since the index plays a central role in my empirical analysis, I will save the details on how it is constructed to section 4 where I utilize the index in examining how central bank transparency has changed since 2002. However, the main ideas behind the index are presented in the following paragraph.

2.2.1   Five Transparency Categories

The Geraats-Eijffinger index captures the different dimensions of transparency in monetary policy by making use of five aspects of transparency, first proposed by Geraats (2002). *Political transparency* covers the policy objectives and the institutional arrangements, including central bank independence. *Economic transparency* captures whether the central bank publishes reports covering data on important economic factors such as inflation and capacity utilization, and whether it is transparent about the models used for policy analysis. Next, *procedural transparency* can at first glance be viewed as something binary – the central bank either publishes minutes and/or voting records, or it does not. However, there is more to this category as it covers the whole decision making process, including the policy framework. *Policy transparency* measures how open the central bank is about future actions, and whether it offers an explanation of today's policy actions. Forward guidance, which will be discussed later in this section, is an example of policy transparency. Last, *operational transparency*

relates to the central bank's discussion of the monetary policy's contribution to achieve macroeconomic targets, how successful the central bank is in reaching these targets, and whether or not it evaluates its forecasts errors in relation to unanticipated disturbances. The categories' relationship to the policy process is illustrated in figure 1 (Geraats, 2002, p. 541).
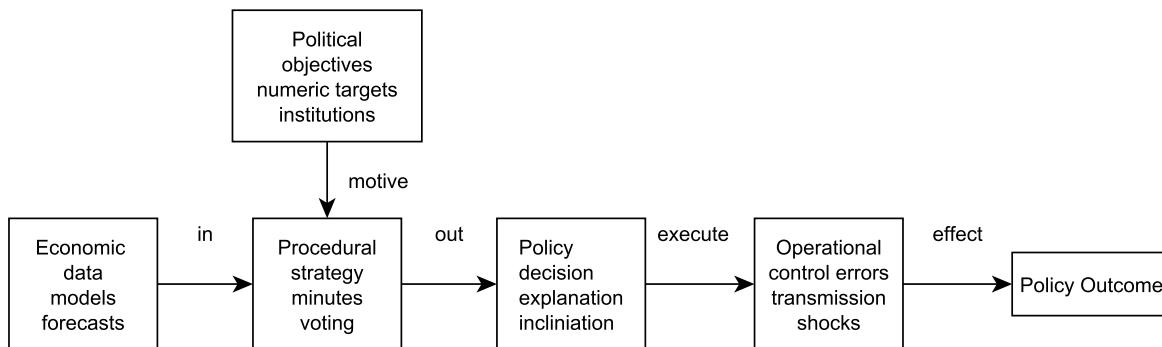
Figure 1: The 5 transparency categories

2.2.2   Forward Guidance

Forward guidance has recently become such a vital part of central bank transparency that it justifies further elaboration. The idea behind forward guidance, regardless of which form it takes, is to signal likely future monetary policy actions in order to stimulate the economy through the expectation channel. Since the agents are regarded as forward-looking, a change in their expectations will have consequences for the economy *today*.

The effect of forward guidance is highly dependent on the central bank's credibility. The problem of convincing private actors that the promised future actions will take place stems from the idea that the central bank might wish to re-optimize in the future period and in the process break its more or less explicit commitment, making the private agents' predictions wrong. Therefore, credibility is a vital feature of today's monetary policy. But how to achieve such credibility?

The answer to this question can be traced back to ancient Greece. Just like Odysseus tied himself to the mast in order not to fall for the temptation of the Sirens' song, the central bank should commit itself to future policy decisions in order not to be drawn toward re-optimization. This is labelled *Odyssean* (Campbell et al., 2012) forward guidance, and takes the form of either a state-contingent commitment or a time-contingent commitment. The Fed's policy of tying itself to a 6.5 % threshold of unemployment

at the monetary policy committee meeting in December 2012 is an example of a *state-contingent* forward guidance.[11] This stands in contrast to the forward guidance of the Bank of Japan, where the two-year time horizon for getting inflation up to 2 % is an example of *time-contingent* forward guidance.

The claim that forward guidance without an explicit commitment "...is like anouncing that you are targeting inflation but not announcing what your inflation target is." (Wren-Lewis, 2014), is illustrative for the view advocated by for instance Woodford (2012). He argues that forward guidance is more effective if a clear commitment is included. At the same time, the challenge related to uncertainty and central bank flexibility, briefly mentioned in section 2.1, is of vital importance when the monetary policy makers decide on the appropriate use of forward guidance. More explicit forward guidance might improve the effectiveness of the communication, but if unanticipated macroeconomic events occur in the future, the central bank will face a situation where it must consider whether the reduction in its scope of action is justified by its credibility not being harmed. Thus, the central bank faces a trade-off between flexibility and credibility.

Once again we turn to ancient Greece when describing another form of forward guidance. *Delphic* forward guidance covers the signal central banks provide on likely future monetary policy actions, examplified by the projected key policy rate paths published by the RBNZ, Sveriges Riksbank and Norges Bank (appendix). As the Delphi Oracle, the central bank seeks to provide guidance of what it views as the most likely outcomes for important variables in the economy, and it is crucial that this is communicated in a way that does not signal commitment of the form the Odyssean forward guidance provide. Instead, the central banks should emphasize the conditional nature of their forecasts, meaning that they need to be clear about the fact that the projected path of the economic variables in question only will be realized if the economy evolves exactly as expected. Arguably the most effective way of communicating this uncertainty is through the use of fan charts providing probability distributions for the forecasts.[12] This is particularly important when communicating the policy rate, Geraats (2009) argues, since the variable forecasted is directly controlled by the central bank, and it is therefore a risk that the forecast is being understood as a promise rather than the sort

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[11]This means that they promised to hold the policy rate between 0 and 0.25 % at least until unemployment falls below the chosen level, conditional on that financial stability is not at risk, that projected medium-term inflation rate does not rise above a half percentage point above their target at 2 % and that inflation expectations remain well anchored.

[12]RBNZ, Sveriges Riksbank and Norges Bank all use fan charts to underline the conditional nature of the forecasts made.

of Delphic communication it is intended to be. The private agents might put too much weight on the forecasts on policy rates published and therefore end up with incorrect expectations relative to what the central bank intends to communicate.

Where the criticism of Odysseus forward guidance indirectly deal with expectations, in the sense that the central bank's promises being broken affects private expectations, the criticism of Delphic communication can be linked more explicit to the forming of them. By publishing policy rate forecasts, the central bank signals two things to the public. First, the public might view the forecast as an indication of the short term interest rate level in the future time periods, possibly affecting long term interest rates, stimulating the economy. Second, the private agents might extract information about the economic state from the publication, forming expectations about the future. By lowering its projected policy rate path, the central bank affects the agents' expectations. The agents will regard future low policy rates as the most likely scenario, thereby increasing consumption today, but they might also see the policy rate path as an indication of the central bank being more pessimistic about the future economic state, possibly leading to a change in the private agents' expectations. Thus, the effect from publishing projected policy rate paths is dependent on which effects dominates the other.

Mishkin (2004) argues that targets should be adopted by central banks, while forward guidance, and in particular policy rate forecasts, should not be part of their communication. He claims that practical problems such as difficulties for committees to decide on one single path and the challenge of communicating the policy decision to the public should be major concerns. Furthermore, he argues that forecasting macroeconomic development in itself is a difficult art, and central banks are in a position where they must get it right, otherwise they will lose credibility, making it more costly to fight inflation at a later date.

To illustrate the challenges related to the more explicit forms of forward guidance, an in-depth case-study of the BoE's recent revision of its forward guidance is provided in section 3.3 as part of my analysis of the optimal degree of central bank transparency.[13]. The study shows that cetral bank transparency is very much a complex area, and the answer to what the optimal degree of transparency is, is both complicated and of vital importance.

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[13]The revised forward guidance was introduced in the Bank of England's February Inflation Report (2014)

3   Optimal Degree of Transparency

The evolution toward more transparency among monetary policy authorities has naturally been accompanied by a discussion of the optimal degree of transparency. In this chapter I seek the answer to what the optimal degree of transparency is. First, I provide an overview of the relevant theoretical literature, before I present a brief evaluation of how central bank forecasts perform relatively to the market's projections. Building on the theoretical arguments in the analysis of the optimal degree of transparency raised in this chapter, I provide an assessment of the BoE's recent revision of forward guidance. This is an in-depth study based on an interview with an anonymous representative from the BoE, and is meant to give an illustration of the considerations made by the central bank in its design of monetary policy. Finally, I argue that more transparency leads to central bankers being more accountable, which is a good in today's democratic society.

3.1   Theoretical Contributions

In order to avoid the challenges related to the measurement of transparency, researchers use theoretical models to quantify the optimal degree of transparency. The idea is that the central bank seeks to minimize a loss function like the one introduced in section 2.1 by adjusting its transparency, measured as the amount of information published by the central bank. Walsh (2007) uses a DSGE model with firms receiving idiosyncratic signals about the current aggregate demand and cost shocks.[14] An expansionary demand shock results in a positive output gap and rising inflation. By raising interest rates, the central bank reduces inflation and output, stabilizing both back to their targets. As opposed to the case of demand shocks, the central bank faces a trade-off in the wake of a cost-shock. This type of shock affects inflation directly, and to prevent inflation from deviating further from its target, the central bank needs to raise its policy rates.[15]. The consequence of the increased real interest rate, is output deviating from target.

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[14]Building on the RBC-model of Kydland and Prescott (1982), the new-Keynesian DSGE models add wage and price stickiness, as well as financial frictions in extended versions, resulting in monetary policy having real effects on the economy in the short term (Gertler et al., 1999). The idea is that households maximize the sum of expected utility derived from leisure and consumption under a budget constraint. Those who favor the "pure" RBC-models believe in market efficiency at all times, whereas the supporters of new-Keynesian models argue there are frictions in the economy which make the market solution sub-optimal and therefore leave room for stabilization policies.

[15]The Taylor (1993) rule states that the central bank needs to raise nominal interest rates more than one-to-one with inflation. This is because the initial increase in inflation also affects inflation expectations, resulting in a lower real interest rate, stimulating to more consumption today. The nominal rates must be raised sufficiently by the central bank, that is, more than the increase in inflation expectations, so that the real interest rate increases and there is a stabilization effect on the economy.

Thus, in the wake of a cost-shock, the central bank faces a trade-off between inflation and output. The optimal degree of central bank transparency in light of this trade-off is examined by Walsh (2007).

Walsh (2007) adds an additional dimension to the model as he includes a signal effect (denoted "incentive effect" by Geraats (2002)) from the actions of a not fully transparent central bank on private inflation expectations. If there is secrecy in the monetary policy, the private agents do not know whether the central bank reacts to a supply or a demand shock. This is important, since the private agents are aware of the trade-off the central bank faces following a cost-shocks. Information on this will affect their forming of expectations. Thus, the optimal degree of transparency is shock-dependent: Conditional on the central bank being able to project disturbances well, it should be *more* transparent when persistent demand shocks occur, and *less* transparent when persistent cost shocks occur. The private agents are aware of the trade-off the central bank faces in the presence of cost shocks and revise their expectations accordingly. In particular, if the cost shocks are persistent, the private actors will revise their expectations to a greater extent, reducing the incentives for the central bank to be transparent. When the economy is hit by demand shocks, on the other hand, the central bank will benefit from being more transparent since the private actors know that the central bank does not face a trade-off. More persistent demand shocks is equivalent to higher potential losses for the central bank, measured by its loss function, incentivizing it to act at an early stage.

Furthermore, Walsh (2007) argues that *accurate* forecasts are welfare increasing, since price dispersions is a source of inefficiency in the model used. He assumes that the firms receive idiosyncratic signals resulting in different information sets, and if the central bank is able to publish accurate projections on macroeconomic variables, these information sets will be less diverse and thereby leading to less price dispersions between firms. This view of accurate forecasting is supported by Geraats (2009) who argues that transparency reduces information asymmetries, and thereby decreases the uncertainty faced by the private agents. This problem of public information is also adressed by Morris and Shin (2002) who argue that both the public information itself and the transmission of it carry noise which affects the private agents' expectations.

Knowing that the forecasts always will carry some inaccuracy, Geraats (2009) argues that the *communication* of the forecasts is very important. This is briefly discussed in section 2.2.2. Where Walsh (2007) focuses on the accuracy of the central banks'

forecasts as vital for the optimal degree of transparency, Qvigstad (2013) follows Geraats (2009) as he puts communication in the center of attention. First, he argues that the central bank's communication should be *clear* and *efficient*. It should leave no room for misinterpretation by the agents, and the information needs to be easy accessible. Second, the central bank needs to be *honest* in its communication. He claims that the central bank will gain from being open about the different scenarios discussed in the decision-making process, and from emphasizing that the future policy actions communicated are conditional. The principle of the central bank's communication reflecting its internal decisions-making, is termed the *Duisenberg principle* (Qvigstad, 2009), and is used as a guideline for Norges Bank's communication with the public. In sum, Qvigstad's arguments are a reminder that the forecasts can be accurate, but if the communication of the forecasts is unclear, the gain from them will be sub-optimal.

3.2   The Accuracy of Central Bank Forecasts

Having argued that accurate forecasts are crucial for the central bank's ability to decide on an optimal degree of transparency, a brief overview of the literature on the central banks' forecasts accuracy is the natural next step. Kool and Thornton (2012) examine the effects of forward guidance by comparing the central banks that publish projections on the key policy rate to ones that do not, but otherwise share similar characteristics.[16] In addition to this, they compare the projections of the central banks that have adopted forward guidance to what is obtained by random walk simulations, and performes statistical tests using a slightly adjusted DM-test (Diebold and Mariano, 1995).[17][18] Since much of the criticism of forward guidance has been linked to public information crowding out private information, which is not beneficial if the central bank is less accurate than the private agents in their projections, the empirical analysis by Kool and Thornton (2012) is an important contribution.[19] They find that most tests, with a few exceptions, show that the central banks' projections on the interest rate outperform the ones obtained from random walks. However, they find no statistically significant evidence that the projection accuracy of the central banks using forward guidance as

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[16]The central banks of New Zealand, Norway and Sweden, being central banks with an explicit forward guidance strategy through their policy rate forecast, are compared to the ones of Australia, Canada and the United Kingdom, respectively. In addition, the Fed, which publish the board members' view on future policy rate, is compared to the BoE.

[17]The DM-test is a comparison between two forecasts, where the differences between the forecast errors, the "loss-differential serie", form the test observator which is compared to a critical value. Depending on the assumptions made, several tests can be utilized.

[18]Mathematically, random walks can be defined as a series of random events. In this context, it can be viewed as a way to model a situation where the forecasters' information is not superior to the foundation of the uninformed guess.

[19]See for instance Walsh (2007) and Morris and Shin (2002).

a tool outperform the ones which do not. Using likelihood-tests and R^2-tests, the authors find that the market participants in Sweden, operating under a central bank using forward guidance, are better at forecasting. In addition, they conclude that the variance is lower in the forecasters' predictions.

Labbe and Pepper (2009) evaluate a vital part of New Zealand's forward guidance as they compare the accuracy of RBNZ's forecasts to the projections of the market. RBNZ began to publish projected policy rates in 1997 , 8 years prior to Norges Bank (the second central bank to do so) and the market participants in New Zealand should therefore be well-equipped to utilize the information provided by the central bank. Labbe and Pepper (2009) cover forecasts on GDP growth, inflation, 3 month interest rate and the TWI published in the period between (and including) the first quarter of 2003 and the last quarter of 2008, thereby including a severe period of the recent financial crisis.[20] The latter point is of particular importance for a small open economy like New Zealand, illustrated by the increased forecast errors on the TWI toward the end of the period.[21] Furthermore, using a DM-test (Diebold and Mariano, 1995) to compare the forecasts published by the RBNZ and the market actors, Labbe and Pepper (2009) conclude that the central bank significantly outperforms the external average for 1 year ahead GDP growth, 2 year ahead TWI and 2 year ahead inflation. However, the data set is gathered over a relatively short time-period where the financial turmoil in the latter part of the period largely unsettled economic conditions. The conclusions must therefore be evaluated with caution. Nevertheless, the central bank's forecast play a central role in the analysis of the optimal degree of forward guidance. The study by Kool and Thornton (2012) shows that the central banks' publication of forecasts can be welfare increasing since they might reduce the market participants' forecast errors, but this argument is reliant on the accuracy of the forecasts produced by the central banks.

3.3 An In-depth Case Study of the Optimal Degree of Forward Guidance in the Bank of England

Following the recent trend toward extensive use of forward guidance, there is an ongoing debate on which form of forward guidance is the most beneficial for the central banks to utilize. This section is based on an interview with an anonymous representative

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[20]TWI is short for "trade weighted index", which is a trade-adjusted exchange rate.

[21]The emphasis on *small* economy is in this case justified by the fact that exchange rates of smaller economies tend to be more volatile in periods of financial turmoil as investors move their money to "safe havens" such as the US and Japan.

from the Bank of England[22] and seeks to offer a clarification of the different trade-offs the BoE has faced following its introduction of forward guidance in August 2013.

In the months prior to the Monetary Policy Committee (henceforth MPC) meeting in August 2013, the BoE saw some signs of the UK economy picking up. This was encouraging, but the level of GDP was still below its pre-crisis level following the recession and the weak growth in the wake of it (Bank of England, 2013a). Furthermore, the growth was regarded as fragile, and there was great uncertainty about the state of the economy. By offering more claritiy about the trade-off faced by the central bank, the BoE wanted to reduce the risk of people forming their expectations according to historical correlations between output growth and rate hikes (Bank of England, 2013b). This was important to communicate because, despite the positive growth, GDP was at a low level and therefore justified a prolonged period of expansive monetary policy. Although the amount of slack in the economy was unclear, the introduction of forward guidance was evidence of that the consensus within the MPC was that the benefits of providing additional information on the reaction function outweighed the costs. Their main aim was to assure the agents of the economy that the BoE did not consider to tighten monetary policy at the time (Bank of England, 2013b). As a result, the degree of forward guidance was increasesd in August 2013 by introducing the unemployment rate as a threshold for when to evaluate its expansive monetary policy. "In particular, the MPC intends not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to the conditions below" was stated in the August Inflation Report (Bank of England, 2013a, p. 7), introducing an explicit state-contingent forward guidance. To include the other targets of the BoE, the following three knock-out clauses were included:

- In the MPCs view, it is more likely than not, that CPI inflation 18 to 24 months ahead will be 0.5 percentage points or more above the 2% target.

- Medium-term inflation expectations no longer remain sufficiently well anchored.

- The Financial Policy Committee (FPC) judges that the stance of monetary policy poses a significant threat to financial stability that cannot be contained by the substantial range of mitigating policy actions available to the FPC, the Financial Conduct Authority and the Prudential Regulation Authority in a way consistent with their objectives.

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[22]The views expressed are not necessarily the ones of the Bank of England.

Inflation in the UK has been above target for much of the period after the financial crisis, and the central bank forecasts have generally underpredicted inflation (Hackworth et al., 2013). This was a concern for the MPC, with price stability being its main objective. The first knock-out clause relates to inflation forecasts, and, knowing the recent forecast performance of the BoE, this might have been a less credible condition. The credibility of this clause was likely a part of the discussions in the MPC prior to the introduction of the forward guidance. However, there are probably not many options to this clause. Today's CPI, for instance, is not an adequate indicator of future price pressures, and this is particularly so for the UK, which has a measure of inflation which includes taxes and energy prices. Their measure of inflation is more likely to reflect temporary price changes, and is therefore not necessarily a good indication of future inflation.[23] Furthermore, if the MPC failed to credibly demonstrate its concern on inflation, the risk was that the inflation expectations would de-anchor, thereby making it more costly for the central bank to reach its inflation target in future time periods. As a result of this concern on price stability, the MPC decided to add inflation expectations being well-anchored as a clause to the forward guidance. The framework for measuring inflation expectations was already established since the BoE published a number of quarterly bulletins on inflation expectations in the wake of the financial crisis (see Maule and Pugh (2012) and Harimohan (2012)). This has arguably resulted in a more credibile clause, since the measure of inflation expectations is not artificially created by the MPC.

Price stability, being the main objective for the BoE, was used to defend the usage of the unemployment rate as a threshold for when to consider revising monetary policy. The real side of the economy, represented by the unemployment rate, is linked to price developments through wage inflation. By choosing the unemployment rate, the MPC sought to boost the economy without signalling that the BoE had moved away from its main concern of price stability. This must be seen in relation to the level of inflation at the time, which was about 1 percentage point above target, and had been running above target in much of the period after the financial crisis. A second important reason for using the unemployment rate as the threshold, is related to communication. The unemployment rate is sensitive to changes in labor force participation and productivity, but a possible benefit is that it might be easier to understand for the public than other measures, such as the employment rate.

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[23]Energy prices are quite volatile, resulting in the BoE's measure of inflation being more volatile. The reason for including energy prices is that a large part of the households' spending is on energy, and by removing that part, the inflation measure will be less credible.

UK annual economic growth was 1.9 % in 2013, indicating a moderate economic recovery, while the unemployment rate fell much more than expected (Bank of England, 2014). Much of the increase in economic growth was due to strong growth in the year's final quarter. Prior to the February 2014 MPC meeting, the unemployment rate was 7.1 %, only 0.1 percentage point above the threshold, and was expected to cross the threshold before the May MPC meeting (Bank of England, 2014). However, the committee's view on the economy remained less optimistic than the fall in unemployment would normally indicate. In particular, productivity growth was still weak, and the outlook for it remained uncertain (Bank of England, 2014). Basic microeconomic theory says that the equilibrium wage rate is dependent on the level of productivity. In reality, this relationship is complicated by for instance wage rigidities. It is likely that wage inflation lags productivity growth, meaning that workers are expected to reap the benefits of the productivity growth some time after the productivity has picked up. This is important, since demand growth, which is an important factor in the economic recovery, is highly dependent on wage inflation. People cannot run down their savings forever, and there is evidence that the savings rate in the UK is reduced, although these numbers are quite volatile and subject to revision (Bank of England, 2014). Financial stability, one of the knock-out clauses for the first forward guidance, is an explicit concern for the MPC, but the reduction in the savings rate is regarded as a result of people running down their precautionary savings, which is an indicator of the households being more optimistic about the future (Bank of England, 2014). This, however, is not supported by the survey published in the February 2014 Inflation Report, where it is shown that the households' optimism following the forward guidance introduced in August 2013 remained unchanged.

The initial forward guidance was centred around the unemployment rate, which is easily communicated, but the unemployment rate was never meant to be a complete indicator for the economic recovery. Therefore, as the unemployment rate fell to levels close to the threshold prior to the February 2014 MPC meeting, the BoE chose to change its forward guidance at the meeting. The unemployment rate proved to be an efficient tool for affecting expectations, highlighted by Mark Carney – the governor – at the press conference following the publication of the February 2014 Inflation Report, where he pointed out that businesses seemed to understand forward guidance. However, being closer to fully having eliminated the slack in the economy, the unemployment rate was considered "too simple" in describing the economic state, and the notion of spare capacity was therefore elaborated on in the February Inflation Report (2014). The belief that there is not one single indicator which adequately describes the economic

state is held by the MPC, evident from the publication of forecasts on the 18 different indicators published. Labor productivity and surveys of spare capacity in companies are among the variables utilized, and are meant both to give a deeper assessment of the UK's economy and to provide better understanding for the judgements the MPC reaches. This might enhance the MPC's credibility, since the publication of the indicators makes an assessment of their decisions easier. Thus, the MPC's aim is not to perfectly predict how the variables evolve, but rather to communicate their internal decision-making to the public. This is very much in line with the Duisenberg principle presented in section 3.1.

The accuracy of a central bank's forecasts, as argued in section 3.1, is of great importance. Although the forward guidance introduced by the BoE in August 2013 was explicitly not time-contingent, the indicator utilized – the unemployment rate – was first expected to cross the threshold in mid-2016 – that is, at the end of the medium-term forecast horizon (Bank of England, 2013a). However, it fell to 7.1 % already in February 2014, only six months into the forecast period. To be fair to the BoE, it should be noted that most external forecasters were even more off than the BoE. However, the failure to predict the unemployment rate resulted in questions on the BoE's credibility being raised during the press conference following the revised forward guidance introduced in the February 2014 Inflation Report. After all, having missed with its projections before, why should the public believe the forward guidance provided this time? Thus, the communication of the conditional nature of these forecasts is of importance in relation to credibility, favouring the use of well-communicated state-contingent thresholds, but it is also vital in the design of monetary policy. Since the economy's spare capacity is difficult to measure, and naturally therefore also hard to forecast, the decision of when to tighten monetary policy is difficult. As Charlie Bean – the deputy governor – noted at the press conference following the publication of the February 2014 Inflation Report, a change in monetary policy affects the economy with a lag. The consequence of raising rates too soon would be to risk the recovery of the economy. On the other hand, if the BoE holds rates too low for too long, inflation, and possibly financial stability, will be an issue. The implication for forward guidance is that, as you are closer to the point where slack is eliminated completely, you need to assess the economy more carefully, and can therefore no longer rely on one single indicator. In order to provide a better understanding for the MPC's decision, the BoE now monitors and provides forecasts on 18 additional indicators. Critics have argued that the first phase of forward guidance introduced in August 2013 was hard to understand for the public, and in particular for the households. With the additional information

included in the revised forward guidance, the critics are probably not yet silenced.

The case of the BoE's revision of forward guidance serves as an illustration of how complicated designing monetary policy is. To assess and to forecast the economic state is a difficult art in itself, and there are challenges related to the communication of the analyses as well. The central bank needs to assess whether its information is sufficiently accurate to be communicated, and in addition it needs to evaluate whether the economic actors are sophisticated enough to utilize the information published. Furthermore, the trade-off between output and inflation is a major concern for central banks utilizing forward guidance. Signals from the central bank are not necessarily interpreted as intended, and by focusing more on output growth, the markets might view this as the central bank being less concerned of price stability. As an illustrative example, Narayana Kocherlakota – the Minneapolis Fed governor – dissented from the revised forward guidance provided by the Fed at its monetary policy meeting in March 2014, and claimed that the credibility of the inflation target was at risk.[24] However, the inflation in the US is currently 1 percentage point below target, while it is approximately on target in the UK. Nevertheless, inflation in the UK has been above target for much of the time period after the financial crisis (Hackworth et al., 2013), and it is therefore essential for the BoE to underline its concern on price stability.

Being clear about its intentions is likely to benefit the central bank in the long run, but there are other arguments in favor of more transparency as well. The next section will elaborate on one of those arguments.

3.4 Democratic Concerns

Modern democracies are organized in various forms, but the aim of reflecting the general will of the people is a common characteristic. Therefore, the last aspect I have chosen to look into in the search of the optimal degree of transparency, are the arguments in favour of more transparency originating in the legitimacy of an independent central bank's actions in today's democratic society. A higher degree of transparency is synonymous to being more accountable to the public, which is a good in itself, given the importance of monetary policy. The role of the representative politician is to ensure that the general will is reflected in the policy decisions. However, central banks in today's society are, for various reasons discussed in section 2.1, typically autonomous from the political system, which results in the politicians, and therefore the people, not being able to form the monetary policy directly. Since the central banks possess

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[24]https://www.minneapolisfed.org/publications_papers/pub_display.cfm?id=5281

great power in affecting the economy, this is a concern from a democratic point of view, and it is therefore essential that the central banks are transparent about their actions. A higher degree of transparency is equivalent to the central banks being more accountable for their actions, altering the power of balance. However, this accountability might hinder the effectiveness of the monetary policy comittee. By publishing minutes, for instance, the views of the different members will be revealed, making them more accountable, but it might also hinder them from arguing their case in the same way as they would have done under more secrecy.

Even though the elected politicians do not have a *direct* influence on the monetary policy decisions, they instruct the central banks to a various degree. It is common to follow Debelle and Fischer (1994) in distinguishing between *goal* and *instrument* independence. The former is a measure of whether the central bank is allowed to form its goals itself, while the latter concerns whether the central bank decides which instruments to be used to reach the goals. Furthermore the decision-making process is organized in various ways. Blinder (2006) distinguishes between *individualistic* committees, where each member is entitled, and expected, to have her own opinion, and *collegial* committees, where the committee seeks to appear unanimous in their decision.[25] Central banks differ on the institutional arrangements and how the decision-making process is organized. The Federal Reserve sets its own target and chooses the instruments to be utilized in order to reach it, and provides anonymised minutes and attributed votes three weeks after the decision is reached (Qvigstad, 2013). Norges Bank does not disclose votes or minutes of the Executive Board's discussions. Its inflation target is set by the government, but it is free to choose the instrument used to reach the targets set (Qvigstad, 2013). Like the Fed, the BoE publish attributed votes, but is less independent in setting its own targets. The chancellor of exchequer sets the inflation target, and the government can even, in theory, override the MPC's decision (Committee and Tyrie, 2011, page 62). Thus, the public controls the central banks to some degree through various political measures. However, central banks might be held to account through different channels than the political one. Norges Bank Watch Report is published annually, and seeks to analyze Norway's central bank's monetary policy and its management of the sovereign wealth fund.

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[25]Blinder (2006) further splits the type of collegial committees into two types: genuinely-collegial and autocratically-collegial. This relates to how the internal discussions leading to the decisions are, and the former notion involves a flatter hierarchy.

4 Empirical Evidence on Central Bank Transparency

Having established a theoretical foundation for the analysis of transparency in a monetary policy framework, the next two chapters examine two issues in particular: the development toward more central bank transparency and the effect it has on key macroeconomic variables. As argued in section 2.2, measuring transparency is challenging, but essential in order to identify a possible trend and to analyze the impact of central bank transparency on economic variables. The Geraats-Eijffinger index, briefly presented in section 2.2.1, seems to be the dominant taxonomy within the field, and is utilized in the majority of the empirical literature. Therefore, in this chapter, I first establish how transparency is quantified by this index. Second, I provide a brief overview of the empirical literature on the quantification of central bank transparency and its effects. Finally, I update a data set obtained using the Geraats-Eijffinger index, and compare central bank transparency in 2002 with the degree of transparency in 2014.

4.1 Central Bank Transparency Indices

Following Issing (1999), Dincer and Eichengreen (2013) seek to quantify central bank transparency using objective measures. The index consists of 15 questions, each with an equal weight and a maximum score of 1, resulting in a maximum total score of 15. Three questions on each of the five transparency categories presented in section 2.2 are raised. First, on *political* transparency, questions are raised on whether there is a formal prioritization of the goals, if the central bank has formal targets, and how the institutional arrangements are. Second, questions on the data provided by the central bank, the publishing of the models used for policy analysis, and how advanced the central bank's forecasts are, falls under *economic* transparency. Third, publication of voting records and minutes from the meetings, in addition to whether the central bank are transparent about the monetary policy strategy, is a measure of *procedural* transparency. Fourth, the degree of *policy* transparency is dependent on whether the central bank promptly announces adjustments to the operating instruments, including a thorough explanation, and whether the central bank provides an indication on what the likely future policy actions are. Finally, the central bank's evaluation of whether it reaches its targets, whether the central bank announces information on unanticipated macroeconomic events and an account of the monetary policy's role in achieving the outcomes reached, measures the *operational* transparency. In order to be transparent about the method used in my analysis, the full wording of the questions are added to the appendix.

Crowe and Meade (2008) base their survey on the Geraats-Eijffinger index, but it differs somewhat. Their index is an unweighted average of the same five transparency categories, where the different categories are unweighted averages of two questions, resulting in a total of 10 questions. Since their data set covering 1998 is based on a survey by the BoE (Fry, 2000), Crowe and Meade (2008) are restricted to raise more or less the same questions as Fry (2000). The implication for their analysis is that they are not able to measure the score on the different categories in the same way as they would if there were no restrictions, but they still succeed in producing an index consisting of the five different transparency categories introduced by Geraats (2002).

4.2 Quantification of Transparency and Its Effects

Compared to their first publication in 2007 (Dincer and Eichengreen, 2007), counting 100 central banks from 1998 to 2005, Dincer and Eichengreen (2013) have expanded their data set to include an additional twenty central banks and five more years, from 1998 to 2010. This data is valuable not only due to the number of central banks included, but also due to the length of the time period, covering 13 years. The authors find a trend toward a higher degree of central bank transparency, and point out that the average transparency in the sample score rose from 3.2 in 1998 to 5.5 in 2010.[26] Dincer and Eichengreen (2013) argue that open economies, strong political institutions, flexible exchange rate systems and well-functioning financial markets are all factors which are typical for countries with more transparent monetary policy authorities. As a consequence, central banks in advanced countries are more transparent than those in emerging markets, while the latter group in turn have more transparent central banks than the developing countries. Well-functioning financial markets as a characteristic of more transparent central banks is an especially important finding, since it is sometimes argued that periods of financial turbulence are characterized by less transparent central banks. The argument is that, due to asymmetric information, central banks should withhold information on the financial markets' state and thereby reduce their transparency (Dincer and Eichengreen, 2013). Self-fulfilling prophecies such as bank-runs are more likely to occur if negative news about the financial system is revealed, and the central banks should therefore be incentivized to reduce the information published.[27] However, Dincer and Eichengreen (2013) do not find evidence of reduced central bank transparency in the wake of the recent financial crisis, and in section 4.3, I will argue

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[26]Including Urugay, which is the only country in the sample to experience a central bank that was less transparent in 2010 than it was in 1998.

[27]A bank-run is a term used to describe a situation where a large number of depositors wish to withdraw cash. A solvent, but illiquid bank, might have difficulties in meeting the demand, which might cause fear among more depositors, resulting in the solvent bank turning insolvent.

that several important central banks actually have increased their transparency during this time period.

Table 1: Changes in the Geraats-Eijffinger index (Eijffinger and Geraats, 2006) from 1998 to 2002

Country	Political	Economic	Procedural	Policy	Operational	Total
Australia	0	+1	0	0	0	+1
Canada	0	0	0	0	0	0
Euro zone	0	+1.5	0	+0.5	0	+2
Japan	0	+0.5	0	0	-0.5	0
New Zealand	0	+0.5	0	+2	+1	+3.5
Sweden	+1	+0.5	+1	+1.5	+1	+5
Switzerland	+1.5	+0.5	0	0	-0.5	+1.5
United Kingdom	0	+1.5	0	0	+0.5	+2
United States	0	0	0	+1.5	0	+1.5
Norway*	+1.5	-0.5	0	0	+0.5	+1.5

*:The 2002 data for Norway are from Dincer and Eichengreen (2013)

Using an extension of the data set constructed by Dincer and Eichengreen (2007), Siklos (2011) finds that the greatest changes in transparency took place in the late 1990s and the early 2000s.[28] Eijffinger and Geraats (2006) provide an overview of the change in central bank transparency from 1998 to 2002, offering support to the claim that there was a great increase in transparency in the late 1990s and early 2000s. In particular, this overview, presented in table 1 , shows that the RBNZ and Sveriges Riksbank increased their total score by 3.5 and 5 points, respectively, during the period. With a score of 14, the two central banks were the most transparent in 2002. The RBNZ miss out on the full score due to its operational transparency, while Sveriges Riksbank's failure to disclose the macroeconomic model used for policy analysis results in it not achieving a score of 15. Over the time period, Sveriges Riksbank, in addition to provide an explicit policy inclination, began publishing minutes, voting records and an annual evaluation of inflation. In 1999, the RBNZ changed its formal policy instrument from the daily settlement cash target to the Official Cash Rate (OFR), increasing its

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[28]Siklos extended the data set published in 2007 to include the years up to (and including) 2009, adding 4 years to the data set.

policy and operational transparency.[29] The Swiss National Bank began publishing semi-annual forecasts on inflation in 1999, and one year later, in 2000, it became constitutionally independent and a quantitative target for inflation was introduced. Australia and ECB both published their model used for policy analysis in 2001, and ECB furthermore began publishing semiannual projections and held press conferences following each monetary policy meeting. The Fed started to provide an explanation and disclosed a policy inclination with every policy decision.

The former paragraph provides evidence for Siklos' (2011) claim that the majority of the change in transparency took place at the millenium shift. However, as I will dig deeper into in section 4.3, central banks have adjusted their transparency in recent time. Since 2009, the Bank of Japan and the Federal Reserve have both adopted inflation targets, and they, along with the Bank of England and the ECB as the most important, use an increasing amount of forward guidance. This could suggest that the trend toward more central bank transparency is not restricted to the millennium shift. In fact, in my analysis presented in section 4.3, I find that transparency increased more between 2002 and 2014 than in the period between 1998 and 2002, much due to recent transparency measures. Furthermore, although most central banks in the developed world operate on a quite high level of transparency, there are still possibilities to become more transparent, examplified by the ECB recently considering to publish minutes (Bloomberg, 2014) and the recent, extensive use of forward guidance by for instance the Fed and the BoE. However, whether central banks will increase transparency depends crucially on their perception of the optimal degree of transparency, as discussed in section 3.

Crowe and Meade (2008) follow in the footsteps of Dincer and Eichengreen (2007) and seek to quantify developments in central bank transparency using an objective measure of it. Their analysis is based on a set of 37 central banks observed in 1998 and then again in 2006, consisting of 24 advanced countries and 13 emerging markets or developing economies.[30] In contrast to what Dincer and Eichengreen (2013) conclude, Crowe and Meade (2008) do not find significant statistical evidence that there has been an increase in central bank transparency among countries not classified as advanced. The explanations offered for this contrasting result are technical difficulties and a lower demand for transparency due to an absence of well-functioning financial markets in these countries.

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[29]Eijffinger and Geraats (2006) argue that the RBNZ targeted the MCI, which is a weighted average of the effective exchange rate and the short-term interest rate, until 1999.

[30]Their measure of central bank transparency is explained in section 3.1.

In order to analyze the effects of central bank transparency, Crowe and Meade (2008) examine whether a higher degree of transparency is negatively correlated with the variance of the private forecasts, and argue that this correlation is increasing (in absolute terms) in both the accuracy of the central banks' forecasts and their communication of it. The results are strongly statistically significant. In particular, the authors find that the negative coefficients found when regressing the *economic* and *operational* components on their measure of private forecast variance are statistically significant on a 5 and 1 percent significance level, respectively.

Focusing more on the effect of monetary policy transparency on macroeconomic variables, Dincer and Eichengreen (2013) evaluate whether the degree of central bank transparency affects inflation volatility, defined as the standard deviation of monthly inflation in a given year (Dincer and Eichengreen, 2013, p. 20). Using a number of variables as instruments for the transparency index, the authors find that a higher degree of central bank transparency significantly stabilizes inflation.[31] Furthermore, the authors find that there is a negative correlation between central bank transparency and the inflation *level*, although the results are not equally robust when adding different controls.[32]

In an empirical attempt to analyze the effect central bank transparency has on the economy, Gurkaynak et al. (2005) use a simple regression model. They seek to quantify the inadequacy of including only the policy rate as an explanatory variable, and examines whether the central bank's communication influences the market.[33] The way Gurkaynak et al. (2005) solved the challenge of measuring the surprise component of monetary policy was to use high-frequency data of futures contracts at the time of a policy announcement. By narrowing down the time-horizon analyzed sufficiently close to the policy announcements, they succeeded in isolating the effect of forward guidance. By coding whether or not the FOMC announces a statement about future policy as a dummy, they are able to regress this variable's absolute value on the volatility of the futures. By rejecting the hypothesis (at a 10 % significance level) that forward

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[31]The instrument variables are as follows: rule of law, political stability, accountability, government efficiency and regulatory quality.

[32]As with the analysis of inflation variability, the authors control for openness, financial depth and past inflation.

[33]The limitation of only including the policy rate as the explanatory variable is well illustrated by the 20 and 25 basis points (bp) increase in two- and five-year yields in January 28, 2004, following the FOMC's decision to keep the policy rate unchanged. At that time, the Fed changed its communication by dropping the phrase *"Policy accommodation can be maintained for a considerable period"*, which was interpreted by the markets as a signal of tighter future monetary policy.

guidance and the policy rate decision have no effect on asset prices, they conclude that statements about likely future actions and policy rate decisions are the most influential tools the central bank possesses. Furthermore, they find that forward guidance accounts for more than three fourths of the explained variation in the five- and ten-year Treasury yields. In addition, the intra-day data shows that the markets are "slower learners" when adjusting to statements. This is intuitively not very controversial, since the consequences following a policy rate decision is much easier to quantify than the information contained in the speech of a central banker.

4.3 Degree of Central Bank Transparency Today versus in 2002

One of the first influential empirical studies on the degree of central bank transparency is a survey conducted by the Bank of England of 74 different central banks in 1998 (Fry, 2000). Although the study was an important contribution to the (empirical) field at the time of publishment, it is quite limited in the sense that it does not capture the dynamic dimension. A survey by Eijffinger and Geraats (2006) fills this gap as it covers the transparency of nine of the most important central banks over a time period of five years (1998 - 2002). In order to measure central bank transparency, they utilize the Geraats-Eijffinger index. To illustrate how central banks have developed in terms of transparency since 2002, I will provide an update on the findings of Eijffinger and Geraats (2006) in this section. The findings are summarized in Table 2.[34]

As shown in Table 2, the greatest changes in central bank transparency are found in the economic and policy categories. Much of the change in policy transparency is due to recent changes, and in particular the use of forward guidance by several important central banks. Moreover, the trend toward higher economic transparency might be a result of economic data being more easiliy available in today's society. There has also been a steady increase in the three other categories making up the transparency index. Furthermore, one should note that the political transparency already was at a relatively high level in 2002, meaning that there has been less scope for central banks to further improve transparency within that category, while both procedural and operational still have potential for increases. In order to provide a qualitative breakdown of the numbers, I will now assess each of the central banks included in the table individually.

The Reserve Bank of Australia has increased its score on the Geraats-Eijffinger index

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[34]The information is gathered from the central banks' websites. An explanation of how the points were given is found in the appendix.

Table 2: The change in central bank transparency from 2002 to 2014.

Category	Political		Economic		Procedural		Policy		Operational		Total	
Country	2002	2014	2002	2014	2002	2014	2002	2014	2002	2014	2002	2014
Australia	3	3	2	2.5	1	2	1.5	2	1.5	1.5	9	11
Canada	3	3	2.5	3	1	1	2	2	2	2	10.5	11
Euro zone	3	3	2.5	3	1	1	2	3	1.5	2	10.5	12
Japan	1.5	3	1.5	3	2	3	1.5	3	1.5	1.5	8	13.5
New Zealand	3	3	3	3	3	3	3	3	2	2	14	14
Sweden	3	2.5	2	3	3	3	3	3	3	3	14	14.5
Switzerland	2.5	3	1.5	3	1	1	2	2	0.5	1.5	7.5	10.5
United Kingdom	3	2.5	3	3	3	3	1.5	2.5	2.5	3	13	14
United States	1	2.5	2.5	3	2	3	3	3	1.5	2.5	10	14
Norway*	2.5	2.5	1	3	1	1	1.5	3	1.5	3	7.5	12.5
Total Change	+ 3.5		+ 8		+ 3		+ 5.5		+ 4.5		+ 24.5	

Notes: *:The 2002 data for Norway are from Dincer and Eichengreen (2007)

The data presented is based on the questions found in appendix 1.

by 2 points spread across economic, procedural and policy transparency. With respect to higher *economic* transparency, the RBA now publish forecasts on both inflation and output, and emphasize the uncertainty using fan charts. The central bank is also quite detailed in their analysis of the economy, and includes thorough discussions on the different sectors in addition to a broad labor market survey. However, the central bank does not produce an explicit number for either output utilization or money supply, and does therefore not receive maximum score. Next, the RBA is the only central bank to begin publishing minutes in the time period examined, and does therefore increase its *procedural* transparency. Voting records are not published today – and was not in 2002. Although RBA has not followed a number of central banks in adopting forward guidance to its monetary policy, *policy* transparency has nevertheless increased. This is due to the fact that RBA now issues media releases following each decision, including an assessment of risks in the economy. Finally, its *operational* transparency and *political* transparency is unchanged, the latter at the maximum level.

The *Bank of Canada* is among the central banks that have experienced the smallest change in its transparency. It received maximum score on *political* transparency in 2002, and this is unchanged in 2014. Its *economic* transparency has increased somewhat following the Bank of Canada's decision to publish forecasts on inflation and output quarterly. At the onset of the financial crisis in 2008, the central bank adopted forward guidance, but has abandoned this in recent time, resulting in no change in the *policy* transparency. The small change in transparency is a characteristic shared by the RBNZ, Sveriges Riksbank and the Bank of England. However, these central banks were already highly transparent in 2002.

The *European Central Bank* has maintained its maximum score on *political* transparency, and has increased its *economic* and *policy* transparency. It now publishes quarterly forecasts on both inflation and output, and provides forward guidance on when monetary policy is expected to be tightened. Furthermore, the ECB will follow the Australian central bank in publishing minutes, according to Bloomberg (2014), and thereby increase its *procedural* transparency.

Bank of Japan, among the least transparent in 2002, has established itself at the top of the list, much due to recent changes in its monetary policy. The economic conditions in the country have forced the central bank to adopt new measures. The *political* transparency of the Bank of Japan is increased due to the inflation target, first introduced in 2012, but the increase could arguably be lower, since the central

bank's goal independence is reduced following the political pressure to boost inflation. Regarding *economic* transparency, the Bank of Japan has increased its openness as it now publishes quarterly economic forecasts on both inflation and output in addition to disclosing the model used for policy analysis. An explicit time-contingent forward guidance was introduced one year after the inflation target was implemented, which combined with a more detailed explanation of the policy decisions, has resulted in more *policy* transparency.

Being one of the pioneers for central bank transparency, the *RBNZ* received full score on all categories except the *operational* transparency in 2002, and has not experienced any changes as measured by the Geraats-Eijffinger index since then. It is worth to note that the RBNZ was the first to publish projections on its policy rates, pioneering the *Delphic* form of forward guidance in 1997. Furthermore, the *procedural* transparency of the RBNZ differs from the other central banks in the sample. The responsibility for the decision made rests with the governor alone, but he reaches these decision after consulting the Official Cash Rate Advisory Group (Qvigstad, 2013). Minutes from these meetings are not released, but the Governor – solely responsible – provides an explanation after a decision is reached, and must answer questions from the Committee on Finance and Expenditure following the quarterly published *Monetary Policy Statement*.

Sveriges Riksbank receives the highest score in 2014. In 2002, it only missed out on the full score on *economic* transparency, but after the publishment of Ramses II, its DSGE-model used for policy analysis, it now receives full score in this category as well. The Riksbank's primary function is to maintain both price stability and financial stability, and since there is no explicit prioritization of the targets, the *political* transparency is somewhat reduced. Its *operational* transparency is impressive; only Norges Bank and the BoE accompany Sveriges Riksbank in receiving maximum score. Its report "Account of Monetary Policy" is published annually, and provides a highly structured and detailed assessment of the targets set and whether they are achieved, the forecast accuracy and a discussion of the development of key macroeconomic variables.

The Swiss National Bank has increased its *political* transparency as they are "...giving priority to price stability.". Its *economic* transparency has increased, and it publishes quarterly forecasts on both inflation and output in addition to being transparent about the model used for policy analysis. The SNB has increased its *operational* transparency, and does now provide an explanation for significant deviations from the targets set and

an assessment of macroeconomic developments.

The *Bank of England*, among the most transparent central banks in 2002, holds its position at the upper part of the list. Its recent focus on financial stability has resulted in it having several objectives without a clear prioritization, and therefore the *political* transparency is somewhat reduced. However, this reduction is met by an increase in its *policy* transparency. The Bank of England has in recent time used forward guidance increasingly, but does not provide a thorough explanation of the policy decision at the day of announcement. Furthermore, the introduction of forward guidance has been accompanied by an increase in the *operational* transparency. The BoE now accounts for the role of monetary policy in reaching macroeconomic objectives, and does also discuss its forecast performance.

The *Federal Reserve* has experienced an above-average increase in its total transparency. The implementation of a 2 percent inflation target has increased its *political* transparency, but the Fed still receives the lowest score on this category in the sample. Its "Summary of Economic Projections" now includes quarterly forecasts on inflation and output, and the publishment of an explicit monetary policy strategy along with press conferences being held following every second meeting since 2011, has increased the *economic* and *procedural* transparency, respectively. The Fed has also experienced an increase in *operational* transparency, since it now assesses the risks to the economy and to the transmission mechanism of monetary policy.

Norges Bank has along with the Bank of Japan experienced an increase in transparency exceeding 5 points on the Geraats-Eijffinger index. Its *political* transparency is unchanged at 2.5 since Norges Bank still has multiple objectives. In particular, the weight put on financial stability is not explicitly stated, and, though it was meant to provide the markets with more information, it has been criticized for confusing the market actors. Norges Bank does not publish minutes or voting records, and therefore it receives a relatively low score on *procedural* transparency. Its *operational* transparency is increased since 2002, and Norges Bank evaluates the inflation rate including a discussion of the current macroeconomic state and how this has effected the forecasts, in addition to an account of how the policy rate affects the economy. Apart from on the political and the procedural transparency, Norges Bank receives maximum score on the transparency categories.

All in all, central bank transparency has increased much in recent years, but some

opacity prevails on certain aspects of monetary policy. In particular, *procedural* and *operational* transparency are still characterized by low scores. This is important, since the degree of procedural transparency is an indication of how accountable the central banks are, and since some of the criticism raised on the quantiative easing of today's central banks concerns the effectiveness of the transmission mechanism in the financial markets (Woodford, 2012), central banks should increase their operational transparency. An interesting remark is that the most transparent central banks in 2002, the RBNZ and Sveriges Riksbank, are the monetary policy authorities of relatively small economies. Today, the Fed, the ECB and the Bank of Japan – central banks of great economic powers – are all at the top, indicating that the smaller central banks have had a pioneering role in the development toward higher degree of central bank transparency. It is also noteworthy that the central banks that were quite transparent in 2002 – Sveriges Riksbank, the BoE and the RBNZ – have become more transparent, as is the case for the two first-mentioned, or have remained very transparent, as is the case for RBNZ.

In sum, the sections included in this chapter offer evidence that central bank transparency has increased in recent years. Having established that, the natural next step is to empirically examine the economic implications following this trend. As argued in chapter 2, there is a strong case for central bank transparency founded in theoretical economic benefits. The last chapter of this thesis is devoted to answer this question, and in the process shed more light on the discussion of the optimal degree of transparency.

5 Analyzing the Effects of Transparency

In my assessment of the optimal degree of transparency, I will now present an empirical analysis of the effect central bank transparency has on macroeconomic variables. As elaborated on in chapter 2, central bank transparency might reduce the uncertainty under which the agents operate through a reduction in the volatility of macroeconomic variables such as inflation. Chapter 4 concluded that the degree of central bank transparency has increased, first by analyzing the time period between 1998 and 2002, and then again the period between 2002 and 2014. In order to capture this dynamic dimension in my analysis, I use panel data estimation methods to examine the effect of *central bank transparency on inflation and output volatility, as well as on the level of inflation.*

The chapter is organized in the following way: First, I present the data used, including an explanation of how they are transformed into the variables used in the analysis. Descriptive statistics is also presented in this section. Second, the relevant econometric models are presented. The tests performed to decide which method was best suited, including the specification tests, are briefly introduced as well. Finally, the results are presented, followed by a discussion of the implications this could have for monetary policy.

5.1 Data

The data set constructed by Dincer and Eichengreen (2013) is used as a measure of the level of central bank transparency in the analysis. The maximum score is 15, and this is spread over the five categories presented in section 2.2. An illustration of how the score is calculated was given in section 4.3. Although I will not use the entire set in my analysis, a broad range of central banks are represented. My focus is on the OECD-countries in the time period from 1998 to 2010. This is partly because a substantial number of outliers vanish when the non-OECD-countries are left out of the analysis, and partly because the statistical data are likely to be more reliable given the level of institutional development in the OECD-countries.

Data on output growth and inflation are from OECD.[35] Output growth is defined as the annual real GDP growth, and is measured as the percentage change in real GDP

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[35]Numbers on both inflation and output are available at http://stats.oecd.org/. Data on the inflation are from the database "Prices and Purchasing Power Parties", while data on output are from the data base "National Accounts".

from the same quarter in the previous year. Inflation is measured as the percentage change in prices from the same month in the previous year.

I follow Dincer and Eichengreen (2013) in measuring inflation volatility as the standard deviation of the measure of inflation utilized.[36] This approach is also used for measuring output volatility. The data on output growth are published quarterly, while inflation numbers are published monthly. Exceptions are New Zealand and Australia, which publish inflation numbers quarterly. Since inflation numbers are published monthly, the measure of volatility utilized will probably give a quite accurate result. Data on output growth, however, are published quarterly, meaning that there are substantially fewer observations. The volatility of the variables will increase for lower n, everything else equal. However, if there are significant variations from month to month, quarterly observations smooth those variations, resulting in lower output volatility as measured by the standard deviation in a given year. To answer which effect dominates the other is not the aim of this thesis, but table 3 shows that output volatility is fairly high relative to inflation volatility, indicating that few observation is the dominant effect. The results for output volatility should therefore be interpreted with caution.

Table 3: Summary statistics

Variable	Mean	Std. Dev.	N
Totalindex	8.912	2.666	278
Inflevel	3.22	2.815	286
Infvol	0.779	0.636	286
Outputvol	1.238	1.032	280

Table 3 presents descriptive statistics for the transparency index (Totalindex), the level of inflation (Inflevel), and the volatility of both output (Outputvol) and inflation (Infvol) in the OECD-countries included. This table shows that the there are few missing observations. Only Slovakia and Slovenia, which entered the euro-zone in 2007, miss observations on the transparency index, and the only country to have missing observations for output volatility is Chile, which has missing numbers for output growth in the time period between 1998 and 2003. Furthermore, table 4 summarizes the levels of the various transparency categories in 2010 – the last time period. This shows that operational transparency is substantially lower than the others, while the central banks are more transparent on the political and economic categories. Table 4 also shows that the values of procedural, policy and operational transparency are more volatile.

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[36]The formula for the standard deviation used is: $\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$

Table 4: Summary statistics for the transparency categories in 2010

Variable	Mean	Std. Dev.	N
Political	2.65	0.564	20
Economic	2.575	0.467	20
Procedural	1.95	0.930	20
Policy	1.825	0.878	20
Operational	1.475	0.658	20

Table 3 and 4 do not capture the dynamic dimension of the data, and I have therefore included scatter plots to illustrate how the variables have evolved over time, and how substantial the heterogeniety is.[37]

Figure 2 and 3 further nuances the previous chapter as it shows that there is great heterogeniety also in the larger sample presented in this chapter. Nevertheless, there is a clear tendency toward a higher degree of transparency, evident from the 3.6 point increase in the average transparency index score from 1998 to 2010 for the full sample.[38] It is also noteworthy that the increase in transparency clearly is not restricted to the millenium shift, as Siklos (2011) argues.
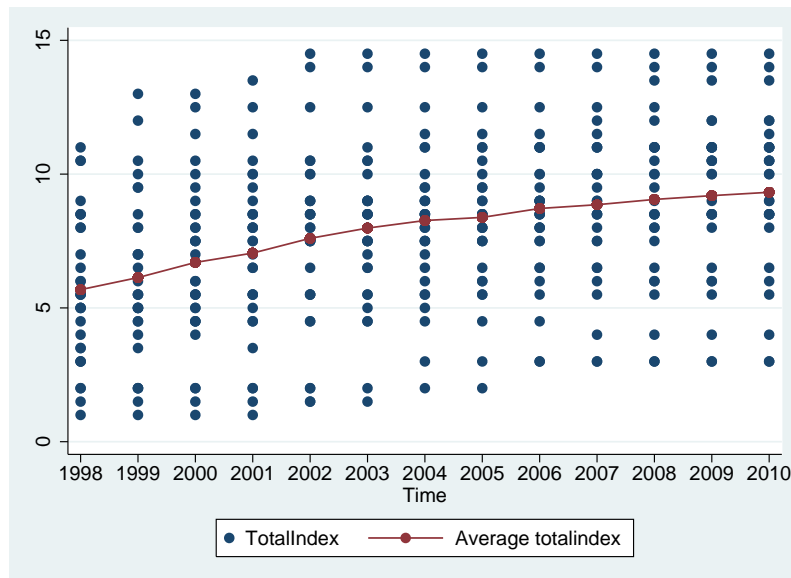
Figure 2: The changes in central bank transparency in the full sample of countries.

To see how changes in central bank transparency in the OECD-countries differ from the development in the non-OECD-countries in the sample, figure 3 is included. It is

[37]Turkey, an OECD-country, is a clear outlier on both the volatility and level of inflation, and is therefore left out of the plots and the analysis.

[38]The full sample includes Argentina, Brazil, China, India, Indonesia Russia and South Africa in addition to the OECD-countries.
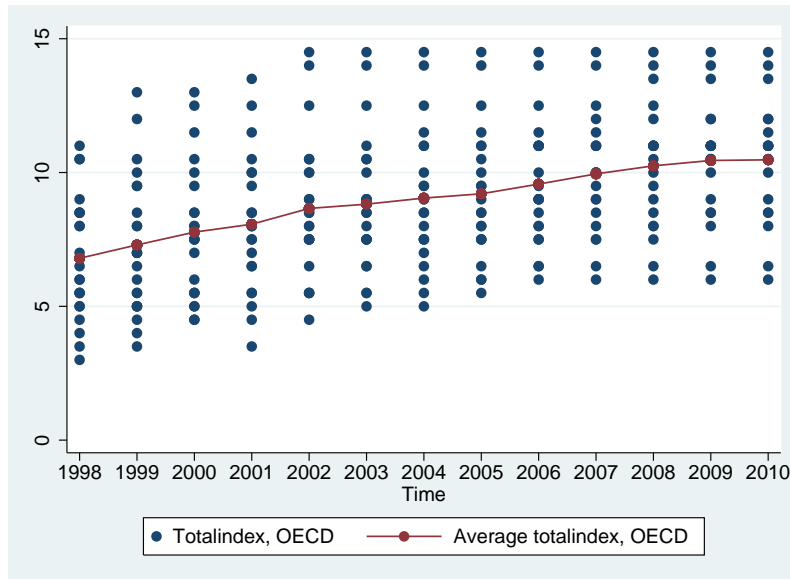
Figure 3: The changes in central bank transparency in the OECD-countries.

clear that some outliers at the bottom-end of the transparency index vanish when the non-OECD-countries are excluded. The exclusion of non-OECD-countries raises the average level of transparency in 2010 from 9.3 to approximately 10.5.

Figure 4: Inflation level in the OECD-countries.

Figure 5 shows that the average inflation rate is quite stable over time. The average level of inflation is reduced from approximately 4.9 % in 1998 to 2.4 % in 2005. If the data set had covered the time period from the early 1980s, the reduction in the level of inflation would have been even clearer. The period covered in figure 4 coincides with

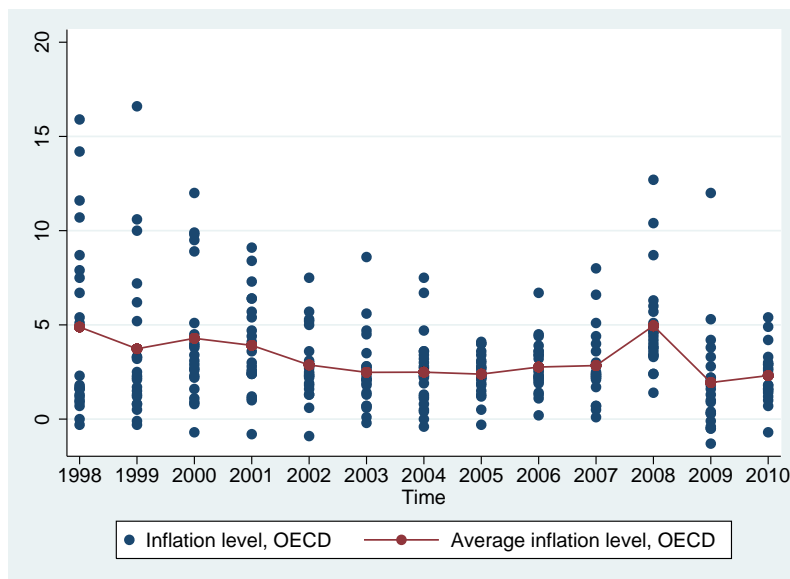central banks increasingly focusing on price stability, often in the form of an inflation target. Furthermore, the decline in the inflation rate following the financial crisis is in line with economic theory: A severe recession affects demand which in turn results in lower inflation. Last, the presence of heterogeniety is evident from the scatter plot.
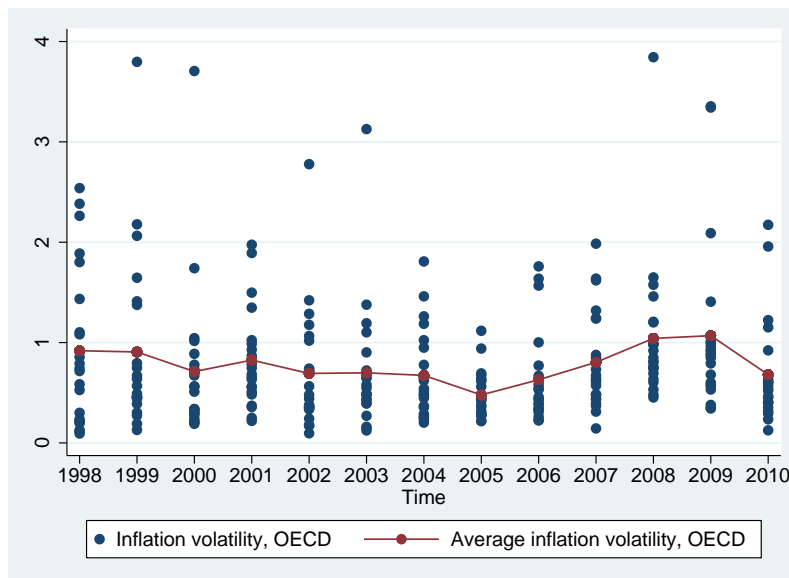

Figure 5: Inflation volatility in the OECD-countries

As opposed to the inflation level, figure 5 shows that the average value of inflation volatility seems to fluctuate more over years and across countries. A possible explanation for this observation is that some prices, such as energy prices, might be more volatile within years than between years. Nevertheless, it seems to be a quite clear time effect present, which justifies the use of time dummies in the analysis. Furthermore, if the analysis had included the 1970s and the 1980s, we would probably see a clear pattern of reduced inflation volatility since the levels of inflation were higher in this period.

Although the standard deviation of output growth is higher than for inflation volatility (table 3), this is not necessary an indication of output growth being more volatile than inflation. We see that output growth was quite stable throughout the mid-2000s, before the volatility increased in 2008. Intuitively, there is reason to suspect that spatial dependence (Driscoll and Kraay, 1998) is present when analyzing output volatility.[39] Global shocks, such as the financial crisis in 2008, affect most countries in the sample

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[39]Spatial dependence is present when the disturbance terms for the different entities within a given time period are correlated. By treating the cross-sections as independent from eachother, the standard errors will be incorrect.
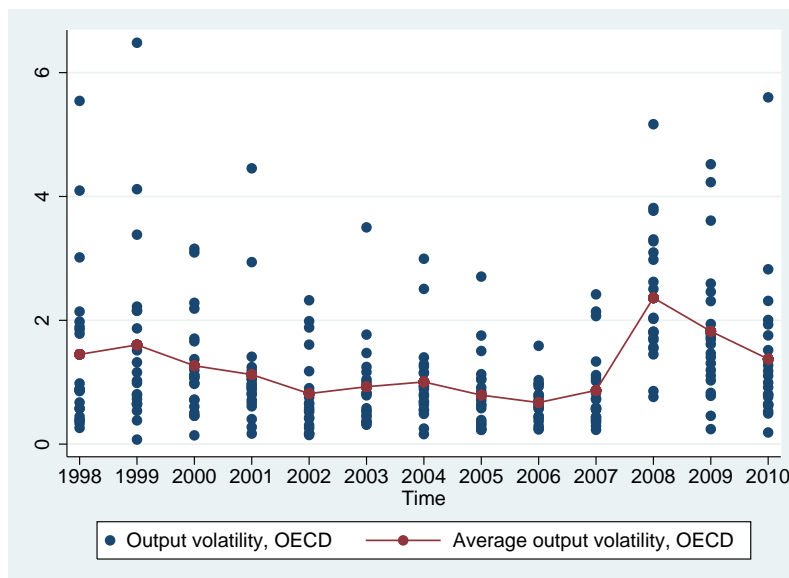
Figure 6: Output volatility in the OECD-countries

in the same way, and the disturbance terms might therefore be correlated. Again, this justifies the use of time dummies in the analysis, and highlights the importance of testing for cross-sectional dependence, elaborated on in the next section.

5.2 Relevant Models and Tests

5.2.1 Fixed Effect and Random Effect

To simplify, I present the models as bivariate cases, but the results generalize to cases with several explanatory variables.

The *fixed* effect model is appropriate when there is reason to suspect that the explanatory variables are correlated with the *unobserved* effect, a_i. By time-demeaning the value of the variables, this effect is removed. The assumptions for the fixed effect model are (Wooldridge, 2008, p.p. 481-505):

- FE.1: For each i, the model is $Y_{it} = \beta x_{it} + a_i + u_{it} \quad t = 1, 2, ..., T \quad , i = 1, 2, ..., N$

- FE. 2: We have a random sample from the cross section

- FE. 3: $Var(x) > 0$, and no perfect multicollinearity among the explanatory variables in the case of several explanatory variables.

- FE. 4: $E(u_{it}|x_i, a_i) = 0$, the strict exogeniety assumption.

- FE. 5: $Var(u_{it}|x_i, a_i) = Var(u_{it}) = \sigma_u^2$ for all t = 1,...,T, meaning that the idiosyncratic errors are homoskedastic.

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- FE. 6: $Cov(u_{it}, u_{is}|x_i, a_i) = 0$, meaning that the idiosyncratic errors are serially uncorrelated.

- FE. 7: Conditional on x_i and a_i, the idiosyncratic errors are i.i.d. $N \sim (0, \sigma_u^2)$. This assumption ensures that the F- and t-statistics are valid in the finite sample.

In order to estimate the coefficients, it is necessary to average the values over time for each entity:

$$\bar{Y}_i = \beta \bar{x}_i + a_i + \bar{u}_i \tag{4}$$

Subtracting equation 5 from the model in FE.1 yields:

$$Y_{it} - \bar{Y}_i = \beta(x_{it} - \bar{x}_i) + a_i - a_i + u_{it} - \bar{u}_i \tag{5}$$

$$\tilde{Y}_{it} = \beta \tilde{x}_{it} + \tilde{u}_{it} \tag{6}$$

In theory, β in equation 6 can be estimated consistently using pooled OLS, and is sometimes referred to as the *within* estimator since it uses the variation over time within each entity (Wooldridge, 2008).

The assumptions for the *random effect* model are the same as for the fixed effect model, except that assumption FE. 3, FE. 4 and FE. 5 are reformulated in the following way (Wooldridge, 2008, p.p. 481-505):

- RE. 3: Absence of perfect multicollinearity in the case of several explanatory variables. The random effect model allows for time-invariant explanatory variables.

- RE. 4: In addition to FE.4, $E(a_i|x_i) = \beta_0$. The value of the unobservable effect is constant given x_i.

- RE. 5: In addition to FE. 5, $Var(a_i|x_i) = \sigma_a^2$

The crucial assumption that distinguishes the random effect model from the fixed effect model is RE.4: The explanatory variables are uncorrelated with the individual-specific effect, a_i: $Cov(x_{it}, a_i) = 0$. Performing pooled OLS will produce consistent estimators, but the standard deviation, and hence the test statistics, might be misguiding (Wooldridge, 2008) since pooled OLS ignores the serial correlation in the model. To show this, define $v_{it} = a_i + u_{it}$ as the composite error term. Then:

$$Corr(v_{it}, v_{is}) = \frac{Cov(v_{it}, v_{is})}{\sqrt{Var(v_{it})Var(v_{is})}} = \frac{Cov(a_i + u_{it}, a_i + u_{is})}{\sqrt{Var(a_i + u_{it})Var(a_i + u_{is})}} \tag{7}$$

Since FE. 6 states that $Cov(u_{it}, u_{is}) = 0$ and FE. 4 ensures strict exogeniety, equation 7 can be written:

$$Corr(v_{it}, v_{is}) = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_u^2} \tag{8}$$

Where σ_u and σ_a denote the standard deviation of a_i and u_{it}, respectively. This serial correlation is substantial if the individual characteristic is volatilte relative to u_{it}, resulting in a less accurate standard deviation. The full derivation of the GLS-estimator used to eliminate this serial correlation is quite technical, and for the purpose of this thesis, I only include the transformation itself (Wooldridge, 2008, p. 490).

$$\lambda = 1 - (\frac{\sigma_u^2}{\sigma_u^2 + T\sigma_a^2})^{1/2} \tag{9}$$

...resulting in the transformed equation to be:

$$y_{it} - \lambda \bar{y}_i = \beta_0(1 - \lambda) + \beta_1(x_{it} - \lambda \bar{x}_i) + (v_{it} - \lambda \bar{v}_i) \tag{10}$$

The random effect model is similar to the fixed effect model in the sense that both models subtract the time average within the entities, but differ as only a fraction of that time average is being subtracted in the former.

5.2.2 Relevant Tests

Since the coefficients estimated under the fixed effect (FE) model are consistent regardless of the covariance between the explanatory variables and the individual characterstics, while the coefficients estimated using the random effect (RE) model are not consistent if $Cov(x_{it}, a_i) \neq 0$, the coefficients estimated under the RE and FE models, β_k^{RE} and β_k^{FE}, are compared when deciding on which model to use (Wooldridge, 2008, p. 493). The test proposed by Hausman (1978) tests whether the two (vectors of) estimates obtained are statistically different. Due to the efficiency of the RE model, the null hypothesis is that the individual effect is not correlated with the explanatory variables. Thus, $H_o : \boldsymbol{\beta}^{RE} = \boldsymbol{\beta}^{FE}$.[40] In this context, using intuition is a good supplement to the tests. Is it likely that individual effects, such as labour market regulations or the financial openness, are correlated with the central banks' transparency and the volatility of macroeconomic variables? I believe this is not unlikely, as one would expect that countries with more developed financial markets might be characterized by more

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[40]Not rejecting this hypothesis is not equivalent with the RE model being consistent. Since $Var(\boldsymbol{\beta}^{RE} - \boldsymbol{\beta}^{FE})$ is a function of the two variables' variances, failure to reject the null hypothesis might be due to large sampling variation in the estimates (Wooldridge, 2008, p. 493).

transparent central banks due to higher demand for information. Since more developed financial markets – arguably a fairly time-invariant characteristic – are likely to result in more stable inflation, the FE model is preferred.

Furthermore, if the Hausman test fails to reject the hypothesis of no significant difference between the estimates obtained using the FE and the RE model, the Breusch and Pagan (1979) test is used to decide on whether pooled OLS is appropriate. $H_o : Var(a) = 0$, that is, the individual differences between units in the panel are not statistically significant. In that case, neither the FE or the RE model would be appropriate.

The importance of using the appropriate model for drawing inference of the relationship between variables in a panel data set was highlighted in the two previous paragraphs. Furthermore, failing to correct for heteroskedasticity, autocorrelation and cross-sectional dependence will, in the presence of such, result in biased standard errors (Hoechle, 2007). Intuitively, this is likely to occur in this context. First, heteroscedasticity might be present because the countries in the sample probably differ on for instance labor market regulation and wage negotiation structure, which are likely to affect both the inflation and output volatility. Second, autocorrelation is likely to be present because business cycles tend to have spill-over effects on more years. Third, cross-sectional dependence is likely to be present since global shocks hit more countries in the same time period. Higher volatility of oil prices for a period will probably lead to inflation volatility in the time period being above its projected level for most countries, and thus also the residuals to be correlated within a given year.

Therefore, in addition to performing the Hausman (1978) test and the Breusch and Pagan (1979) test, I will briefly report the results from performing tests on heteroscedasticity, autocorrelation and cross-sectional dependence. Heteroscedasticity is tested using a modified Wald test (Baum, 2000). A test proposed by Wooldridge (2002) (Drukker, 2003) is used to test for autocorrelation. Finally, the Pesaran test (De Hoyos and Sarafidis, 2006) is used to test for spatial dependence.

5.2.3 Test Results

In all the models presented in section 5.3, a F-test rejects the null hypothesis of all the coefficients associated with the time dummies being jointly equal to zero.[41] This is in line with what the descriptive statistics presented in section 5.1 indicate, namely that time effects are present for all variables. The results obtained from performing

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[41]P-values are approximately equal to zero for all the models.

the other tests are summarized in table 5.

Table 5: P-values from the specification tests performed

Model	Hausman	Breusch-Pagan	Autocorr.	Het.sced.	Spatial dep.
1	≈ 1	≈ 0	≈ 0	≈ 0	0.4939
2	≈ 0	-	≈ 0	≈ 0	0.5589
3	≈ 1	≈ 0	0.04	≈ 0	0.1316
4	≈ 0	-	≈ 0	≈ 0	0.3791
5	≈ 1	≈ 0	≈ 0	≈ 0	0.2679
6	≈ 0	-	≈ 0	≈ 0	N/A
7	≈ 0	-	≈ 0	≈ 0	0.2442
8	≈ 0	-	≈ 0	≈ 0	N/A
9	≈ 0	-	≈ 0	≈ 0	0.5087

A low p-value in the Hausman test indicates that it is likely that the FE model is appropriate, while a low p-value in the Breusch-Pagan test indicates that random effect is appropriate. Furthermore, low p-values in the tests of autocorrelation, heteroscedasticity and spatial dependence indicate that these issues are present.

Model 1, 3 and 5 analyze the impact of central bank transparency on the inflation level, the inflation volatility and the output volatility, respectively, without including the lagged value of the dependent variable. The Hausman test fails to reject the use of the RE model for these models. However, by including the value of the lagged dependent variable in model 2, 4 and 6, the Hausman test rejects the use of the RE model. Furthermore, in the analysis isolating the various transparency categories – model 7, 8 and 9 – the Hausman test rejects the use of the RE model. These models include the value of the lagged dependent variable. Not surprisingly, heteroscedasticity and autocorrelation are present in all the relevant models, also when the lagged dependent variable is included, and is therefore adjusted for in the estimation. Cross-sectional dependence, however, is not statistically present in any of the models. This is somewhat surprising, but apparently a result of the inclusion of the time dummies. By omitting the time dummies in model 3, for instance, the null hypothesis of cross-sectional independence is rejected at a 1 % significance level.

5.3 Empirical Models and Results

5.3.1 Inflation Level

The introduction of inflation targets as a means for quantifying the central banks concern on price stability, led, as discussed in section 5.1, to lower and more stable inflation. However, the average level of inflation was still approximately 5 % in 1998,

some 2-3 % above most central banks' inflation target.[42] In 2010 the average inflation rate was approximately 2.3 %, and this decrease coincides with central banks increasing their transparency. In order to analyze this relationship statistically, the following equations are estimated:

$$\pi_{it}^{level} = \beta_0 + \beta_1 TI_{it} + \beta_2 TI_{it}^2 + \boldsymbol{\gamma}'\mathbf{x} + a_i + u_{it} \tag{1}$$

Model 1 includes the transparency index, TI_t, as well as the square of it, TI_t^2. The reason for choosing this functional form, is that it seems likely that the marginal effect of increasing transparency is lower for higher values of transparency. In order to capture the general inflation dynamics, I will estimate model 2 which includes the value of the lagged inflation rate, π_{t-1}^{level}. β_k is the coefficient associated with the k-th explanatory variable. $\boldsymbol{\gamma}$ is a column vector of coefficients for the time dummies, the latter represented by the column vector $\mathbf{x}$. a_i represents the individual effect, while u_{it} is the individual disturbance term. Model 1 is estimated using the RE model, while model 2 is estimated using the FE model.

Table 6: The effect of transparency on the inflation level[†]

	(1) π_t^{level}		(2) π_t^{level}	
TI	-2.430***	(-5.62)	-1.067**	(-2.66)
TI^2	0.110***	(4.76)	0.0474**	(2.35)
π_{t-1}^{level} 1			0.325***	(3.11)
N	278		256	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[†]: Adjusted for autocorrelation and heteroscedasticity. The Stata-command is: "xtreg depvar indepvar, fe/re vce(cluster countrycode)."

The results are presented in table 6. In line with what was expected, an increase in central bank transparency over time results in a lower inflation level. The coefficients are highly statistically significant, and it is important to note that, unlike in the analyses of inflation and output volatility, the coefficients for TI_t and TI_t^2 are statistically significant at a 5 % level also when the lagged dependent variable is included as an explanatory variable. Regardless of which model is used, TI_t and TI_t^2 enter with a negative and a positive sign, respectively, indicating a diminishing marginal effect of central bank transparency on the inflation level. In particular, for the less transparent

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[42]14 of the 22 OECD-countries had a quantification of its monetary policy in 1998. Switzerland and Poland introduced targets in 1999.

central banks, the gain, in terms of a lower inflation level, from increasing transparency is large. To be precise, according to model 2, the marginal effect from increasing transparency on the level of inflation is equal to zero when the level of transparency is approximately 11. However, most central banks aim at an inflation rate close to 2 %, and the optimal degree of transparency for a central bank fully concerned with reaching its inflation target is therefore different from 11.[43]

5.3.2 Inflation Volatility

The empirical models used in the analysis of the impact central bank transparency has on inflation volatility are the following:

$$\pi_{it}^{vol} = \beta_0 + \beta_1 TI_{it} + \beta_2 TI_{it}^2 + \boldsymbol{\gamma}_t' \mathbf{x} + a_i + u_{it} \tag{3}$$

The central bank transparency index, TI_t, as well as the square of it, TI_{it}^2, is included because there is reason to supect that the marginal effect of increasing transparency is diminishing. That is, the relationship between inflation volatility and central bank transparency is non-linear. In model 4, I have included the lagged value of the dependent variable, π_{it-1}^{vol} in order to control for general dynamics in inflation volatility. The remaining notation is similar to the one used in model 1 and 2. Model 3 is estimated using the RE model, and model 4 is estimated using the FE model.

Table 7: The effect central bank transparency has on inflation volatility[†]

	(3) π_t^{vol}		(4) π_t^{vol}	
TI_t	-0.267***	(-2.95)	-0.144	(-1.18)
TI_t^2	0.0104**	(2.21)	0.00571	(0.93)
π_{t-1}^{vol}			0.156***	(2.89)
N	278		256	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[†]: Adjusted for autocorrelation and heteroscedasticity.

The results are presented in table 7. The statistically significant coefficients for TI_t and TI_t^2 in model 3 are less convincing in model 4, where the value of the lagged dependent

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[43]In order to calculate the level of transparency that results in inflation being equal to 2 %, the following equation must be solved: $\beta_1 TI_{it} + \beta_2 TI_{it}^2 + \beta_3 \pi_{t-1}^{level} = 2$. In order to solve this, the initial level of both the inflation rate and the transparency index is needed. For the purpose of this thesis, however, I believe that it suffices to say that the optimal degree of transparency is somewhat higher than 11, but below 15 (max).

variable is included. By including this variable, both the t-values and the standard errors of the coefficients for TI and TI^2, respectively, are substantially reduced. Since the inflation volatilty is quite volatile across years, that is, it is not time-invariant, the fixed effect model does not succeed in eliminating its effect on inflation volatility. Hence, there will be an omitted variable bias if the lagged dependent variable is correlated with TI (and TI^2). Furthermore, by including the lagged dependent variable, autocorrelation is likely to be reduced, resulting in standard errors to be greater, but less biased. Nevertheless, the coefficients (although not statistically significant) estimated in model 4 still have an economic interpretation. TI_t and TI_t^2 enter with a negative and a positive coefficient, respectively, offering support to the claim that there is a non-linear relationship between central bank transparency and price stability. In fact, simple calculations show that the optimal degree of transparency for a central bank fully concerned with minimizing inflation volatility is approximately 12.5.[44]

5.3.3 Output Volatility

As elaborated on in section 3.3, a great motivation for accurate central bank communication is to affect expectations. More specifically, the central banks seek to reduce the uncertainty the private agents operate under. To analyze whether increased central bank transparency reduces output volatility, the following models are estimated:

$$y_{it}^{vol} = \beta_0 + \beta_1 TI_{it} + \beta_2 TI_{it}^2 + \boldsymbol{\gamma}'\mathbf{x} + a_i + u_{it} \tag{5}$$

Where the notation is similar to the one in the analysis of inflation volatility and the level of inflation. Model 5 is estimated using the RE model, while the FE model is used to estimate model 6. The results are presented in table 8.

Table 8: The effect of transparency on output volatility[†]

	(5)		(6)	
	y_t^{vol}		y_t^{vol}	
TI_t	-0.340	(-1.79)	-0.0837	(-0.39)
TI_t^2	0.0140	(1.56)	0.000131	(0.01)
y_{t-1}^{vol}			0.359***	(7.03)
N	272		250	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[†]: Adjusted for autocorrelation and heteroscedasticity.

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[44] $\frac{\partial \pi_{it}^{vol}}{\partial TI_{it}} = \beta_1 + 2\beta_2 TI_{it}$ where β_1 and β_2 are the coefficients associated with TI_t and TI^2, respectively. By setting the expression equal to zero, the solution is found.

By including the value of the lagged dependent variable in model 6, the t-statistics are substantially reduced. Again, this indicates that the fairly high t-values obtained in model 5 follow from specification errors.[45] The coefficients of TI_t and TI_t^2 in model 6 are negative and positive, respectively, but the t-values are close to zero, and an interpretation of them is therefore not justified. That central banks are not able to affect the volatility of output is not very surprising for (at least) two reasons. First, when central banks target output, it is not the primary concern. Second, the notion of the output gap is vague and the numbers on output growth are subject to revision, making it difficult for the economic actors to gain insight from the information a more transparent central bank provides.

5.3.4 Isolating the 5 Transparency Categories

To further nuance the analysis, I have performed an analysis of the transparency categories' impact on the volatility of inflation and output, as well as on the level of inflation. It is likely that the various transparency categories impact the economy in different ways. The models to be estimated are:

$$\pi_{it}^{vol} = \beta_0 + \beta_1 \pi_{it-1}^{vol} + \boldsymbol{\alpha}' \mathbf{TC}_{it} + \boldsymbol{\gamma}' \mathbf{x} + a_i + u_{it} \tag{7}$$

$$y_{it}^{vol} = \beta_0 + \beta_1 y_{it-1}^{vol} + \boldsymbol{\alpha}' \mathbf{TC}_{it} + \boldsymbol{\gamma}' \mathbf{x} + a_i + u_{it} \tag{8}$$

$$\pi_{it}^{level} = \beta_0 + \beta_1 \pi_{it-1}^{level} + \boldsymbol{\alpha}' \mathbf{TC}_{it} + \boldsymbol{\gamma}' \mathbf{x} + a_i + u_{it} \tag{9}$$

Where $\boldsymbol{\alpha}$ is a column vector of coefficients associated with the 5 transparency categories, represented by the column vector $\mathbf{TC}_{it}$. All three models are estimated using the FE model. The results are presented in table 9.

The estimates from model 7, 8 and 9 are important for policy analysis. Inflation volatility is statistically significantly affected by a change in *economic* transparency over time, and a one unit increase over time in this category reduces inflation volatility by roughly 0.15. Knowing that the mean value of inflation volatility was 0.68 in 2010, this effect is substantial. The average level of economic transparency among the OECD-countries in 2010 was approximately 2.5, meaning that there is less scope for further improvement by publishing forecats and data, or by disclosing the models used for policy analysis. Furthermore, *policy* and *operational* transparency enter with a negative (although not statistically significant) coefficient, while the *procedural* and

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[45]Likely specification errors are elaborated in the previous section.

Table 9: The effect of the transparency categories on inflation volatility, output volatility and the inflation level[†]

	7 π_t^{vol}		8 y_t^{vol}		9 π_t^{level}	
Political	0.170	(1.23)	0.161	(0.66)	-0.430	(-0.74)
Economic	-0.149*	(-1.98)	0.178	(1.31)	-0.0425	(-0.19)
Procedural	0.163	(0.79)	-0.102	(-0.49)	0.298	(0.89)
Policy	-0.161	(-1.00)	-0.271	(-1.51)	-0.698	(-1.51)
Operational	-0.147	(-0.64)	-0.433	(-1.27)	-0.368	(-0.78)
π_{t-1}^{vol}	0.141**	(2.22)				
y_{t-1}^{vol}			0.328***	(5.93)		
π_{t-1}^{level}					0.343***	(3.29)
N	256		250		256	

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[†]: Adjusted for autocorrelation and heteroscedasticity.

policy transparency enter with positive, but not statistically significant coefficients. Procedural transparency includes publishment of minutes and voting records, and is arguably a more "qualitative" category. This might make it harder for the private agents to form expectations on the basis of that information.

The results from model 8 are also noteworthy. Although none of the coefficients are statistically significant (at a 10 % significance level), the coefficient for *economic*, *policy* and *operational* transparency have an economic interpretation. The two latter enter with a negative coefficient, that is, output volatility is reduced following an increase in these transparency categories over time, while the economic transparency enter with a positive coefficient. Evident from table 9, economic transparency enters with a negative coefficient in model 7, that is, economic transparency apparently reduces inflation volatility, but increases (although not statistically significant) output volatility. Furthermore, policy transparency enters with a negative coefficient in both models. This is of particular interest, since a great motivation for the use of forward guidance is the possibility to affect the private agents' expectations (Bank of England, 2013b), and, although the recent extensive use of forward guidance is not accounted for in the sample, clear communication seems to reduce both inflation and output volatility. A possible explanation for the findings in model 8, is that more operational and policy transparency result in more sophisticated markets, which in turn results in a more critical evaluation of the information provided by the central banks.

The analysis of transparency's effect on the level of inflation – model 9 – shows that all the coefficients except the one associated with *procedural* transparency are negative. Only the coefficient for *policy* transparency, with a t-value of -1.51, close to being statistically significant. It is also noteworthy that clear, explicit prioritized targets in the form of increased *political* transparency over time seems to reduce (although not statistically significantly) the level of inflation. These two latter points offer further evidence to the belief that central banks benefit from clear communication, as discussed in Qvigstad (2013).

5.3.5   Limitations of the Analyses

The aim of this section is to discuss possible limitations of the analysis. First, the measurement of the fundamental variable in the analysis – central bank transparency – is debated, as discussed in chapter 2. The index utilized in the analysis presented is not necessarily the most accurate to quantify central bank transparency. However, the results from model 4 show that a higher degree of central bank transparency over time is likely to reduce inflation volatility. This indicates that more central bank transparency results in lower inflation volatility and, given that inflation volatility can be viewed as an appropriate indicator of the markets' utilization of public information, that the notion of transparency is a good one following Issing (1999). A second possible limitation of the analysis, is that instrumental variables are not used. The possibility of a feedback effect can lead to biased estimates (Wooldridge, 2002). In this context, the story might be that greater inflation volatility in one year might result in the central bank transparency being increased in the next period as a response to this. To eliminate this potential problem, one would want to use instrumental variables. However, good instruments are difficult to find, and the restrictions on the available data make this challenge harder. A third point is related to testing. Not rejecting the Hausman test is not equivalent to verifying consistency for the random effect model. Preferably, more controls should be included in the analysis. However, the p-values in the cases where the random effect model is preferred are close to 1, clearly indicating that there are no differences between the estimates obtained in the specified models. Having these limitations in mind, the empirical analysis should still be a part of the discussion of what the optimal degree of central bank transparency is.

5.4   Policy Implications

The analyses presented in this chapter indicate that the effect of central bank transparency is restricted to price stability and its level. Although flexible inflation targeting

is adopted by many central banks, price stability is still the main concern of most central banks. According to the analysis, inflation volatility is likely (although not statistically significant) to be reduced following an increase in central bank transparency over time. In particular, increasing economic transparency is expected to reduce inflation volatility. Evident from table 7, the marginal benefit from increasing the degree of central bank transparency in terms of price stability is diminishing as the level of transparency increase. Since the estimates themselves are subject to uncertainty, the optimal degree of transparency, as measured by its effect on inflation volatility, is necessary uncertain. The simple calculations presented in the last section show that, according to model 4, the optimal degree of central bank transparency for a central bank fully focused on maximizing price stability is 12.5, measured by the Geraats-Eijffinger index.

Furthermore, the results from the analysis of central bank transparency's effect on the inflation level are robust. The marginal benefit of increasing transparency is diminishing as the level of transparency is increased, meaning that the less transparent central bank will gain the most from increasing transparency. The optimal degree of transparency following from this analysis is more complicated since central banks do not seek to minimize the inflation, but rather aim at a certain level of inflation. Nevertheless, for a central bank in an economy characterized by high levels of inflation, the benefits of increasing transparency are present.

The analysis of central bank transparency's effect on output volatility is less conclusive. This might be due to the issues related to the number of observations on output growth, but it is intuitively not very suprising that central bank transparency does not affect output volatility. After all, the concern of output growth is, when explicitly stated, a secondary concern for most central banks. Furthermore, the output gap is challenging to measure, and therefore also to forecast. The markets know this, and are therefore probably less willing to utilize the information provided by the central banks. However, clear communication about the central bank's policy decisions might stabilize output.

The analysis of the Fed's policy rate rule presented in Clarida et al. (2000) shows that the Fed was more concerned with reacting to rising inflation expectations after the appointment of Paul Volcker as chair of the Fed. Furthermore, they find that by being more concerned about price stability, the central bank succeeds in reducing output volatility as well. The key, as they see it in their DSGE model, is to affect expectations about future inflation levels. "Expectations" is also a key word in the analysis of the various transparency categories' effect on inflation and output volatility, as well as on

the level of inflation. Although not statistically significant, the *policy* transparency – covering the transparency measures which arguably are most directed toward affecting expectations – enters with a negative coefficient in all three models, and the t-values are high enough to justify an economic interpretation. Thus, it seems that the OECD-countries included – with an average score of 1.825 in 2010 – will benefit from adopting even clearer communication to affect expectations.

A second important finding in the analysis of the transparency categories' impact on the economy, are the coefficients associated with *economic* transparency. By increasing this type of transparency over time, inflation volatility will decrease (statistically significantly) while output volatility will increase. The first result is in line with what was expected, while the second is somewhat surprising. A possible explanation is that it is more challenging for the central bank to forecast the output gap, since the notion of it is arguably less well-defined compared to the inflation rate. As Long (1996) argues, the Fed miscalculated the natural rate of unemployment in the post-war period prior until the stagflation in the 1970s, and, as section 3.3 illustrates, it is likely that measurement errors in the analysis of the economy's potential output still prevails. A second plausible explanation is that by publishing its models used for policy analysis, the markets put too much weight on these. If that is the case, an increase in the *policy* transparency, in order to clarify the discretionary nature of monetary policy, would probably result in a better outcome. A third explanation is in line with what (Galí, 2009, p. 83) shows. He claims that the economy will have a greater welfare loss if the central bank becomes more concerned with stabilizing output, manifested in the relative values of the coefficients in the reaction function.[46] In this context, publishing more data on for instance capacity utilization, output and unemployment, might be interpreted by the markets as the central bank being more concerned with stabilizing output.

It is also noteworthy that the *operational* transparency enters with a negative (although not statistically significant) coefficient in all the models that include the transparency categories. In light of the economic transparency's effect on output volatility, this is particularly interesting, since there is reason to suspect that higher operational transparency will result in the markets being more sophisticated in evaluating the economic data published. An implication for the central banks is the possible interaction between the transparency categories. The central banks have to make a broader assessment of

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[46]A reaction function is basically a policy rule for how the central bank adjusts its interest rate in response to inflation and output deviating from their targets, among other things.

the level of the transparency categories when deciding on the optimal degree of central
bank transparency.

6 Conclusion

The evolution toward a higher degree of central bank transparency has been rapid in the last two decades. In a sample of 120 central banks, Dincer and Eichengreen (2013) find that the mean score of transparency almost doubled between 1998 and 2010. Furthermore, the analysis presented in chapter 4 shows that central banks are more transparent on some aspects, such as political and economic transparency, and that the development of transparency has continued since 2010. It is important to note that several of the most important central banks – the Fed, the BoJ and the BoE as the most prominent – have followed the central banks of smaller economies in adopting transparency policies. In particular, forward guidance has been used extensively in order to boost the economy. However, the justification of this policy is to a smaller extent embedded in the empirical literature. This is natural since the available data are limited due to forward guidance only being used for a relatively short time period.

The shortage of available data should be accompanied with thorough assessments by the central banks. A number of important arguments in the discussion of the optimal degree of central bank transparency are raised in this thesis. First, credibility is essential for the central bank's ability to affect expectations. The issue of credibility in monetary policy dates back to Kydland and Prescott (1977) and is still relevant, examplified by the BoE's recent revision of forward guidance. When considering introducing forward guidance, a part of the discussion should therefore be related to forecast accuracy: How likely is the central bank to find itself in a future situation where it must deviate from its monetary policy stance, and thereby trade flexibility for credibility? This problem can to a certain degree be solved by carefully choosing the wording of the forward guidance. Tying the forward guidance to a state-contingent threshold, such as the BoE did in August 2013, should be preferred if forecast accuracy is weak. Clear communication is essential in forming the public's expectations.

Second, the type of shock identified by the central bank – and thus also the central bank's ability to distinguish cost from demand shocks – is important. Depending on how well-informed the public is expected to be, the central bank should be more transparent if persistent demand shocks occur, while it should be less transparent if persistent cost shocks hit the economy. Again, communication is important, and the central bank must assess whether the information it possesses is accurate enough, and also the risk of the private agents misinterpreting the information published.

Third, the solution to the time-inconsistency problem raised by Kydland and Prescott

(1977) can be summed up in one word: *independence.* This solution has, however, highlighted another important challenge in today's society. A common feature of to-day's democracies is the aim to reflect the general will. Independent central banks are not under direct political control, but more transparency, especially procedural, is equivalent to the central banks being more accountable. Publishing minutes and disclosing voting records are typical measures taken to ensure accountability.

A fourth important point is the effect transparency has on macroeconomic variables. Building on the result presented in chapter 4 – that central bank transparency has increased since 1998 – chapter 5 quantifies its effect on macroeconomic variables. That central bank transparency brings with it economic benefits seems to be an established fact, and it is an argument supporting the development toward more transparency. However, the empirical documentation is scarce. My analysis concludes that more central bank transparency reduces the level of inflation significantly, and that these findings are robust to various specifications. The volatility of inflation is also reduced following an increase in central bank transparency over time, but by including the lagged value of inflation volatility in the analysis, these results are less statistically significant. The coefficients, however, have the same interpretation, namely that an increased level of central bank transparency over time reduces the volatility of inflation up to a certain point. The effect of transparency on output volatility is less statistically convincing. By allowing for non-linearity, I find that the marginal effect transparency has on inflation volatility is diminishing. Although the calculations are uncertain, they yield an optimal level of transparency for a central bank fully concerned with minimizing inflation volatility equal to 12.5 on the Geraats-Eijffinger index. Moreover, economic transparency is the only significant component of the transparency index when analyzing inflation volatility. This indicates that the models used for policy analysis and the central bank's forecasts are important for markets when predicting the actions of a central bank. Also, although not statistically significant, policy transparency enters with a negative coefficient in the analysis of the effect transparency has on inflation and output volatility, as well as in the analysis of the level of inflation. Given the recent, extensive use of forward guidance, a suggestion for future research is to test whether the results are more robust with an updated data set, and also to analyze whether there are interaction effects between the transparency categories.

References

Adolfson, M., S. Lasen, L. Christiano, M. Trabandt, and K. Walentin (2013). RAMSES II - Model Description. Sveriges Riksbank Occasional Paper Series 12, Sveriges Riksbank.

Bank of England (2013a). August Inflation Report.

Bank of England (2013b). Monetary Policy Trade-offs and Forward Guidance.

Bank of England (2014). February Inflation Report.

Barro, R. J. and D. B. Gordon (1983). Rules, Discretion and Reputation in a Model of Monetary Policy. *Journal of Monetary Economics 12*(1), 101–121.

Baum, C. F. (2000, October). XTTEST3: Stata module to compute Modified Wald statistic for groupwise heteroskedasticity. Statistical Software Components, Boston College Department of Economics.

Blinder, A. (2006, February). Monetary Policy by Committee: Why and How? DNB Working Papers 092, Netherlands Central Bank, Research Department.

Bloomberg (2014, March). Ecb said to experiment with minutes of council meetings. http://www.bloomberg.com/news/2014-03-03/ecb-said-to-experiment-with-governing-council-meeting-minutes.html.

Brayton, F. and P. Tinsley (1996). A guide to FRB/US: a macroeconomic model of the United States. Finance and Economics Discussion Series 96-42, Board of Governors of the Federal Reserve System (U.S.).

Breusch, T. S. and A. R. Pagan (1979, September). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica 47*(5), 1287–94.

Brubakk, L. and T. Sveen (2009). NEMO - A New Macro Model for Forecasting and Monetary Policy Analysis. Economic Bulletin 80(1), Norges Bank.

Buiter, W. (1999, April). Alice in Euroland. CEP Discussion Papers dp0423, Centre for Economic Performance, LSE.

Burgess, S., E. Fernandez-Corugedo, C. Groth, R. Harrison, F. Monti, K. Theodoridis, and M. Waldron (2013, May). The Bank of England's forecasting platform: COMPASS, MAPS, EASE and the suite of models. Bank of England working papers 471, Bank of England.

Campbell, J. R., J. D. F. Charles L. Evans, and A. Justiniano (2012). Macroeconomic Effects of Federal Reserve Forward Guidance. *Brookings Papers on Economic Activity 44*(1 (Spring), 1–80.

Christoffel, K., G. Coenen, and A. Warne (2008, October). The New Area-Wide Model of the euro area: a micro-founded open-economy model for forecasting and policy analysis. Working Paper Series 0944, European Central Bank.

Clarida, R., J. Galí, and M. Gertler (2000, February). Monetary Policy Rules And Macroeconomic Stability: Evidence And Some Theory. *The Quarterly Journal of Economics 115*(1), 147–180.

Committee, G. B. P. H. T. and A. Tyrie (2011). *Accountability of the Bank of England: twenty-first report of session 2010-12, Vol. 1: Report, together with formal minutes, oral and written evidence.* Accountability of the Bank of England. Stationery Office.

Crowe, C. and E. E. Meade (2008, December). Central Bank Independence and Transparency: Evolution and Effectiveness. *European Journal of Political Economy 24*(4), 763–777.

De Hoyos, R. E. and V. Sarafidis (2006). Testing for cross-sectional dependence in panel-data models. *Stata Journal 6*(4), 482–496.

Debelle, G. and S. Fischer (1994). How Independent Should a Central Bank Be? Working Papers in Applied Economic Theory 94-05, Federal Reserve Bank of San Francisco.

Diebold, F. X. and R. S. Mariano (1995, July). Comparing Predictive Accuracy. *Journal of Business & Economic Statistics 13*(3), 253–63.

Dincer, N. and B. Eichengreen (2013, September). Central Bank Transparency: Updates and New Measures. BOK Working Papers, Bank of Korea.

Dincer, N. N. and B. Eichengreen (2007, March). Central Bank Transparency: Where, Why, and with What Effects? NBER Working Papers 13003, National Bureau of Economic Research, Inc.

Driscoll, J. C. and A. C. Kraay (1998, November). Consistent Covariance Matrix Estimation With Spatially Dependent Panel Data. *The Review of Economics and Statistics 80*(4), 549–560.

Drukker, D. M. (2003). Testing for serial correlation in linear panel-data models. *Stata Journal 3*(2), 168–177.

Eijffinger, S. C. and P. M. Geraats (2006, March). How Transparent are Central Banks? *European Journal of Political Economy 22*(1), 1–21.

Fry, M. (2000). *Monetary Policy Frameworks in a Global Context*, Chapter Key Issues in the Choice of Monetary Framework, pp. 1 – 15. Routledge, London.

Galí, J. (2009). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*. Princeton University Press.

Geraats, P. M. (2002, November). Central Bank Transparency. *Economic Journal 112*(483), 532–565.

Geraats, P. M. (2007, March). The Mystique of Central Bank Speak. *International Journal of Central Banking 3*(1), 37–80.

Geraats, P. M. (2009, 08). Trends in Monetary Policy Transparency. *International Finance 12*(2), 235–268.

Gertler, M., J. Galí, and R. Clarida (1999, December). The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature 37*(4), 1661–1707.

Gurkaynak, R. S., B. Sack, and E. Swanson (2005, May). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking 1*(1).

Hackworth, C., A. Radia, and N. Roberts (2013). Understanding the MPCs forecast performance since mid-2010. *Bank of England Quarterly Bulletin 53*(4), 336–350.

Hara, N., H. Ichiue, S. Kojiuma, K. Nakamura, and T. Shirota (2009). Practical Use of Macroeconomic Models at Central Bank. Bank of Japan Review 2009/01, Bank of Japan.

Harimohan, R. (2012). How has the risk to inflation from inflation expectations evolved? *Bank of England Quarterly Bulletin 52*(2), 114–123.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica 46*(6), 1251–71.

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *Stata Journal 7*(3), 281–312.

Issing, O. (1999). The Eurosystem: Transparent and Accountable or Willem in Euroland. *JCMS: Journal of Common Market Studies 37*(3), 503–519.

Kool, C. J. and D. L. Thornton (2012). How Effective is Central Bank Forward Guidance? Working Papers 2012-063, Federal Reserve Bank of St. Louis.

Kydland, F. E. and E. C. Prescott (1977, June). Rules Rather Than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy 85*(3), 473–91.

Kydland, F. E. and E. C. Prescott (1982, November). Time to Build and Aggregate Fluctuations. *Econometrica 50*(6), 1345–70.

Labbe, F. and H. Pepper (2009, December). Assessing recent external forecasts. *Reserve Bank of New Zealand Bulletin 72*, 19–25.

Lees, K. (2009, June). Introducing KITT: The Reserve Bank of New Zealand new DSGE model for forecasting and policy design. *Reserve Bank of New Zealand Bulletin 72*, 5–20.

Leitner, S. M. and R. Stehrer (2012, June). Labour Hoarding during the Crisis: Evidence for selected New Member States from the Financial Crisis Survey. wiiw Working Papers 84, The Vienna Institute for International Economic Studies, wiiw.

Long, J. B. D. (1996, May). America's Only Peacetime Inflation: The 1970s. NBER Historical Working Papers 0084, National Bureau of Economic Research, Inc.

Maule, B. and A. Pugh (2012). Do inflation expectations currently pose a risk to the economy? *Bank of England Quarterly Bulletin 53*(1), 110–121.

Mishkin, F. S. (2004). Can Central Bank Transparency Go Too Far? In C. Kent and S. Guttmann (Eds.), *The Future of Inflation Targeting*, RBA Annual Conference Volume. Reserve Bank of Australia.

Morris, S. and H. S. Shin (2002, December). Social Value of Public Information. *American Economic Review 92*(5), 1521–1534.

Murchison, S. and A. Rennison (2006). ToTEM: The Bank of Canada's New Quarterly Projection Model. Technical Reports 97, Bank of Canada.

Qvigstad, J. F. (2009, May). On Transparency. Occasional Paper 41, Norges Bank.

Qvigstad, J. F. (2013). Monetary Policy Committees and Communication. Staff Memo 2/13, Norges Bank.

Rogoff, K. (1985, November). The Optimal Degree of Commitment to an Intermediate Monetary Target. *The Quarterly Journal of Economics 100*(4), 1169–89.

Rudolf, B. and M. Zurlinden (2014). A Compact Open Economy Model for Switzerland. SNB Economic Studies 08, The Swiss National Bank.

Siklos, P. (2011). Central Bank Transparency: Another Look. *Applied Economics Letters 18*(10), 929–933.

Stone, A., T. Wheatley, and L. Wilkinson (2005, December). A Small Model of the Australian Macroeconomy: An Update. RBA Research Discussion Papers rdp2005-11, Reserve Bank of Australia.

Svensson, L. E. (1997, July). Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts. NBER Working Papers 5251, National Bureau of Economic Research, Inc.

Taylor, J. B. (1993, December). Discretion versus Policy Rules in Practice. *Carnegie-Rochester Conference Series on Public Policy 39*(1), 195–214.

Walsh, C. E. (1995, March). Optimal Contracts for Central Bankers. *American Economic Review 85*(1), 150–67.

Walsh, C. E. (2007, March). Optimal Economic Transparency. *International Journal of Central Banking 3*(1), 5–36.

Woodford, M. (2012). Methods of Policy Accommodation at the Interest-rate Lower Bound. *Proceedings - Economic Policy Symposium - Jackson Hole*, 185–288.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Econometric Analysis of Cross Section and Panel Data. MIT Press.

Wooldridge, J. (2008). *Introductory Econometrics: A Modern Approach*. ISE - International Student Edition. Cengage Learning.

Wren-Lewis, S. (2014). Forward guidance is not forward commtiment. http://mainlymacro.blogspot.no/2014/03/forward-guidance-is-not-forward.html.

A Construction of the Central Bank Transparency Index

This attachment seeks to clarify the construction of the Geraats-Eijffinger index. The wording is the exact same as Dincer and Eichengreen (2007) use. There are 3 questions on each of the 5 categories, resulting in a total of 15 equally weighted questions.

A.1 Political Transparency

Political transparency refers to opennes about policy objectives. This comprises a formal statement of objectives, including an explicit prioritization in case of multiple goals, a quantification of the primary objective(s), and explicit institutional arrangements.

(a) Is there a formal statement of the objective(s) of monetary polcy, with an explicit prioritization in case of multiple objectives?

- No formal objective(s) = 0

- Multiple objectives without prioritization = 0.5

- One primary objective, or multiple objectives with explicit priority = 1

(b) Is there a quantification of the primary objective(s)?

- No = 0

- Yes = 1

(c) Are there explicit contracts or other similiar institutional arrangements between the monetary authorities and the government?

- No central bank contracts or other institutional arrangements = 0.

- Central bank without explicit instrument independence or contract = 0.5.

- Central bank with explicit instrument independence or central bank contract although possibly subject to an explicit override procedure = 1.

A.2 Economic Transparency

Economic transparency focuses on the economic information that is used for monetary policy. This includes economic data, the model of the economy that the central bank employs to construct forecasts or evaluate the impacts of its decisions, and the internal forecasts (model based or judgmental) that the central bank relies on.

(a) Is the basic economic data relevant for the conduct of monetary policy publicly available? (The focus is on the following five variables: money supply, inflation, GDP, unemployment rate and capacity utilization.)

- Quarterly time series for at most two out of the five variables = 0.

- Quarterly time series for at most four out of the five variables = 0.5.

- Quarterly time series for all five variables = 1.

(b) Does the central bank disclose the macroeconomic model(s) it uses for policy analysis?

- No = 0.

- Yes = 1.

(c) Doe the central bank regularly publish its own macroeconomic forecasts?

- No numerical central bank forecasts for inflation and output = 0.

- Numerical central bank forecasts for inflation and/or output published at less than quarterly frequency = 0.5.

- Quarterly numerical central bank forecasts for inflation and output for the medium term (one to two years ahead), specifying the assumptions about the policy instrument (conditional or unconditional forecasts) = 1.

A.3   Procedural Transparency

Procedural transparency is about the way monetary policy decisions are taken.

(a) Does the central bank provide an explicit policy rule or strategy that describes its monetary policy framework?

- No = 0.

- Yes = 1.

(b) Does the central bank give a comprehensive account of policy deliberations (or explanations in case of a single central banker) within a reasonable amount of time?

- No or only after a substantial lag (more than eight weeks) = 0.

- Yes, comprehensive minutes (although not necessarily verbatim or attributed) or explanations (in case of a single central banker), including a discussion of backward and forward-looking arguments = 1.

(c) Does the central bank disclose how each decision on the level of its main operating instrument or target was reached?

- No voting records, or only after substantial lag (more than eight weeks) = 0.

- Non-attributed voting records = 0.5

- Individual voting records, or decision by single central banker = 1.

A.4 Policy Transparency

Policy transparency means prompt disclosure of policy decisions, together with an explanation of the decision, and an explicit policy inclination or indication of likely future policy actions

(a) Are decisions about adjustments to the main operating instrument or target announced promptly?

- No or only after the day of implementation = 0.

- Yes, on the day of implementation = 1.

(b) Does the central bank provide an explanation when it announces policy decisions?

- No = 0.

- Yes, when policy decisions change, or only superficially = 0.5.

- Yes, always and including forward-looking assessments = 1.

(c) Does the central bank disclose an explicit policy inclination after every policy meeting or an explicit indication of likely future policy actions (at least quarterly)?

- No = 0.

- Yes = 1.

A.5 Operational Transparency

Operational transparency concerns the implementation of the central bank's policy actions. It involves a discussion of control errors in achieving operating targets and (unanticipated) macroeconomic disturbances that affect the transmission of monetary policy. Furthermore, the evaluation of the macroeconomic outcomes of monetary policy in light of its objectives is included here as well.

(a) Does the central bank regularly evaluate to what extent its main policy operating targets (if any) have been achieved?

- No or not very often (at less than annual frequency) = 0.

- Yes but without providing explanations for significant deviations = 0.5.

- Yes, accounting for significant deviations from target (if any); or, (nearly) perfect control over main operating instrument/target = 1.

(b) Does the central bank regularly provide information on (unanticipated) macroeconomic disturbances that affect the policy transmission process?

- No or not very often = 0.

- Yes but only through short-term forecasts or analysis of current macroeconomic developments (at least quarterly) = 0.5.

- Yes including a discussion of past forecast errors (at least annually) = 1.

(c) Does the central bank regularly provide an evaluation of the policy outcome in light of its macroeconomic objectives?

- No or not very often (at less than annual frequency) = 0.

- Yes but superficially = 0.5.

- Yes, with an explicit account of the contribution of monetary policy in meeting the objectives = 1.

B Central Bank Transparency in 2014

This appendix shows how the scores for central bank transparency in 2014 were calculated. The data are gathered from the central banks' websites.[47]

B.1 The Reserve Bank of Australia

Political: The RBA receives full score on this category. It has a quantified, prioritized inflation target stating that it aims to achieve an inflation rate of 2-3 % (1a and 1b). Furthermore, its instrument independence is ensured by the *Reserve Bank Act 1959* (1c).

Economic: The RBA publishes the macroeconomic model used for policy analysis (Stone et al., 2005) (2b), and provides quarterly forecasts on both inflation and output (2c). However, the RBA does not receive full score for its economic transparency since data on capacity utilization and money supply are not explicity published (2a) in the *Statement on Monetary Policy*. The RBA provides a quite detailed analysis of the various sectors in the economy including labor market surveys, but in order to remain objective, I have given 0.5 points on question 2a, resulting in a 2.5 score on economic transparency.

Procedural: The RBA is, as the other inflation-targeters, transparent about its strategy for monetary policy (3a). It publishes minutes (3b), but does not disclose the voting records (3c). The RBA receives 2 points on procedural transparency.

Policy: The RBA publishes a media release following monetary policy meeting, including policy rate adjustments (4a) and an explanation (4b) of the decision reached. It does, however, not disclose an explicit policy inclination (4c). The RBA receives 2 points for its policy transparency.

Operational: In its *Statement on Monetary Policy*, the inflation target is evaluated (5a), and current macroeconomic developments are analyzed (5b). However, it does not receive full score on the latter since a discussion of past forecast errors is not included. The RBA does not provide an evaluation of the policy outcome in the light of its macroeconomic objectives (5c). Its score on operational transparency is 1.5.

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[47]RBA: rba.gov.au , BoC: www.bankofcanada.ca , ECB: ecb.europa.eu , BoJ: boj.or.jp/en/ , RBNZ: rbnz.govt.nz , Sveriges Riksbank: riksbank.se/en/ , SNB: snb.ch , BoE: http://bankofengland.co.uk/ Fed: federalreserve.gov , NB: norges-bank.no/en

B.2 The Bank of Canada

Political: The BoC aims to keep inflation in the range between 1 and 3 %, and prioritizes this (1a and 1b). *The Bank of Canada Act* ensures its instrument independence (1c). The BoC receives full score for its political transparency.

Economic: Quarterly forecasts and a data on a broad range of variables are published (2a and 2c) in the *Monetary Policy Report,* and the macroeconomic models used for policy analysis are published (Murchison and Rennison, 2006) (2b). It receives full score for its economic transparency.

Procedural: Its strategy for monetary policy is given by its inflation target (3a). However, the BoC does not publish minutes (3b) and does not disclose the voting records (3c). It receives 1 point for its procedural transparency.

Policy: The BoC issues a statement following a monetary policy meeting (4a), and holds a press conference the same day, explaining the decision (4b). It did adopt time-contingent forward guidance in the wake of the financial crisis, but this stance is now changed, and it does not disclose an explicit policy inclination. Its score on policy transparency is therefore 2.

Operational: In its quarterly *Monetary Policy Report,* the BoC offers a thorough explanation of reasons for why inflation has developed the way it has done (5a). It examines the macroeconomic state, but does not evaluate its own forecast errors (5b). Furthermore, a superficial reasoning behind the policy rate level is presented in the *Annual Report* (5c), including a brief judgement of risks to the financial sector. The BoC receives 2 points for its operational transparency.

B.3 The European Central Bank

Political: The ECB aims at an inflation rate close to, but below 2 % measured by its HICP-index, and prioritizes this (1a and 1b). Its instrument independence is formalized in article 127 in the *Treaty on the Functioning of the European Union* (1c). The ECB receives full score for its political transparency.

Economic: A broad range of macroeconomic variables (2a) are published monthly along with forecasts on inflation and output (2c) in the *Monthly Bulletin,* and the ECB is transparent about the model used for policy analysis (Christoffel et al., 2008). It therefore receives full score on economic transparency (2b).

Procedural: The ECB is clear about its monetary policy strategy through the inflation target (3a), but does not publish minutes (3b) or disclose voting records (3c). It receives 1 point for its procedural transparency.

Policy: A press conference follows the announcement of a policy rate decision (4a and 4b). Furthermore, the ECB uses forward guidance, and does therefore disclose a policy inclination (4c). The ECB receives 3 points for its policy transparency.

Operational: In its *Monthly Bulletins* the ECB provides a thorough analysis of the macroeconomic state including the inflation rate (5a and 5b), but does not account for forecast errors (5b). Furthermore, the ECB provides a superficial account of the policy outcome in light of the inflation rate. It receives 2 points for its operational transparency.

B.4   The Bank of Japan

Political: The BoJ aims at an inflation rate of 2 % (1a and 1b), and price stability is its solely priority. Its instrumental independence is ensured by the *Bank of Japan Act*. The BoJ receives full score for its political transparency.

Economic: The BoJ receives full score on 2a since it publishes data on a broad range of variables quarterly in either the *Outlook for Economic Activity and Prices* released twice a year, or in the interim release. Furthermore, its macroeconomic model for policy analysis is disclosed (Hara et al., 2009) (2b), and the BoJ publishes forecasts on inflation and output at a quarterly frequency (2c). The BoJ receives full score for its economic transparency.

Procedural: Its strategy is published since the BoJ is an inflation-targeter (3a). It publishes minutes (3b) and discloses the voting records (3c) following monetary policy meetings. Its procedural transparency receives full score.

Policy: The BoJ holds a press conference following its monetary policy meeting (4a and 4b), and it introduced time-contingent forward guidance in 2013 when the 2-year time-horizon for hitting a 2 % inflation target was disclosed. The BoJ receives full score for its policy transparency.

Operational: In its *Outlook for Economic Activity and Prices*, the BoJ looks at the past inflation rate (5a), the macroeconomic development (5b) and the outlook for

monetary policy (5c). However, the analyses are superficial, and no discussion of past forecast errors is included. Therefore, the BoJ receives 1.5 points for its operational transparency.

B.5   Reserve Bank of New Zealand

Political: The RBNZ aims to keep inflation between 1 and 3 %, and prioritizes this (1a and 1b). Its instrument independence is formalized in the *Reserve Bank of New Zealand Act 1989.* The RBNZ receives full score for its political transparency.

Economic: The RBNZ publishes data quarterly on the variables required for full score on 2a in the *Monetary Policy Statement.* It has disclosed its macroeconomic model used for policy analysis (Lees, 2009) (2b). Furthermore, forecasts on inflation and output are published quarterly (2c), resulting in full score for the RBNZ on economic transparency.

Procedural: As an inflation-targeter, the RBNZ provides a strategy for its framework of monetary policy (3a), and in addition, the RBNZ signals the likely future policy rate. Although minutes from the discussion leading to the decisions is not published, the governor – solely responsible for the decision – must explain his decision, and must face the elected politicians. Therefore, the RBNZ receives full score on both 3b and 3c. The RBNZ receives full score on procedural transparency.

Policy: The RBNZ publishes a statement and holds a press conference immediately following a monetary policy decision (4a and 4b). Through its forward guidance on the policy rate, it discloses an explicit policy inclination. The RBNZ receives full score on its policy transparency.

Operational: The RBNZ evaluates past inflation (5a). It also discusses macroeconomic disturbances, but does not include a discussion of past forecast errors (5b). Furthermore, although it provides Delphic forward guidance on the policy rate, its evaluation of the policy outcome in the light of macroeconomic objectives is not very detailed (5c). The RBNZ receives 2 points for its operational transparency.

B.6   Sveriges Riksbank

Political: The objective to maintain price stability is manifested as a 2 % inflation target (1b), but the concern of financial stability without an explicit prioritization

results in a score of 0.5 on 1a. Its instrumental independence is formalized by the *Sveriges Riksbank Act*[48] (1c). Sveriges Riksbank scores 2.5 on political transparency.

Economic: Sveriges Riksbank publishes data on a broad range of variables (1a) six times a year in either the *Monetary Policy Report* or its update, and has disclosed its model used for policy analysis (Adolfson et al., 2013) (2b). It also provides forecasts on inflation and output quarterly (2c). Sveriges Riksbank receives full score on economic transparency.

Procedural: Sveriges Riksbank is transparent about its monetary policy strategy through its projected policy rate and the inflation target (3a). It publishes minutes (3b) and discloses voting records (3c). Sveriges Riksbank receives full score for its procedural transparency.

Policy: Press conferences are held the same day decisions are announced (4a and 4b). Sveriges Riksbank provides Delphic forward guidance by publishing projected policy rate (4c). Sveriges Riksbank receives full score on policy transparency.

Operational: The report *Account of Monetary Policy* discusses forecast errors (5b) and reviews whether the inflation target was reached in the previous year (5a), including an account of how monetary policy works (5c). Furthermore, a thorough discussion of the inflation target and the macroeconomic development is given in the *Monetary Policy Report*. Sveriges Riksbank receives full score for its operational transparency.

B.7 The Swiss National Bank

Political: The SNB prioritizes price stability (1a), and aims at an inflation rate of 2 % (1b). The instrument independence is formalized in the *Federal Act on the Swiss National Bank* (1c). The SNB receives full score on political transparency.

Economic: The SNB publishes data quarterly on a broad range of variables (2a) in the *Monetary Policy Report*, and is transparent about the models used for policy analysis (Rudolf and Zurlinden, 2014) (2b). Furthermore, forecasts on inflation and output are published at a quarterly frequence. The SNB receives full score for its economic transparency.

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[48]Swedish: "Lagen (1988:1385) om Sveriges riksbank".

Procedural: The SNB provides a strategy that describes its monetary policy framework (3a), but does not publish minutes (3b) or disclose voting records (3c). It receives 1 point for its procedural transparency.

Policy: The SNB publishes a press release the same day a monetary policy decision is announced (4a), and this includes a forward-looking analysis of the economy (4b). It does not disclose an explicit policy inclination (4c). The SNB receives 2 points for its policy transparency.

Operational: The SNB evaluates the inflation target quarterly (in the *Monetary Policy Report*), and discusses reasons for deviations (5a). In the report, macroeconomic developments are discussed, but forecast errors are not being accounted for (5b). Its *Annual Report* evaluates the monetary policy in the previous year, but does only superficially discuss the policy outcome in relation to the exchange rate, not the inflation target (5c). Therefore, the SNB receives 1.5 points for its operational transparency.

B.8   The Bank of England

Political: The BoE aims at an inflation rate of 2 % (1b), but does not explicit prioritize price stability (1a). The *Bank of England Act* formalized its instrument independence. The BoE receives 2.5 points for its political transparency

Economic: In its quarterly published *Inflation Report*, the BoE provides data on a broad range of variables (2a) and forecasts both inflation and output (2c). Its macroeconomic models used for policy analysis is disclosed (Burgess et al., 2013). The BoE recieves full score for its economic transparency.

Procedural: The BoE is, as an inflation-targeter, transparent about the strategy for its monetary policy (3a). Minutes are published (3b) and the voting records are disclosed (3c). The BoE receives full score for its procedural transparency.

Policy: A brief press release is published at the day of a policy rate announcement (1a), but the press conference is held following the publication of the *Inflation Report* about a week later, and the explanation offered at the day the policy rate decision is superficial (1b). Forward guidance is adopted by the BoE (1c), resulting in a score of 2.5 on policy transparency.

Operational: In the *Inflation Report*, the BoE discusses the inflation target in detail (5a), and, following the introduction of forward guidance, evaluates the forecasts published qualitatively (5b). It also discusses the role of monetary policy in reaching the targets (5c). The BoE receives full score for its operational transparency.

B.9 The Federal Reserve of the United States

Political: The Fed adopted an inflation target in 2012, and aims at an inflation rate of 2 % (1b), although price stability is not solely prioritized (1a). Its instrument independence is formalized by the *Federal Reserve Act*. The Fed receives 2.5 points for its political transparency.

Economic: The Fed publishes data quarterly on a broad range of variables (2a). Its models used for analysis are published (Brayton and Tinsley, 1996), and it publishes forecasts on inflation and output quarterly (2c) in the *Summary of Economic Projections*. The Fed receives full score for its economic transparency.

Procedural: As an inflation-targeter, the Fed is transparent about its strategy for monetary policy (3a). It publishes minutes (3b) and discloses the voting records (3c). The Fed receives fulll score for its procedural transparency.

Policy: Decisions reached at the meetings are announced the same day as the adjustments are made (1a), and an explanation for the decision is provided (1b) in either a press release or by arranging a press conference. The latter is held after every second meeting. The Fed also provides forward guidance on its monetary policy. It receives full score for its policy transparency.

Operational: In the *Monetary Policy Report*, deviations from the inflation target is discussed (5a). Analyses of macroeconomic developments are provided, but a discussion of past forecast errors is not included (5b). It does include a discussion of the role of monetary policy in reaching the macroeconomic variables (5c). The Fed receives 2.5 points for its operational transparency.

B.10 Norges Bank

Political: Norges Bank aims to keep inflation at 2.5 % (1b), but does not explicitly prioritize this goal (1a). Instrument independence is formalized in the *Norges Bank Act*. Norges Bank receives 2.5 points for its political transparency.

Economic: In its *Monetary Policy Report*, data on a broad range of variables are published (2a) and forecasts on inflation and output are provided (2c). The models used for policy analysis are published (Brubakk and Sveen, 2009). Norges Bank receives full score for its economic transparency.

Procedural: Norges Bank is transparent about its monetary policy strategy, and has published its reaction function (3a). It does not publish minutes (3b) or disclose the voting records (3c). Norges Bank receives 1 point for its procedural transparency.

Policy: Decisions about the policy rate are promptly announced the same day as the adjustments are made, and followed up by a press conference and the publication of the *Monetary Policy Report* (4a and 4b). Norges Bank provides Delphic forward guidance on the policy rate (4c). Norges Bank receives full score for its policy transparency.

Operational: In the *Monetary Policy Report*, Norges Bank evaluates the inflation rate, including a discussion of the factors affecting it (5a). Evaluation of forecasts are presented graphically (5b). A discussion of the policy rate's role in meeting the macroeconomic objectives, including different scenarios, is presented (5c). Norges Bank receives full score for its operational transparency.