The economic impact of central bank transparency

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of
Central Bank Transparency

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Aanwezig in afwezigheid en
daarom nooit verleden tijd.

Preface in Dutch – Voorwoord

Zoals op de meeste plekken zitten er ook bij een centrale bank vogels van verschillende pluimage. In tegenstelling tot de zogenoemde *duiven* blijven de *haviken* ook in periodes met lage economische groei het inflatiedoel steeds voor ogen houden en bestand tegen politieke druk. Tijdens mijn proefschriftonderzoek heb ik mij met veel plezier verdiept in de manier waarop deze centrale bankiers met de buitenwereld communiceren. De Nederlandsche Bank (DNB) was hiervoor de ideale plek, omdat ik niet alleen van onderzoek maar ook van beleid heb kunnen proeven en deze combinatie mijn proefschrift ten goede is gekomen. Laat mij van deze mogelijkheid gebruik maken om - in vogelvlucht - enkele mensen te bedanken.

Te beginnen met mijn promotoren (het beste te typeren als *wijze uilen*) die mij met hun kennis, ervaring en vertrouwen in een goede afloop succesvol door het promotietraject hebben geleid. Ik heb me altijd weer verwonderd over de snelheid waarmee jullie op mijn werk reageerden. Sylvester, bedankt dat jij mijn passie voor onderzoek tijdens mijn student-assistentschap hebt aangewakkerd en mij wegwijs hebt gemaakt in de onderzoekswereld. Lex, bedankt dat jij mij de mogelijkheid hebt geboden om bij DNB te promoveren en dat jij mij hebt getoond dat er tussen onderzoek en beleid tweerichtingsverkeer bestaat.

Natuurlijk ben ik mijn collega's dankbaar voor de prettige werksfeer en hun opbouwende commentaar. Ook de discussies op de Universiteit van Amsterdam waren waardevol en vormden een goede voorbereiding op mijn buitenlandse presentaties. De lijst is te lang om iedereen te noemen, maar ik kan het toch niet nalaten om er enkele collega's uit te lichten. Maria, jij zorgde altijd voor een aangenaam werkklimaat op onze kamer (letterlijk en figuurlijk), maar ook voor een vliegende start van mijn proefschrift en een inspirerende begeleiding. Peter, bedankt voor jouw betrokken management gedurende de afgelopen vier jaar. Marco en David-Jan, bedankt voor de vruchtbare transparantiediscussies. Wilko, bedankt dat ik door jou snel mijn draai bij DNB vond.

Een vogel is graag daar waar hij gebroed is en zo geldt het ook voor mij. Mijn ouders vormen ieder op hun eigen wijze een inspiratiebron voor mij. Mama, Theo, Adri en Anneke bedankt voor een warm nest. Familie, volleybal- en dansmaatjes veel dank voor de broodnodige afleiding. Vrienden (in het bijzonder Anita, Michella, Sieneke en Wendy) bedankt voor de fijne gesprekken, etentjes en uitstapjes.

Dan blijft er nog één persoon over om te bedankten: Joris. Ik vond het bijzonder om samen te promoveren. Ik denk dat weinig promovendi een partner hebben die daadwerkelijk hun proefschrift van A tot Z hebben gelezen (laat staan becommentarieerd). Bedankt voor jouw vertrouwen in mij en dat je er altijd voor me bent.

Een proefschrift schrijven was een mooie reis en de moeite waard. Ik laat het aan jullie over om mijn pluimage te bepalen, maar ik zal een tipje van de sluier oplichten. Vandaag ben ik zo trots als een ....!

Den Bosch, 2008

Carin van der Cruijsen

Contents

CHAPTER 1

Introduction

1. Setting the stage

During the last decades a lot of central banks have become more transparent about their monetary policy. The manner in which modern central banks communicate to financial markets and the general public has changed tremendously. Nowadays, central bankers regard transparency as an important tool to build up credibility (Blinder 2000). Central bank transparency can be changed almost instantaneously, which is an advantage compared to other reputation enhancers (e.g. the build up of a reputation of honesty and low inflation and legal independence).

Not only the sender of information, the central bank, considers transparency as something of paramount importance but the receivers value transparency too. Building on Blinder (2000), Waller and De Haan (2005) show that private sector economists find transparency an important instrument for credibility. They thereby share the opinion of central bankers that transparency matters. My survey among Dutch households (presented in Chapter 5 of this book) provides insight into the opinion of another group of receivers: households. A majority of Dutch households view the transparency of the European Central Bank (ECB) about its monetary policy as either important or (very) important.

How important is it that the ECB is transparent about its monetary policy?
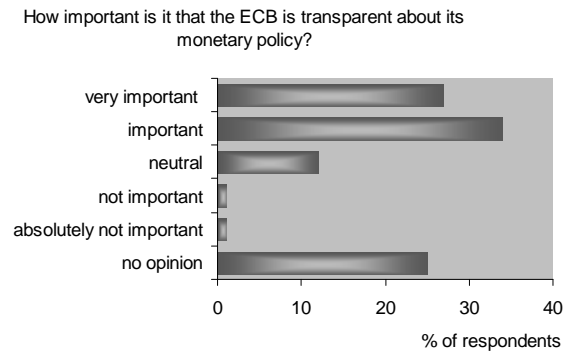

Figure 1. Importance of central bank transparency

Source: CentERpanel, 1-5 June 2007.

Central bank transparency is often defined as the absence of asymmetric information between the central bank and the private sector. According to this definition

more information provision results in a higher degree of transparency. This is in line with various transparency measures at hand. These indices are constructed by summing up the many ways in which a central bank is transparent about its monetary policy. The more communication tools a central bank uses the higher is its transparency score. However, as I will argue later in this book too, it need not be the case that more information is actually better. It might confuse people instead of clarifying matters. An alternative, broader definition of transparency would therefore be *"...the degree of common understanding of monetary policy between the central bank and the public."* (Winkler 2002: 402). This is however difficult to measure in practice and therefore current measures of transparency are based on the degree of information disclosure.

I can illustrate the evolving views on transparency the best by using some quotes of the former and the current head of the US Federal Reserve Bank (US Fed). Let me start with an often used statement of Alan Greenspan, the head of the US Fed from 1987-2006, to illustrate the mystique that central banks used to be veiled in:

"I guess I should warn you, if I turn out to be particularly clear, you've probably misunderstood what I've said." (Greenspan 1988)

Since the end of the 1980s the US Fed, like many other central banks, has made several steps towards more transparency. For example, in 1994 it started to announce and explain its policy changes. Quite a few years after the above statement and several transparency enhancements later Greenspan emphasized the relevance of transparency:

"Openness is more than just useful in shaping better economic performance. Openness is an obligation of a central bank in a free and democratic society." (Greenspan 2001)

The current head of the US Fed, Ben Bernanke, is a proponent of more transparency. He continues the earlier steps that the US Fed has made towards more transparency. The most recent transparency move is to provide more information on the forecasts of the Federal Reserve Board members and the Federal Reserve Bank presidents. Bernanke stresses that the limits of transparency are not reached yet.

"The communications strategy of the Federal Reserve is a work in progress. I believe that the changes announced by the FOMC today are an important advance: The changes will provide a more-timely insight into the Committee's outlook, will help households and businesses better understand and anticipate how our policy decisions respond to incoming information, and will enhance our accountability for the decisions we make. But the changes are also evolutionary, in that they build on long-established practices; in that respect, they represent just one more step on the road toward greater transparency at the Federal Reserve. The Committee will continue to look for ways to improve the accountability and public understanding of U.S. monetary policy making." (Bernanke 2007)

It is only a few decades ago that central banks did not communicate their policy decisions at all. What explains this change? First, a lot of central banks have gained greater autonomy in determining and pursuing their objectives. Society desires transparency from legally independent institutions. It is a necessary prerequisite of accountability. Second, proponents of transparency believe it is a helpful tool for central banks to increase the effectiveness of their monetary policy, which has become more and more dependent on the ability to steer market expectations. In this book I focus on the latter: the desirability of central bank transparency from an economic standpoint. The research question that I address in this book is:

"Is central bank transparency desirable from an economic viewpoint, and if so to what extent?"

2. Research contributions

My research contributes to the transparency literature in various ways. First, I provide an up-to-date overview of the transparency literature (Chapter 2). Second, I contribute to fill three different gaps observed in the transparency research (Chapter 3-6).

The mushroom growth that the transparency literature experienced (especially in the last decade) makes such an overview of great value. Surveys of the transparency literature (e.g. Geraats 2000) are not up-to-date anymore: new theoretical research has been carried out, some first empirical analyses have been performed and several empirical measures of transparency have been constructed. The overview that I present in Chapter 2 helps identify various gaps in the transparency literature, which are summarized in Figure 1. In the rest of the book I present my research that aims to contribute to filling these gaps. Next, I briefly discuss the identified areas that would benefit from more research.

I find that the theoretical research on the economic effects of central bank transparency is inconclusive, although decreasingly so over time. The ultimate answer to remaining theoretical question marks might be given by empirical research. At the time I started writing this book, the empirical research on the economic effects of central bank transparency was scarce because of the lack of transparency data (gap 1). Existing empirical analyses were mainly based on comparisons of the outcomes before and after a particular change in transparency that a central bank experienced. Cross-country and panel data analyses were scarce because a cross-country and time-varying data set was missing. Now that several central banks have experienced various transparency changes, more transparency data is available. Furthermore, the construction of transparency measures simplifies empirical research. I therefore use these new measures of transparency to perform more thorough empirical research on the economic effects of central bank transparency. In Chapter 3 I investigate the relationship between transparency and the degree to which inflation expectations are anchored and in Chapter 4 I discuss the effect of transparency on the level of interest rates.

A second observation is that not much is known about the actual knowledge of the private sector about the transparency practices of the central bank and not much attention is paid to transparency perceptions and their relevance (gap 2). In Chapter 5

I provide more insight into the knowledge of households of the transparency practices of the ECB. Furthermore I investigate the difference between actual and perceived transparency and the relevance of transparency perceptions for economic outcomes. Particularly innovative is the data that I use: the results of a questionnaire that I conducted among Dutch households.
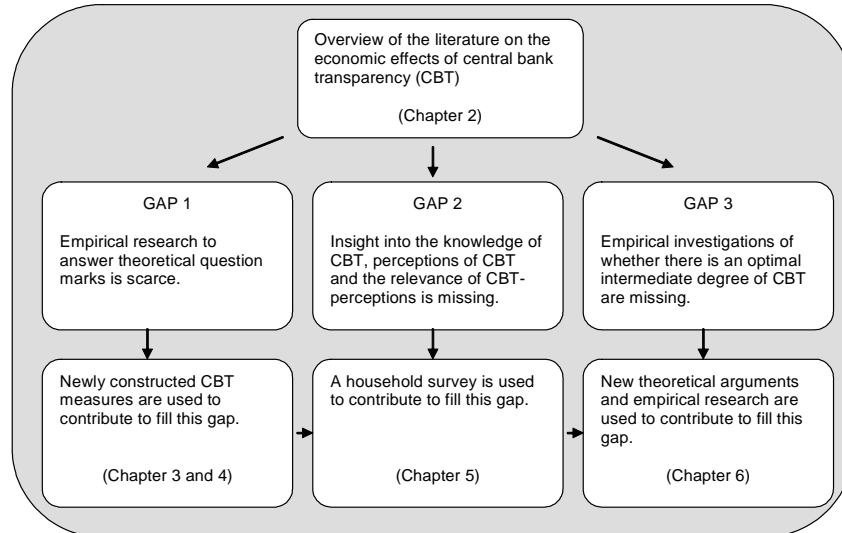
Figure 2. Contributions to the transparency literature: An overview

The last gap that I observe is the lack of empirical research on the possibility of the presence of an optimal intermediate degree of transparency (gap 3). Although touched upon theoretically, it is not tested empirically yet whether it exists. In Chapter 6 I first provide some arguments for the hypothesis that an intermediate degree of transparency would results in the best private sector forecasts of inflation and the lowest inflation persistence. Subsequently I test this by using a large panel data set on transparency.

3. Research approaches

The research presented in this book differs in various ways. Table 1 gives an overview of the various research approaches that I apply.

The first line in Table 1 offers an overview of the transparency measures that I use. In Chapter 3 I use the transparency changes which the Eijffinger and Geraats (2006) index (henceforth EG-index) is based upon. In Chapter 4 I utilize various different transparency indices but most analyses are performed based on the information contained in the EG-index complemented with other sources. In contrast to other transparency measures the EG-index is time-varying, which is useful for time-series analysis. In Chapter 5 I first measure the transparency knowledge of Dutch households by asking them questions on the transparency of the ECB going along the components of the EG-index. In addition I explicitly asked the survey participants to report their perceived transparency of the ECB. In Chapter 6 I use the transparency

Table 1. Research approaches: A summary

	Chapter 3	Chapter 4	Chapter 5	Chapter 6
CBT measure	EG (2006)	EG(2006), BSG(2001), S(2002) and D(2004) and various additional sources for the timing of CBT changes	Perceived CBT measure based on survey question	DE(2007)
Method	Time series	Panel and time series and rearranging the results of Levin et al. (2004)	Cross-section, CentERpanel	Panel data
N	8 countries	9 countries	1800 persons	100 countries
Period	1993-2002	1989S2-2004S1	June 2007	1998-2005
Variables	Level of policy, short and long interest rates	Inflation expectations and inflation persistence	CBT knowledge, CBT perceptions, trust, inflation persistence, inflation expectations	Quality of private sector forecasts, inflation persistence

Note: CBT=central bank transparency, N=number of cross-sections. EG=Eijffinger and Geraats, BSG=Bini-Smaghi and Gros, S=Siklos, D=De Haan et al. and DE=Dincer and Eichengreen.

data set of Dincer and Eichengreen (2007). This transparency data is constructed in a similar way as the EG-index but the data period is longer (covering 1998-2005) and more central banks are included (100 instead of 9).

I use a broad range of econometric methods. Not only do I perform time series analyses to investigate the effects of changes in transparency (mostly transparency increases), I also compare countries and individuals by performing cross-section analyses. The data period under consideration varies within the period 1989-2007, a period in which most of the transparency increases took place. The number of cross-sections included in the analyses is between 8 to 100 countries and 1800 individuals. Furthermore, I use panel data to take into account both the time and the cross-section information.

For the analyses with macro data I utilize existing sources. In addition I use micro data which I have constructed by conducting a survey among Dutch households (the CentERpanel) about their knowledge and perceptions of the transparency of the ECB.[1]

I look at the effect of central bank transparency on various variables: the degree to which inflation expectations are anchored, inflation persistence (related to the quality of private sector inflation forecasts), the level of interest rates (inversely related to the degree of flexibility and reputation of the central bank), trust in the central bank, inflation perceptions and expectations.

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[1]Detailed information on the CentERpanel can be found on http://www.centerdata.nl/en.

4. Layout of the book

The chapters in this book are ordered as follows. I start with an overview of the transparency literature in Chapter 2. Then, I research whether transparency is desirable from an economic point of view. First by analyzing the effect of central bank transparency on the level of nominal interest rates (Chapter 3). Second by examining the relationship between central bank transparency and the degree to which inflation expectations are anchored (Chapter 4). Thereafter, in Chapter 5, I show Dutch households' knowledge about the transparency of the ECB and how relevant it is for perceived ECB transparency. In addition, I research to what extent these transparency perceptions are relevant for trust, inflation perceptions and inflation expectations. The findings of these research projects raise the question of whether there is likely to be some optimal degree of transparency beyond which more transparency would be detrimental e.g. by causing confusion. In Chapter 6, I therefore analyze the presence of an optimal intermediate degree of transparency by linking transparency to the quality of private sector forecasts. I end this book with an answer to my overarching research question (Chapter 7). In this conclusion I also briefly summarize the value added of my research, the main insights put forward, and the scope for future research.

Given the fact that this thesis is largely a collection of articles, I would like to acknowledge the following publications as the basis of some of the chapters of this book.

-Chapter 2 is an updated version of Cruijsen, C.A.B. van der and S.C.W. Eijffinger (2007a). The economic impact of central bank transparency: A survey. CEPR Discussion Paper No.6070, which also appeared as CentER Discussion paper No.2007-06 and DNB Working paper No.132.

-Chapter 3 is an updated version of Geraats, P.M., S.C.W. Eijffinger and C.A.B. van der Cruijsen (2006). Does central bank transparency reduce interest rates? CEPR Discussion Paper No.6625, which also appeared as DNB Working Paper No.85 and CentER Discussion Paper No.2006-11.

-Chapter 4 is an adapted version of Cruijsen, C. van der and M. Demertzis (2007). The impact of central bank transparency on inflation expectations. *European Journal of Political Economy* 23(1), 51-66 (Copyright Elsevier, 2007), of which an earlier version appeared as DNB Working Paper No.31.

-Chapter 5 is an updated version of Cruijsen, C.A.B. van der and S.C.W. Eijffinger (2008). Actual versus perceived transparency: The case of the European Central Bank. DNB Working Paper No.163, of which earlier versions appeared as CEPR Discussion Paper No.6525 and CentER Discussion paper No.2007-78.

-Chapter 6 is an updated version of Cruijsen, C.A.B. van der, S.C.W. Eijffinger and L.H. Hoogduin (2008). Optimal central bank transparency. CEPR Discussion Paper No. 6889, which also appeared as CentER Discussion Paper No. 2008-59 and DNB Working Paper No. 178.

CHAPTER 2

The economic impact of central bank transparency:
A survey

Abstract[1][2]

Since the move towards more central bank transparency a lot of research on its desirability from an economic viewpoint has been carried out. We provide an up-to-date overview of this transparency literature. First, we show how the theoretical literature has evolved, by looking into branches inspired by Cukierman and Meltzer (1986) and by investigating several, more recent, research strands (e.g. coordination and learning). Then, we review the empirical literature which has been growing more recently. Last, we discuss whether the empirical research resolves all theoretical question marks, how the findings of the literature match the actual practice of central banks, and where there is scope for more research.

1. Introduction

Central banks used to be very secretive, but the last two decades a lot of central banks changed their regime into a more transparent one.[3] As central banks became independent, transparency gained importance because it is a necessary prerequisite of accountability, for which the need increased. An additional reason why transparency came into prominence is its likely influence on the formation of expectations. With the increased importance of financial markets, managing inflation expectations has become key in monetary policy making. It determines the success of the transmission of monetary policy. There are several benefits from successfully steering market expectations, like reduced uncertainty, improved planning of market participants, lower interest rate volatility, and more effective monetary policy (e.g. Issing 2005). It is, however, not obvious whether transparency actually improves the steering of market expectations. Although a lot of research has been conducted in this field, no agreement has yet been achieved on the desirability of transparency from an economic

[3] Goodfriend (1986) provides a nice summary of, and comments on, the Fed's written defense for secrecy, made in 1975 when it was sued to make its policy directive and minutes public immediately after Federal Open Market Committee meetings.

viewpoint. These studies vary with respect to the analyzed aspect of transparency and their method of analysis, which makes it difficult to assess an overall pattern.

Central bank transparency is often defined in the literature as "the absence of asymmetric information between the central bank and the private sector". According to this narrow definition of transparency the degree of transparency automatically increases when the central banks provides more information. However, in practice, more information does not always improve the public's understanding. A broader definition of transparency accounts for this fact and defines transparency as "*...the degree of common understanding of monetary policy between the central bank and the public.*" (Winkler 2002: 402).

We provide more insight into the transparency literature, refraining from accountability issues. By doing so, several questions will be answered: 1) Does the theoretical literature come to a unanimous conclusion with regard to the desirability of transparency? 2) If not, what causes differences in outcomes? 3) Does the empirical literature provide answers to some potential theoretical question marks? 4) Is there scope for further research?

This is not the first overview of the literature on the economic effects of central bank transparency. Earlier surveys discussed the literature based on different categorizations of transparency (Geraats 2002; Hahn 2002; Carpenter 2004) or views of transparency (Posen 2003).[4] Since the realization of these overview papers, however, the literature on central bank transparency has further developed. Moreover, several new theoretical research strands emerged, such as the work on coordination games, committees, and the literature on learning. Our survey describes the chronological development of the theoretical transparency literature to give more insight into its development. In addition, and only starting to evolve more recently, a lot of empirical research has been performed, which is reviewed as well. To improve the insight into the desirability of more transparency from an economic viewpoint, an up-to-date overview is needed.

Figure 1 summarizes the chronological evolution of the theoretical transparency literature. We start by exploring the theoretical literature based on the seminal work of Cukierman and Meltzer (1986), henceforth CM (1986). Three different branches that are (partly) based on this work are distinguished and discussed in chronological order. They differ in the specific aspect of transparency that is discussed: transparency about preferences, economic transparency, or control error transparency. Besides the research inspired by CM (1986), we summarize various other strands of the theoretical literature. The research based on reserve targeting models, which dates from the end of the eighties, beginning of the nineties, has become outdated because nowadays almost all central banks target inter-bank or repo-rates instead. Therefore, it is not discussed in detail in this chapter. More recently, several new strands of literature emerged which will be analyzed in this chapter. The analysis of transparency within coordination games is a concept first introduced by Morris and Shin (2002). The idea is that there is public as well as private information about the fundamentals of the economy. Agents want to match these fundamentals, but face a coordination motive as well. Another recently emerged strand of literature

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[4]See Geraats (2006) for an overview of the practice of monetary policy transparency.

analyzes the effect of transparency within monetary policy committees (e.g. Sibert 2003). The newest strand of research discussed here is the learning literature based on Evans and Honkapohja (2001), which, in contrast to the previous literature on central banking, does not assume rational expectations. After Svensson (2003) pointed out that the effect of transparency on learning was largely neglected, research within this field evolved. This strand of literature assumes that agents engage in learning, for example, about the central bank's policy model. Managing inflation expectations then becomes more important.
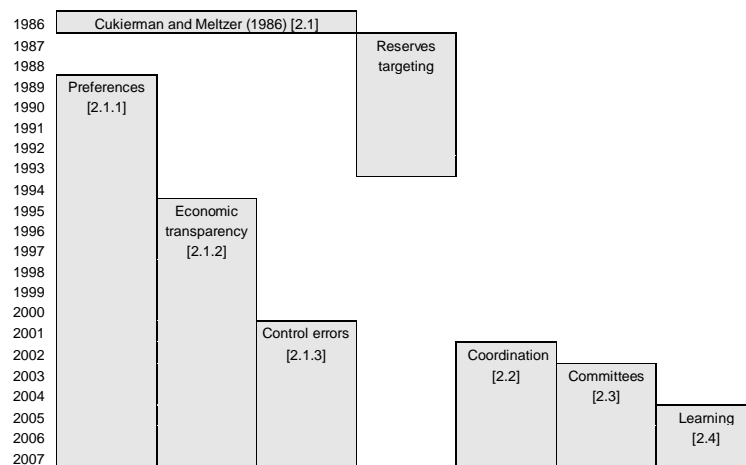
Figure 1. Overview of the theoretical transparency literature

Note: This figure summarizes the theoretical transparency literature. We distinguish five different strands: (I) Cukierman and Meltzer (1986), (II) Reserves targeting, (III) Coordination, (IV) Committees, and (V) Learning. Strand (I) consists of three separate branches: (I) Preferences, (II) Economic transparency, and (III) Control errors. The numbers in brackets in the figure correspond with the subsections in which these parts of the literature will be discussed. The time line is on the vertical axis.

The ultimate test for the desirability of transparency from an economic standpoint is empirical research. One requirement for empirical research is to have some measure of transparency at one's disposal. At first, empirical research was hindered by the lack of transparency data. Later on, the construction of several measures of transparency enabled more empirical research. For example, the time-varying Eijffinger and Geraats (2006) index is helpful because besides containing information about the relative degree of transparency of central banks, it includes information about the timing of transparency events. Here we focus on the papers analyzing the effects of longer lasting transparency changes, and abstain from work on the effects of day-to-day communication, which is reviewed by Blinder et al. (2008).

This chapter is structured as follows. In Section 2 we provide an overview of the theoretical literature. In order of appearance we discuss the findings of: CM(1986)

and the research inspired by it (2.1), the coordination literature (2.2), the committee models (2.3), and the learning literature (2.4). We conclude on the theoretical literature in Subsection 2.5. In Section 3, we move to the empirical findings. Anticipation, synchronization, macroeconomic variable effects, and credibility, reputation, and flexibility effects are analyzed in separate subsections (3.1-3.4). A brief cross-country comparison of the results is given in 3.5. Finally, in Section 4, we discuss the findings and provide some directions for further research.

2. Theoretical findings

We focus here on the particular aspect(s) of transparency which is (are) changed in a direct manner in the models used and on which more insights into its desirability is provided. We use the classification of Geraats (2002) into five different transparency categories:

1) *Political transparency* includes information provision about the central bank's goals: a formal statement of the target(s), how they are prioritized, and quantified. Institutional arrangements (e.g. central bank independence) lead to higher political transparency because there is less pressure to deviate from these objectives.

2) *Economic transparency* exists when the central bank shares the knowledge about the economy which it uses for monetary policy: the economic data, policy models and internal forecasts.

3) *Procedural transparency* concerns openness about the procedures used to make monetary policy decisions. It is higher when the central bank is open about its the strategy, when it publishes voting records, and minutes.

4) *Policy transparency* is present when the central bank announces and explains its policy decisions immediately and indicates future policy paths.

5) *Operational transparency* considers openness about how well policy actions are implemented. It is higher when the central bank is open about the control errors in realizing its operating instrument or the goal set, and when the central bank discusses the macroeconomic disturbances that influence the transmission process from policy instruments to outcomes.

The relevance of model choice is illustrated by Cukierman (2002), who compares the transmission of monetary policy in three different models: 1) a Monetarist Lucas-type expectations-augmented Phillips curve, 2) a Neo-Keynesian model with backward-looking pricing, and 3) a New Keynesian model with fully forward-looking prices. In the latter two models nominal prices are sticky and therefore the nominal interest rate affects the real interest rate. In these three models monetary policy affects inflation and output levels in different ways. In the first (Lucas-type) model, only unanticipated monetary policy has an effect on output and inflation is directly related to the money supply (quantity theory of money). In the other two models, short run output is demand determined. Independent of the presence of surprise inflation, interest rate changes can influence output by affecting demand. The effect that the policy choice has on the inflation rate depends on its effect on the size of the output gap. In the backward-looking Neo-Keynesian model, current policy can affect the output gap with a one period lag, and inflation with a two-year lag. In contrast, in the forward-looking New-Keynesian model current policy can already affect

the present values of the output gap and inflation by changing the expectations that currently exist about future variables.

In the next sections we will discuss the various strands of literature in chronological order. A summary of the theoretical literature is provided in Appendix A.

2.1 Cukierman and Meltzer (1986)

The theoretical work on the economic effects of central bank transparency started in the 1980s with the work of CM (1986). Based on the optimal policy models by Kydland and Prescott (1977), and Barro and Gordon (1983b), they conclude that the economic desirability of transparency is ambiguous. To give an idea of how they reach this result, we briefly describe the general structure of their model, and shortly discuss the intuition of the results that CM found based on this model.

As is shown by eq.(2.1), period i's realized inflation rate (π_i) is a function of the policymaker's planned inflation rate (π_i^p). Control is imperfect; ψ_i is a stochastic serially uncorrelated normal variate. Its mean is zero and its variance is σ_ψ^2.

$$(2.1) \qquad \pi_i = \pi_i^p + \psi_i$$

Eq.(2.2) is the central bank's multi-period, state dependent objective function. The central bank chooses the planned rate of inflation such that this objective function, which depends on both inflation and output, is maximized. Ceteris paribus, lower inflation is preferred. In addition, central banks want to create surprise inflation to stimulate output.[5] In eq.(2.2) β is the central bank's discount factor, E_0 is the expected value operator conditioned on the available information in period 0, including a direct observation of the central bank's period 0 weight (x_0) attached to inflation surprises (e_i) to stimulate output. The policymaker's choice of the planned inflation rate depends on its weight attached to the benefits of surprise inflation (economic stimulation) and its costs (higher inflation).

$$(2.2) \qquad \max_{\left\{\pi_i^p, i=0,1,..\right\}} E_0 \sum_{i=0}^{\infty} \beta^i \left(e_i x_i - \frac{(\pi_i^p)^2}{2} \right)$$

The central bank knows the manner in which the public forms its expectations about inflation, up to a random shock. Therefore the central bank knows the unanticipated rate of inflation (e_i), (as defined in Eq.(2.3)), it creates by picking a particular planned inflation rate. $E[\pi_i \mid I_i]$ is the public's forecast of realized inflation, given the public's information set I_i. This information set includes the realized inflation rate up to and including the previous period.

$$(2.3) \qquad e_i = \pi_i - E[\pi_i \mid I_i]$$

Eq.(2.4) describes the central bank's shift parameter x_i. It is more likely to be positive than negative and the shift parameter changes in response to unanticipated events. These preferences show some persistence which is a function of a constant A (which measures the bias towards economic stimulation) and a time-varying component p_i.

$$(2.4) \qquad x_i = A + p_i, \ A > 0$$

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[5]Variations on this maximization problem are used in other theoretical transparency papers.

This time-varying component depends on its past value, with the strength ρ (between 0 and 1), and on a serially uncorrelated normal variate (v) that does not depend on the control error (ψ_i):

$$(2.5) \qquad p_i = \rho p_{i-1} + v_i, 0 < \rho < 1, v \sim N\left(0, \sigma_v^2\right)$$

The public can not observe the weight attached to surprise inflation (x_i) directly. Control errors can be used to hide shifts in preferences. Based on past observations of inflation, the public then imperfectly infers x_i. For more model details and the derivation of the results, we refer to the CM(1986) paper. For the aim and scope of this review it is sufficient to take a look at the results that they found. The planned inflation rate is described by eq.(2.6).

$$(2.6) \qquad \pi_i^p = \frac{1-\beta\rho}{1-\beta\lambda}A + \frac{1-\beta\rho^2}{1-\beta\rho\lambda}p_i$$

When eq.(2.6) is put into eq.(2.1) the actual inflation rate turns out to be:

$$(2.7) \qquad \pi_i = \frac{1-\beta\rho}{1-\beta\lambda}A + \frac{1-\beta\rho^2}{1-\beta\rho\lambda}p_i + \psi_i$$

The actual unconditional mean of the inflation rate is:

$$(2.8) \qquad E(\pi_i) = \frac{1-\beta\rho}{1-\beta\lambda}A$$

When there is some degree of time preference ($\beta<1$), a higher bias of the central bank towards economic stimulation (A) leads to higher average inflation. When inflation control is less effective (a higher variance of the control errors: σ_ψ^2) the adjustment of expectations is slowed-down (the memory of the public of past policies, λ, is higher: i.e. recent developments carry less weight in the formation of current expectations). Because the public is slower in recognizing shifts to a more expansionary policy, the detrimental effects of surprise inflation are delayed and therefore the central bank gains more from current surprise inflation at the cost of future inflation.

The variance of the inflation rate is given by eq.(2.9).

$$(2.9) \qquad V(\pi_i) = \left[\frac{1-\beta\rho^2}{1-\beta\rho\lambda}\right]^2 \frac{\sigma_v^2}{1-\rho^2} + \sigma_\psi^2$$

From eq.(2.9) it follows that, when there is some degree of time preference, the variance of the inflation rate, $V(\pi_i)$, is higher when inflation rate control is less effective (σ_ψ^2 higher). This impact is both direct (actual inflation rate is more variable for any planned inflation rate) and indirect via λ. λ is higher, so the public is slower in finding out about shifts in the objectives and, as a result, it is more attractive for the central bank to stimulate the economy more by creating more uncertainty.

A central bank with a relatively high time preference is likely to prefer a higher degree of ambiguity. Given the variance of the inflation rate control error, the lower the discount factor β, the higher $V(\pi_i)$. In this case the costs of future expected inflation are less important in the objective function and therefore it is more attractive to stimulate the current economy. This is possible by creating more uncertainty ($V(e)$, which is the variance of the unanticipated inflation rate), partly resulting in higher inflation rate variability.

When the central bank chooses the quality of inflation rate control, the degree of transparency is set. More effective inflation rate control increases transparency and makes it is easier for the public to deduce the central bank's objectives by looking at past inflation. As a result, inflation expectations (which depend both on the policymaker's mean planned inflation and the actual past observations) become more sensitive to past policy outcomes, the public learns faster, credibility is higher, and the inflation bias is reduced. In addition, however, there is a detrimental effect of more transparency. The policymaker's ability to use surprise inflation to stimulate output is reduced. When this detrimental effect is relatively strong, central banks might prefer ambiguity. It makes it easier to use positive surprise inflation when it is needed the most, and negative surprise inflation in periods in which it is relatively concerned about inflation.

Several branches of literature started by building on the CM-model. Based on the particular aspect of transparency that is analyzed in a direct manner, papers are put into three different branches: (1) preference transparency (Section 2.1.1), (2) economic transparency (Section 2.1.2) and (3) control error transparency (Section 2.1.3).

2.1.1. Preferences

Many economists argue in favor of more political transparency because it may improve the reputation and credibility of the central bank (e.g. King 1997; Friedman 2003; Thornton 2003). But transparency about the objective function of the central bank may be difficult to realize, and a role for output in the objective function may confuse the public. It may lead the public to believe that the central bank focusses on counteracting short-run output fluctuations resulting in higher inflation expectations and higher actual inflation (Mishkin 2004).

Several theoretical papers analyze the desirability of preference transparency. Most of these papers are related to CM(1986). Preference transparency concerns the relative weight attached to the goals in the central bank's objective function (in terms of the CM-model: transparency about x_i). In addition, some papers look at transparency about the central bank's targets (in the CM-model: e_i or π_i^p, but in an open economy model it could be the target for the exchange rate). Transparency about the weights in the objective function and transparency about the targets are two of the components of political transparency, as defined by Geraats (2002).

Instead of looking at information given by actions of the central bank, as CM(1986) do, Stein (1989) analyzes the provision of information using words. He argues that there is a reason why the central bank will not be completely transparent about its target for the exchange rate. The idea in this open economy model is that, although transparency about objectives potentially leads to a more swift market reaction, the market knows the central bank is tempted to manipulate inflation expectations and would therefore never belief precise announcements by the central bank. In contrast, when given only the opportunity to talk less precise (announce a range within which the target lies), the central bank's ability to manipulate expectations has become crude (big lies are needed if it wants to lie) and has the potential to do more harm than good.

Lewis (1991) shows why secrecy of central banks might be desirable from society's point of view, as well. First, secrecy about policy intentions (CM-model: v_i is only known by the central bank and therefore p_i and through it x_i) prevents central banks from being secret in in more costly other ways (greater monetary noise: ψ_i). Second, secrecy might be beneficial when the social trade-offs between policy objectives change over time. The central bank is then able to use surprise inflation when society prefers it the most.

Another argument why uncertainty about the preferences of the central bank might be desirable is that it could lead to wage moderation to limit real wage uncertainty as it is unclear in which way the central bank might react to wage claims (Sørensen 1991). More wage discipline lowers inflation and boosts output. In case of an unemployment problem that is large enough and exogenous shocks to unemployment that are not too big, these effects outweigh the resulting higher variability of inflation and unemployment. Using a very similar model as Sørensen (1991), Grüner (2002) too argues in favor of limited central bank transparency based on lower wages and, as a consequence, average inflation and unemployment. But, in addition, it is shown that even when the only objective is to have low inflation uncertainty, transparency might not be desirable because, under bounded rationality of the public, it may lead to a higher variance of inflation.

Several other papers argue in favor of secrecy too, because their models show lower resulting inflation rates as well. Cukierman (2002), using a New Keynesian model setting, shows that when the central bank is a flexible inflation targeter, the absence of transparency about the loss-function and the weight attached to output gap stabilization is important to maintain credibility. Even when policymakers target the average natural level of employment, flexible inflation targeting in conjunction with asymmetric output gap objectives leads to credibility problems. The higher the flexibility of the central bank in targeting inflation, the higher the inflation bias. Secrecy about preferences can prevent an increase in inflation expectations, which affect current pricing decisions.

According to Sibert (2002), secrecy about the preferences of central bankers leads them to inflate less because they want to signal that they are of a good type (relatively low weight on output) so as to obtain lower inflation expectations.[6] These lower inflation expectations make the trade-off between inflation and output favorable, which makes it possible to respond more strongly to shocks.

In contrast, various other papers point out that preference transparency may, in fact, be beneficial for the level of inflation. In the majority of these papers, however, this benefit comes at the cost of the flexibility to stabilize the economy, which could still make transparency undesirable from an overall welfare perspective.

Transparency could reduce the inflation bias for countries with a bad inflation history or relatively little independence, as argued by Schaling and Nolan (1998). The benefit from greater transparency is higher when the degree of inflation aversion of the central bank is relatively low. In Walsh (1999), inflation targeting lowers the average inflation bias when the announced target is equal to the socially optimal inflation rate (which is a function of the supply shocks that are unknown to the public). The

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[6]Only for the central banker with the highest weight on output does this mechanism does not function. His type will be revealed and, therefore, inflation expectations cannot be improved.

central bank's response to supply shocks would be distorted if there would be a non-contingent explicit inflation target that is equal to the expected socially optimal rate. Instead, the central bank could set an inflation target that is based on unverifiable internal forecasts of supply shocks and announce it before the private sector forms its inflation expectations. This announcement reveals private information about supply shocks. The imperfectly credible inflation target that is announced by the central bank could lead to a lower inflation bias without affecting the stabilization policy.

In Eijffinger et al. (2000), transparency lowers inflation as well, because wage setters perceive the central bank as more conservative, and less uncertainty reduces the volatility of inflation.[7] However, it increases the volatility of output in response to supply shocks, which is harmful for society's welfare. When the need for output stabilization policy is large compared to the severity of the time-inconsistency problem, secrecy may be desirable. This trade-off is confirmed by Eijffinger and Hoeberichts (2002), who find improved independence associated with more transparency. However, Beetsma and Jensen (2003) show that the findings of Eijffinger et al. (2000) are not robust to changes in the way in which preference uncertainty is modeled. In addition, they note that one would reach superior outcomes with other arrangements (e.g. an inflation contract or target) or immediately choosing the optimal degree of conservatism. This prevents the need for secrecy to stabilize the inefficiently high output variability associated with a suboptimal degree of conservatism.

According to Hughes Hallett and Viegi (2003) the central bank wants to limit the amount of transparency about the relative weights in its objective function to benefit from lower inflation (that comes at the cost of fiscal stability). In contrast, the private sector would benefit from this form of transparency because their decisions become better informed. The same holds for transparency about the central bank's output target. Instead, assuming reasonable parameter values, reducing this form of transparency does not deliver any strategic benefits for the central bank, although it might be a substitute for credibility.

Hughes Hallett and Libich (2006) show that goal-transparency, which is preferred over goal-independence, works as a commitment device. It makes the policymakers more accountable for price stability by threats of punishment which lowers inflation and improves credibility. Demertzis and Hughes Hallett (2007) demonstrate that political transparency leads to a reduction of the variability of inflation and the output gap, but has no implications for their average levels.

When the public is uncertain about the amount of central bank transparency a discrepancy between actual and perceived transparency might exists and both affect the economy (Geraats 2007). Actual transparency makes the noise of communication smaller, which is beneficial. However, perceived transparency is not always beneficial because markets become more sensitive to information. Whereas clarity about the inflation target is desirable, clarity about the output gap target and supply shocks is not.

In summary, the theoretical research on the effects of preference transparency does not give a unanimous answer with regard to its desirability.

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[7]The result remains intact when Eijffinger et al. (2000) correct for computational mistakes (Eijffinger et al. 2003), in response to Beetsma and Jensen (2003).

2.1.2. Economic transparency

The feasibility and desirability of economic transparency is heavily debated as well. Regarding its feasibility, some forms of economic transparency may not be so easy to realize in practice. For example, transparency about the economic model used may not be feasible because there is no consensus on the correct model of the economy (Cukierman 2001). Even when some form of economic transparency is assumed to be feasible it not clear whether transparency is actually desirable. For example, opponents of economic transparency argue that when forecasts are published, the danger exists that the public attaches too much weight to them (Issing 1999), and when provided too often they could undermine the central bank's credibility as an inflation targeter (Cukierman 2001). Proponents of transparency argue, however, that more economic transparency may improve the markets' understanding of the central bank's actions (e.g. Blinder et al. 2001), and improve the forecasting quality and credibility (e.g. Mishkin 2004).

Several theoretical papers on economic transparency discussed below are (partly) inspired by CM (1986). They analyze the desirability of releasing the central bank's information on economic shocks, and the model and outcomes of forecasts. Therefore, all components of economic transparency as defined by Geraats (2002) are covered. Economic information could, for example, make it easier to discover the intentions of the central bank (e.g. m_i^p in terms of the CM-model).

Noisy announcements (providing a range on its forecast of the money demand disturbance) may make the trade-off between flexibility (to stabilize output) and credibility (to eliminate the inflation bias) more favorable to the extent that the noisy announcements reveal the monetary authority's private forecast (Garfinkel and Oh 1995). By influencing expectations, the monetary authority can stabilize employment even when there is a monetary rule.

Cukierman (2001) points out that transparency about economic shocks might lead to social inefficiencies. He presents two different models. The first is a model with a simple stochastic Lucas-supply function. Transparency exists when information about supply shocks is provided before inflation expectations are being formed. Then the central bank looses its information advantage and can no longer stabilize these disturbances. The second model presented is Neo-Keynesian. In this model the central bank's instrument is the nominal interest rate that, because of inflation expectations that are already formed, determines the real interest rate. Changes in the real interest rate affect demand and demand then affects inflation with a one period lag. Transparency is still defined as before, but in this model monetary policy still plays a role under transparency. Transparency makes inflation expectations more sensitive to policy actions and, as a result, the central bank needs to change the nominal interest rate more often to achieve the same level of stabilization of output and inflation. Transparency is still disadvantageous if society dislikes variability of the nominal interest rate.

According to Gersbach (2003) transparency about supply shocks that affect unemployment (e.g. through publishing forecasts and forecasting models or through releasing minutes) is detrimental because it eliminates the central bank's possibility to stabilize employment.

Several more recent papers, however, highlight that economic transparency may be beneficial. In Chortareas et al. (2003), transparency about economic shocks (the part of the demand shock that the central bank forecasts correctly) can lower the sacrifice ratio of disinflation efforts. The reason is that it is easier for the public to find out the central bank's preferences.

In Hoeberichts, Tesfaselassie and Eijffinger (2004), when the central bank is transparent about the manner in which it assesses the private sector's inflation and output gap expectations, the public can forecast the errors that the central bank makes with this assessment. In their model, transparency may improve output stabilization, and the more so the more conservative the central bank is. However, it makes the stabilization of the inflation rate more difficult because the central bank will use the interest rate to stabilize the effect of the error on the output gap. Nevertheless, overall social welfare is increased.

In Geraats's (2005) model, transparency about the forecasts makes the interest rate a better signaling device of the central bank's preferences. Therefore, inflation expectations will react more to interest rates, which indicates the reputation of the central bank. Central bankers become more interested in building up reputation, because it is easier to do so when the markets watch the signals more closely. As a result the inflation bias will be lower. When the central bank can choose how much transparency to provide, it will become more likely that even when the central bank is weak, concerns about its reputation will make it choose to become transparent. Otherwise the market will punish the central bank with a larger inflation bias. Note that the above analysis is based on forecasts which are based on an explicit interest rate (path) to make sure that transparency creates beneficial incentive effects. In case of unconditional forecasts, the inflation target is directly revealed and the inflation bias is not necessarily reduced because the behavioral incentive (reputation building) is not present.

Gersbach and Hahn (2006) show that transparency about private information about macroeconomic shocks can reduce the margin between the targets announced by the central bank and future inflation. Prerequisite is that this private information is verifiable, otherwise the central bank has an incentive to lie.

Another paper that argues in favor of more transparency is the research by Eijffinger and Tesfaselassie (2007). When combined with political transparency, economic transparency turns out to be desirable. It stabilizes current inflation and output.

Recently some central banks started publishing their interest rate forecasts. Rudebusch and Williams (2008) show that this transparency change might help align financial market expectations and through it improve macroeconomic outcomes. Prerequisite is that the central bank communicates clearly that interest rate projections are conditional and surrounded by uncertainty. Otherwise the public might interpret the interest rate forecast as an unconditional commitment of the central bank and might put too much weight on it, with all the effects it implies.

Overall, although the results found are mixed, we observe a trend of subsiding disagreement; more recent articles on economic transparency are in favor of it.

2.1.3. Control errors

Several papers analyze the economic implications of transparency about control errors (in the CM-model: ψ_i), and thereby build upon CM (1986). Transparency about control errors in achieving the operating targets is one aspect of operational transparency, as defined by Geraats (2002).[8]

Faust and Svensson (2001), henceforth FS, modified the model of CM (1986) by making the loss-function quadratic in the output gap and distinguishing between imperfect monetary control and operational transparency, which measures the degree to which control errors are made public. Given the level of monetary control, and assuming secrecy about the output targets of the central bank, operational transparency will be beneficial for the central bank's reputation. Inflation expectations of the public will be stronger linked to realized inflation, which makes deviations from the announced zero-inflation path more costly for the central bank. Therefore the central bank is less likely to engage in inflation surprises, resulting in lower variability of both inflation and output. When, instead, it is assumed that there is transparency about the central bank's goals, then its actions do not affect its reputation. Inflation will be higher on average and so will the variability of inflation and employment. However, it is pointed out that, in a more complete model, it could well be that this form of transparency is beneficial, e.g. when the public is able to force the central bank to obtain the public's goals.

In contrast to FS (2001), FS (2002) take up the endogenous choice of transparency and monetary control. Most likely there will be commitment about the choice of transparency, whereas there will be discretion about the choice of control. Then the likely outcome is that the degree of control is maximized whereas the choice of transparency depends on the type of central bank. If the central bank cares enough about the future and has a relatively low inflation bias, then it will commit to minimum transparency. The public can punish this patient central bank relatively heavily by reducing future reputation ex post for inflation surprises . Therefore, lower transparency need not lead ex ante to a similar increase in the inflation bias. In addition, when the central bank targets the natural rate of employment in the absence of shocks, then there is no inflation bias independent of the degree of transparency. In contrast, a central bank is likely to commit to maximum transparency when it has a history of high inflation because the benefits in terms of improved monetary performance are relatively large.

Jensen (2002) shows that, within a forward-looking model, some intermediate degree of transparency may be optimal. Transparency about the control errors makes it easier for the public to deduce the central bank's intentions, which makes inflation expectations, and therefore inflation, more sensitive to policy actions. As a consequence, the central bank is likely to pay more attention to inflation. Although beneficial for a central bank that faces a low degree of credibility, this could be detrimental for a highly credible central bank since it makes stabilizing output more costly in terms of inflation. The optimal degree of transparency is determined by the trade-off between credibility (and the related degree of inflation) and the flexibility to stabilize output.

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[8]In addition, operational transparency covers a discussion of how the transmission of monetary policy is influenced by (unanticipated) macro-economic shocks and consist of an analysis of the central bank's performance.

If the central bank instead reveals its preferences for output directly, the full information case, then expectations do not react to central bank's actions, and therefore the central bank would remain flexible to stabilize output.

Sibert (2006a) shows that in the absence of non-transparency (control errors not observed) private information about the preferences (weights in the objective function) leads to lower inflation and the ability to react to shocks is better. When private information about preferences exists, an increase in the degree of transparency has the beneficial effect of lowering equilibrium planned inflation (both level and variance) without affecting the ability to respond to shocks. When the central bank is transparent, the public can deduce the central bank's actions by looking at realized inflation. Instead, it need not be easier for the public to find out what the central bank's preferences are. Numerical simulations show that complete transparency is always preferred.

To conclude, whether more transparency about control errors is beneficial or not is still open to debate. The earlier papers within this branch of literature find a trade-off between credibility (the level of inflation) and flexibility (the degree of output stabilization), as did CM(1986), whereas according to the most recent paper this trade-off is non-existing, and transparency is desirable.

2.2. Coordination

Through its effect on the formation of inflation expectations, transparency influences economic outcomes. The manner in which agents form expectations is therefore crucial when determining whether transparency is desirable or not. A relatively new strand of literature that analyzes the effects of transparency on the formation of expectations is the work based on coordination games.

Morris and Shin (2002), henceforth MS (2002), analyze the social value of public information based on a model in which agents have public and private information about the underlying fundamentals, which they want to match. In addition, they second guess the actions of other agents (coordination motive). The smaller the distance between a player's own action and the actions of other players, the greater the individual reward is. But from an aggregate viewpoint, this coordination does not improve welfare. When public information is the only source of information about the economic fundaments, greater precision in providing this kind of information always leads to higher social welfare because it helps agents align their actions with economic fundamentals. Instead, when some private information is available, and this information is very precise, more public information is likely to lower social welfare. The coordination motive causes agents to put too much weight on the public signal (compared to the private signal) than is justified by the level of its precision (common knowledge effect). Damage resulting from noise in the public information (worsening the forecast of the economic fundamentals and thereby harming the actions taken by the economic agents) might be magnified as a consequence.

Svensson (2006) shows that for empirically reasonable parameter values, the research performed by MS (2002) actually favors greater transparency. The only circumstance in which the welfare is locally decreasing in case of additional transparency (higher precision of the public signal) is when (1) each agent gives more weight to the beauty contest (coordinating its actions with others) than to bringing its actions

in line with economic fundamentals, *and* (2) the noise in the public signal is at least eight times higher than the noise of the private signal. The latter is not likely because, compared to an individual, central banks devote a considerable amount of resources to collecting and interpreting data. In addition, Svensson uses a global analysis, assuming the public signal is at least as precise as the private signal, to show that no public information at all is never desirable.

Morris et al. (2006) are inclined to agree with Svensson's analysis but note in response to the global analysis that when the weight to coordination becomes close to one in the utility function then the precision of public information need not be that low for the absence of public information to be preferred. Morris et al. shift the debate to the empirical question whether the degree of precision of the public signal is sufficient enough to be in favor of transparency. The authors highlight that, in addition to looking at alternative welfare functions, it is important to analyze the correlations between signals:

"The central bank holds a mirror to the economy for cues for its future actions, but the more effective it has been in manipulating the beliefs of the market, the more the central bank will see merely its own reflection." (Morris et al. 2006: 464)

In another paper Morris and Shin (2005) argue that providing too much information to steer market expectations might be harmful. It could lower the informativeness of financial markets and prices and, therefore, worsen public information (which is thus endogenous).

Angeletos and Pavan (2004) assume that there are investment complementarities, which implies that the individual gain from investment is increasing in the total level of investment. When these complementarities are weak, no matter what the structure of information, the equilibrium is unique, and more public information (either relative or absolute precision) is desirable because it improves coordination (although it might increase aggregate volatility). What drives this result is the assumption that, in contrast to the assumption in the MS (2002) paper, more effective coordination is socially valuable. Increased precision of private information might reduce welfare by increasing the heterogeneity of expectations which makes coordination more problematic. When complementarities are strong, two equilibria, a good and a bad one, are possible. Increased transparency facilitates more effective coordination on either one of these equilibria. The only case in which transparency might not be a good idea, is when the market is likely to coordinate on the bad equilibrium.

Walsh (2007) agrees that the reduction of price dispersion is desirable from an aggregate point of view. His analysis shows that while increased precision of central bank's forecasts of *cost* disturbances (or lower persistence of these shocks) increases the optimal degree of economic transparency, the optimal level is lower when the central bank is better able to forecast *demand* disturbances (or these disturbances become less persistent).

Several other papers argue in favor of transparency based on coordination games. Pearlman (2005) argues that the central bank should disclose as much economic information about aggregate demand shocks as possible, and without noise, because it leads to higher welfare. The optimal degree of transparency is positive under all

circumstances in Cornand en Heinemann (2004). Sometimes, to prevent overreaction to public information, however, it is better to withhold information from some agents.

Demertzis and Hoeberichts (2007) show that, when introducing costs to information precision into the MS (2002) framework and, for reasonable parameter values, a trade-off exists between increasing the precision of public information and the accuracy of private information. Increasing the degree of transparency is not necessarily desirable in all circumstances.

Demertzis and Viegi (2008) argue that it can be beneficial for the central bank to provide numerical inflation targets because it can be effective in coordinating expectations of the private sector towards the central bank's goal. Necessary conditions are that the supply shocks that hit the economy are not large and all other public information does not give a clear signal of what inflation is intended to be.

In Lindner (2006) more transparency about the way in which the central bank has assessed the strength of the economy, does not affect public information about the assessment itself but increases the precision of private information. Multiple equilibria are less likely, which makes currency markets more stable.

Gosselin et al. (2007) allow for intermediate degrees of transparency and include uncertainty about the precision of information (fog) in their model. In the intermediate transparency case the central bank publishes its interest rate to steer market expectations. It can use the interest rate to mitigate (exploit) the common knowledge effect when it harms (enhances) social welfare. In the full transparency case the central bank communicates all its information and the interest rate loses its role as a strategic signal. When the central bank's fog is large, full transparency is optimal. When its fog is thin or even absent, partial transparency is better because the central bank keeps its ability to manipulate private sector expectations in an optimal way. These results are independent of the particular social welfare function and hold whether the private sector operates in fog or not.

Overall, we conclude that although, at a first glance, it seems that the work of MS (2002) argues against transparency, it turned out that for reasonable parameter values, their approach actually favors transparency. Indeed, most of the research that has been built upon MS's work is in favor of (at least some degree of) transparency. It is important to note, however, that for the social welfare effect to be positive, it matters *what* the central bank talks about. Although the central bank might wish to coordinate expectations about its monetary policy, it does not want to coordinate expectations about possible problems in the financial system. Cukierman (2008) shows that doing so would increase the chance of a financial crises which would harm the risk sharing of liquidity shocks and also long term investments.

2.3. Committees

A separate strand of literature models decision-making within committees to analyze whether more procedural transparency is desirable. The publication of minutes could be desirable because it leads to accountability, but these minutes should preferably be non-attributed to stimulate open debate (Buiter 1999). On the other hand, the publication of minutes may be harmful as disagreement within the council would become public, which could harm the central bank's credibility. In addition, it could lead to less exchange of information and viewpoints, informal group meetings, and

manipulation of the minutes to make them less informative (Cukierman 2001). The publication of individual votes makes it possible to assess the competence of individual members (Buiter 1999), but may damage the collective responsibility and may come at the cost of clarity, predictability, and coherence of the policy signaled by the committee (Issing 1999). The efficiency and quality of policymaking may decrease when individual members worry about national and personal interests (Issing 1999; Cukierman 2001).

Blinder et al. (2001) argue that the manner of communication depends on the policymakers in place. With one central banker, a clear statement with the reasoning behind the decision is enough. In case of an individualistic committee, everybody votes in its own interest, therefore it is difficult to agree on one statement, but detailed minutes should be available as soon as possible. When the committee is collegial, it can more easily combine immediate statements and minutes. It is important that the message brought about should be consistent.

Sibert (2006b) shows that as the number of committee members increases (something of practical relevance for the ECB) individual's effort decreases. This effect can be prevented by making sure that individual's contributions can be identified and assessed. Prerequisites are a clear objective, publication of voting records and at the most five committee members. It is desirable to have a structure such that committee members do not act as being a group member, because too much striving for consensus might lead members to not pay enough attention to alternative actions.

The arguments in favor and against procedural transparency have formalized by constructing models of the committee decision-making process. Sibert (2003) models reputation building in monetary policy committees, and shows that it is important to publish the individual votes immediately. It raises the expected social welfare because the incentive of junior policymakers to vote in favor of policy against inflation is increased, as it now helps building up reputation. In addition, she finds that putting more weight to senior policymakers' votes, via increased incentives for the junior policymakers to build up reputation, is beneficial for welfare because they are then more likely to vote against inflation.[9]

Gersbach and Hahn (2004) demonstrate as well that it is desirable to publish voting records. In their model, transparency makes the selection of central bankers with desirable preferences easier, which leads to lower social losses. It should be noted, though, that only central bankers with preferences similar to the public would favor more transparency.

In contrast, when one assumes monetary policy within a monetary union, transparency might not be desirable. It makes it easier for national governments to appoint central bankers who have preferences that are in line with national interests, but this might not be desirable for the aggregate monetary union social welfare. Gersbach and Hahn (2005) show that voting transparency can lead to more weight on national, instead of supranational interests, which could make this kind of transparency undesirable when the central bankers' private benefits are relatively high (such that they care more about re-appointments than about beneficial policy outcomes).

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[9]Under the precondition that the young policymakers sometimes vote for inflation.

In Gersbach and Hahn (2008) procedural transparency makes it easier to reelect central bankers that are highly efficient (good at choosing the right interest rate), such that the competence level of the central bank governing council is increased. But central bankers who are less efficient try to imitate the more efficient ones, because they want to keep their job. Their interest rate guess is very likely wrong, and, therefore, it is less probable that the central bank will adopt the right interest rate policy. This detrimental effect of transparency makes procedural transparency undesirable.

In short, the theoretical literature on the procedural transparency does not reach a unanimous conclusion.

2.4. Learning

In the 1970s, the rational expectations hypothesis gained popularity. More recently, however, doubts about the rational expectations hypothesis have emerged, because it is hard to believe that every economic agent behaves rationally. In reaction to this criticism, models that include learning agents were constructed. Agents are provided with learning algorithms which they update based on past data (e.g. Evans and Honkapohja 2005). For example, the private sector could be learning about the model that the central bank uses in conducting monetary policy, whereas both the central bank and the public may have to learn about the way the economy works.

When one incorporates learning in models, managing inflation expectations becomes more important to central bankers (e.g. Orphanides and Williams 2005a). Svensson (2003) put forward the idea that transparency may improve the learning by the private sector to form the right expectations about the economy and inflation and as a result the decisions they make. Up to then, transparency was largely neglected in the learning literature.

Most papers in this strand of literature argue that more transparency is desirable. In Eusepi (2005), transparency about the policy rule can be helpful in reducing the uncertainty and in stabilizing the learning process and expectations of the private sector. Without enough transparency, the economy might be destabilized through expectations-driven fluctuations, even when the central bank is not subject to an inflation bias. The effectiveness of monetary policy is lower so that interest rate changes need to occur more often and need to be larger. The weight that the central bank attaches to output will be higher than optimal (to stabilize the expectations) and the policy rule will prescribe the wrong type of history dependence (how current policy decisions are influenced by past conditions). In addition, it is shown that the publication of forecasts is also desirable. When the central bank and the private sector have different variables in their forecasting models it enables market participants to learn about the monetary policy strategy.

Orphanides and Williams (2005b) find that when the central bank reveals its inflation target, it becomes easier for the public to learn the rational expectations equilibrium and to converge faster to an equilibrium. During disinflation periods, transparency helps reducing inflation and unemployment persistence, as is demonstrated by Westelius (2005), who combines the Barro and Gordon model with incomplete information and learning.

Some papers, however, show mixed results. Cone (2005) argues that transparency is undesirable if, and only if, the private sector's initial inflation forecast is in a certain interval near the equilibrium. The central bank observes the inflation expectations of the public before setting the inflation rate. Over time the public will learn the rational expectations equilibrium. Instead, when market beliefs differ too much from the rational expectations equilibrium, the central bank may be better off not basing policy on these expectations. In contrast, the central bank should be transparent about the true model and therewith influence the private sector beliefs directly.

In Berardi and Duffi (2007) the desirability of transparency in case of discretion is unclear and depends on the policy rate targets. For example, when a central bank has an output target larger than the natural rate and an inflation target of zero it could be beneficial for the central bank to be secret and to fool the private sector by saying that it targets the natural rate of output. The resulting restricted perceptions equilibrium makes sure that the private sector does not question her model. But, as an opposite example, when the central bank wants to achieve the natural rate of output and it has a target of inflation larger than zero, being transparent works out better because it will help coordinate the private sector expectations towards this target, whereas fooling the market is of no use. Under commitment, Berardi and Duffi (2007) find that it is always desirable to be transparent, because the gain from commitment is larger when the public is able to adopt the right forecasting rule.

Overall, a majority of the papers that analyze the effects of transparency when agents learn, find that it can be a helpful tool to improve private sector learning and thereby the decisions that it makes. However some papers show that the finding in favor of transparency is conditional on further assumptions. This strand of research is still in its infancy so more research in this field is both necessary and to be expected.

2.5. Conclusion on theory

One finding that becomes clear from the survey of the theoretical literature is the fact that the debate on the desirability of central bank transparency continues to be a lively one. Since the theoretical research on the economic effects of central bank transparency began the literature has evolved considerably. Theoretical papers are not that much concerned with the exact meaning of transparency (for example, a link to concrete communication is often missing), but focus mainly on the effects of various degrees of transparency. From our review it is clear that increases in transparency increases have both effects on the sender of the information (the central bank) as well as on the receiver of the information (the public).

One of the branches inspired by Cukierman and Meltzer's (1986) work looks into the effects of preference transparency and finds mixed results. While some papers discuss the effect of transparency on inflation, others dispute the effect on the central bank's ability to stabilize the economy. When economic transparency is considered we find that, although earlier papers argue against more transparency, more recent work favors it. A similar trend appears when control error transparency is regarded. Whereas earlier papers within this branch of literature report a trade-off between the central bank's credibility and flexibility to offset shocks, the most recent paper rejects this trade-off and shows that transparency is desirable.

More recently, three completely new strands in the literature have emerged, and research has focused on the way in which individuals take actions.

One strand is based on the work of Morris and Shin (2002). Most of the work building on the idea of coordination games is in favor of more public information. Some papers show, however, that there might be circumstances (for example, when information provision is costly) or topics (like financial stability) that make transparency undesirable.

Another strand of research analyzes decision-making within committees. The discussion on the desirability of procedural transparency is mostly based on accountability arguments. Theoretical work on the economic implications gives mixed results. The manner in which committee members are modeled is pivotal. Probably a mixture of model assumptions used in the various committee models would be more realistic. For example, committee members might not only have different preferences, but also various qualities and national and supranational interests. However, such a combination would complicate the analysis and therefore makes it difficult to come to an overall conclusion on procedural transparency.

Most literature deals with learning. Here, a more realistic idea is adopted, namely that the assumption of rational expectations is too strong. Hence, agents need to learn how the economy works. The majority of the work within this strand supports more transparency because it improves learning. One additional benefit of transparency could be that as agents are learning, transparency helps them to learn in the same direction so to build up consensus, for example, a consensus that keeping wages low is desirable. This strand of literature is still in its infancy.

Even small model differences can lead to a diversity of results. For example, in most papers that analyze the effects of political transparency, only unanticipated monetary policy has an effect on output. Additional assumptions dealing with the importance of reputation building, the manner in which wages are set, and the precise definition of transparency, do differ, however, and can account for differences in outcomes. One needs to keep in mind that while one particular mix of transparency might work for one type of central bank, it might not work for another, as Blinder (2007) emphasizes.

As time passes, models become more and more sophisticated. We observe a tendency that more recent work is in favor of transparency although some disagreement still persists about the benefits of procedural and preference transparency. Nevertheless, the ultimate answer to the question as to whether transparency is desirable depends on the findings of the empirical evaluations of transparency.

3. Empirical evaluations of transparency

The development of explicit indices for central bank transparency has enabled empirical research on theoretical specifications. Several indices exist, such as the ones developed by Fry et al. (2000), Bini-Smaghi and Gros (2001), Siklos (2002), Chortareas et al. (2002a), and De Haan et al. (2004). But all of these indices have the disadvantage that they are constructed at a given point in time and do not provide data about changes in the degree of transparency over time. Eijffinger and Geraats (2006) lifted this constraint by constructing time-varying transparency indices, which have proved to be very helpful in time-series and panel data analysis.

In the following sections we review the empirical evidence to date. A summary of the empirical literature is provided in Appendix B.

3.1. Policy anticipation

One aspect which the empirical literature has looked at is the effect of transparency on the ability of economic agents to forecast the central bank's monetary policy decisions. Several researchers have analyzed financial market prices to check the predictability of the central bank's interest rate decisions in relation to its degree of transparency.

An improvement of monetary policy anticipation is found by the majority of papers in this field. This holds both for research about transparency in general (Muller and Zelmer 1999; Siklos 2003; Coppel and Connolly 2003; Swanson 2006; Lange et al. 2003), as well as for research that considers the anticipation effects of a change in a particular aspect of transparency. In this respect, all areas of transparency are covered. Evidence for improved predictability has been found as a result of political transparency (Haldane and Read 2000; Clare and Courtenay 2001; Lildholdt and Wetherilt 2004; Biefang-Frisancho Mariscal and Howells 2007), the publication of forecasts (Fujiwara 2005), voting records (Gerlach-Kristen 2004), and higher quality inflation reports (Fracasso et al. 2003). However, the latter could be due to better policymakers that cause both improved predictability and better quality of inflation reports. Results indicate that policy transparency has been beneficial for the predictability of monetary policy as well (Demiralp 2001; Poole et al. 2002; Kohn and Sack 2003; Poole and Rasche 2003; Rafferty and Tomljanovich 2002). Research in this field focusses mainly on the transparency increase at the US Fed beginning in 1994. Since that time, interest rate decisions take place following a scheduled meeting of the Federal Open Market Committee, and are immediately disclosed by a press statement. Ehrmann and Fratzscher (2007) show that the introduction of balance-of-risk assessments by the Fed in 1999, led the private sector to anticipate monetary policy decisions earlier.

Not all papers find improved anticipation effects. Reeves and Sawicki (2007) present evidence that near term interest rate expectations are significantly affected by minutes and the inflation report. The timeliness with which minutes are published seems to matter. In contrast, it is harder to find significant effects of speeches and testimonies to parliamentary committees, perhaps because these provide information covering a larger array of topics, its effect is more subtle and more difficult to pick up. In addition, testimonies to parliamentary committees are especially backward-looking and do not contain much new information. Another finding of this empirical strand in the transparency literature is that it matters *what* the central bank is actually transparent about. Ehrmann and Fratzscher (2005) show that although transparency about different points of views about the economic outlook can improve anticipations of future monetary policy, this is not the case for transparency about committee members' disagreement about monetary policy.

3.2. Synchronization of forecasts

In addition to the effects on the anticipation of monetary policy, some papers look at the synchronization of forecasts. Biefang-Frisancho Mariscal and Howells (2007) show that transparency has improved consensus among forecasting agents about future monetary policy (measured by looking at the cross-sectional dispersion of agents' anticipation). However, further tests show that this decrease in dispersion is more likely caused by a fall in the dispersion of inflation rate forecasts. Bauer et al. (2006) demonstrate that forecasts of the private sector about economic conditions and policy decisions have become more synchronized (the idiosyncratic errors of macroeconomic variables decreased). However, they could not find evidence that the common forecast error, which drives the overall forecast errors, has become smaller. Finally, several papers find lower interest rate volatility associated with transparency (e.g. Haldane and Read 2000; Coppel and Connolly 2003).

3.3. Macroeconomic variables

Within this subsection we focus on longer-lasting effects of transparency on macroeconomic variables. Several papers look at these longer-lasting effects. The overall measure of transparency constructed by Fry et al. (2000) is related to lower inflation (Cecchetti and Krause 2002). A drawback of this paper is that transparency is measured in 1998, while the data period examined is the 1990-1997 period. Therefore, causality could run the other way. In this respect, the use of detailed time-series data on transparency has been helpful. Demertzis and Hughes Hallett (2007) look at correlations between the Eijffinger and Geraats index and the levels and variability of inflation and output, and find no significant relation between transparency and average levels of inflation, average levels of output, and the variability of output (at a 95% confidence level). Instead, the total index, and several components of transparency (the economic, alternative economic, and operational index) are significantly correlated with lower inflation variability. Recently, Dincer and Eichengreen (2007) found beneficial effects of transparency on inflation and output volatility, using transparency indices for 100 countries, which they constructed in the same way as the Eijffinger and Geraats index.

Higher political transparency (about the target) has been beneficial for both the level of inflation (Kuttner and Posen 1999; Fatás et al. 2007) and its persistence (e.g. Kuttner and Posen 1999; Levin et al. 2004). Inflation expectations are relatively better anchored, especially for the longer-term horizons (Levin et al. 2004), inflation expectations are lower, and inflation is easier to predict, which holds for transparency about inflation reports as well (Siklos 2003). Fatás et al. (2007) show that if central banks communicate a quantitative target and successfully hit this target then the resulting output volatility is less.

Empirical research finds some costs from increasing procedural transparency: the quality of discussion and debate could decrease (Meade and Stasavage 2004) although it is not clear what effect voicing less dissent with Greenspan's policy proposals has had on the economy. This could have a detrimental effect on policy decisions and, therefore, on the economy.

Chortareas et al. (2002a) find that increased transparency about the forecasts of central banks leads to lower average inflation when the domestic nominal anchor is based on an inflation or money target but not for those countries with an exchange rate target. In addition, there is no evidence that transparency would go hand-in-hand with higher output volatility. Chortareas et al. (2002b) use the same data as Chortareas et al. (2002a) but focus on transparency about policy decisions in addition to transparency about forecasts. Again, they find that higher transparency leads to lower average inflation. Furthermore, their results portray that transparency reduces the sacrifice ratio (the costs of disinflation in terms of lost output and employment). The intuition is that when the public is able to observe the intentions of the central bank more directly through transparency, inflation expectations move fast in reaction to policy changes by the central bank, which reduces the sacrifice ratio. That both forms of transparency are related to lower sacrifice ratios is confirmed by Chortareas et al. (2003), who estimate short-run Phillips curves to get country-specific sacrifice ratios. Publishing detailed forecasts, including a discussion of the forecasts errors and risks, and minutes and voting records seems to help reducing the sacrifice ratio.

3.4. Credibility, reputation, flexibility

Some empirical papers look into the effects of transparency on the central bank's credibility, reputation, and flexibility. Transparency has the potential to improve the degree to which inflation expectations are anchored. This idea is supported by the country-specific and panel data regressions in Chapter 4, where detailed time-series and expectations derived from surveys are used. Transparency helps weakening the link between changes in expected inflation and changes in realized inflation, which indicates better anchored inflation expectations. Gürkaynak et al. (2006) find better anchored inflation expectations accompanied with transparency as well, but they use forward rates on nominal and inflation indexed bonds to determine forward inflation compensation. It turns out that the latter has been sensitive to economic news in the US (a non-inflation targeter) and the UK before 1997 (implying that inflation expectations were not well anchored). In contrast, this is not the case in the UK after it became independent and in Sweden (an inflation targeter). Improved anchoring of inflation expectations is an indication of improved credibility. Demiralp (2001) provides some indication of improved credibility as well.

Lower interest rates may be interpreted as improved reputation and flexibility of central banks. In case of transparency the central bank has more flexibility to offset economic shocks because it does not harm its credibility. The private sector knows when the central bank's decisions are intended to offset economic disturbances, therefore long run inflation expectations, and the long-term nominal interest rates are unaffected by this stabilization policy. In addition, transparency could enhance the reputation of the central bank. It is easier for the private sector to infer the inflation target of the central bank from the policy rate or by looking at inflation outcomes. Assuming that central banks initially have a reputation problem transparency could lower inflation expectations and through it the long-term nominal interest rates.

Siklos (2004) finds that nominal interest rates are lower for countries with a clear inflation objective. In Chapter 3 detailed time-series information is used to analyze the effect of various transparency changes on the levels of interest rates. It is found

that many transparency increases have had a significant beneficial effect on the level of interest rates (policy, short-term and long-term rates), frequently by over 50 basis points, although not all increases in transparency were desirable, and sometimes there was a trade-off between flexibility (lower short-term and policy rates) and reputation (lower long-term rates).

3.5. Cross-country comparisons

Although the empirical papers cover many central banks, some receive more attention than others (e.g. the Federal Reserve Bank of the US). In most cases, it does not matter which central bank is considered, because the majority of articles find beneficial outcomes. Most papers either analyze only one country, or a large group of countries in a cross-country analysis, while some perform case studies for a couple of countries. Some of the latter papers find beneficial effects for all countries examined (e.g. Haldane and Read 2000), but not all of them. Transparency about different point of views about the economy improved anticipations of monetary policy in the US, but no significant effects could be found for the Bank of England and the ECB (Ehrmann and Fratzscher 2005). Possible explanations may be due to differences in objectives across these central banks, as well as Romer and Romer's (2000) finding that the Fed has better knowledge and information about the economy than the markets have. In Chapter 4 improved anchoring after several transparency increases is found. In addition, in Chapter 3 I report lower interest rates in a lot of but not all cases of increased transparency. One explanation for this finding is that it may matter what type of transparency change is analyzed, as well as the particular central bank in question. The central bank's initial level of transparency, and credibility, may play an important role. More research is needed to analyze whether this is indeed the case.

4. Overall conclusion

We have shown that the empirical research on the economic effects of more transparency is of a more recent origin than the theoretical work. It begins in 1999 when data about transparency changes became available. Several years later the empirical research received an extra impulse when measures of transparency were constructed. In contrast to the theoretical research, empirical evaluations attach greater weight to the exact meaning of transparency and how one can measure it. The economic effects of transparency are analyzed both by comparing the economic outcomes of central banks with different levels of transparency (in cross-country analyses), as well as by investigating the effects of particular transparency increases (in country-specific analyses). In Table 1 we briefly summarized the empirical findings.

While the results of the theoretical transparency literature are quite mixed, although increasingly less contentious over time, the empirical results are on almost all aspects of transparency are unanimously in favour of it. Transparency has the potential to improve the anticipations of future monetary policy, which makes monetary policy more efficient. This holds not only for transparency in general, but for all

Table 1. Overview empirical findings

	political	economic	procedural	policy	operational	total
-macroeconomic outcomes	+	+	+	+	+	+
-predictability of future economy				+		
-predictability of inflation	+	+			+	
-level of inflation expectations	+	+			+	
-anchoring of inflation expectations	+					+
-inflation persistence	+					
-predictability of monetary policy	+	+	+*	+	+	+
-degree of synchronization of forecasts	+		+	+		
-market volatility						+
-flexibility						+**
-credibility				+		+**
-pre-meetings and quality of monetary policy making			-			
overall	+	+	?	+	+	+

Note: A beneficial effect is defined as a +, a detrimental effect as a - and unclear effects get a ?. More information about how the concepts in the first column have been operationalized is provided in Appendix B. *Except when transparent about monetary policy disagreement. **In the majority of cases, but sometimes detrimental effects or a trade-off is found.

aspects individually as well. In addition, transparency improvements can reduce interest rate volatility, make forecasts more synchronized, lead to better macroeconomic outcomes and improved credibility.[10]

A large part of the literature focuses on political transparency. From this literature we conclude that, although the theoretical results are mixed, the empirical results are clearly in favor of more political transparency. This is not the case for procedural transparency, which could have some detrimental side-effects, such as a lower quality of discussion and debate. All other aspects of transparency empirical analyses show desirable effects which support the more recent theoretical research.

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[10]Of course there are other possible ways to build up credibility as well, like having a history of low inflation.

Despite the recent growth of empirical research, there is still scope for more empirical work. Not all combinations of aspects of transparency in relation to possible economic effects are analyzed yet. In addition, the evidence on flexibility and reputation do not unanimously point in one direction. Furthermore, several research areas are not explored yet, for example the way in which the initial level of credibility affects the impact of transparency increases on economic outcomes. One area closely linked to transparency, but not included in this survey, is communication. With the move towards more transparency, the role of communication in managing inflation expectations has become more important. It is therefore likely that more research will focus on central bank communication.

Furthermore, future empirical literature should look into the robustness of the results. This is especially important because it is difficult to measure transparency, and there are some specific drawbacks in the construction of indices. For example, it is unclear which components should be included and with what weight. Future research could try to find out which aspects matter most and should be weighted accordingly. Papers that abstain from using indices but use a before-after analysis face several downsides as well. It is difficult to refute the idea that other factors might have driven economic changes. Another empirical problem is reverse causality, which refers to the question which came first: good economic performance or improvements in transparency, which comes first? Additional research into the determinants of transparency would be helpful.

What do we see when we contrast the findings of the transparency literature with the actual practice of central banking? The degree of transparency of nine major central banks in 2002 is presented in Figure 2 (based on Eijffinger and Geraats 2006).
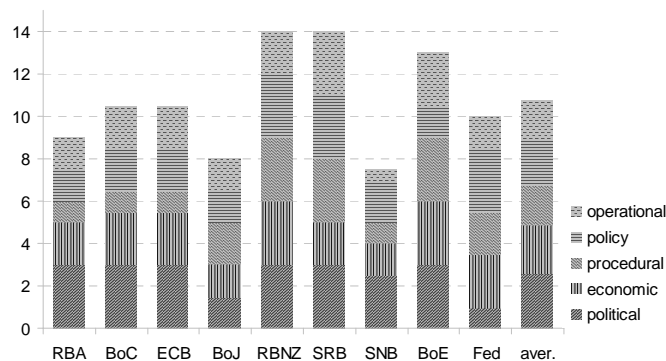
Figure 2. Actual degree of transparency (measured in 2002)

Source: Eijffinger and Geraats (2006).
Note: This figure provides an overview of the degree of transparency of the following nine central banks: the Reserve Bank of Australia (RBA), the Bank of Canada (BoC), the European Central Bank (ECB), the Bank of Japan (BoJ), the Reserve Bank of New Zealand (RBNZ), the Swedish Riksbank (SRB), the Swiss National Bank (SNB), the Bank of England (BoE), and the US Federal Reserve (Fed).

Although central banks have increased their level of transparency, there is still some room left for further transparency increases. The maximum degree of transparency (15, 3 for each of the five aspects) is not yet achieved. In line with the theoretical and empirical findings that support political transparency the most, we observe in practice that it is the aspect of transparency on which central banks score the highest (an average score of 2.6), but there is still some room for transparency increases for three central banks. Economic transparency ranks second (an average score of 2.3), and policy transparency third (2.2 on average). Although the literature shows that both forms of transparency seem to be desirable, only the Reserve Bank of New Zealand achieves the maximum score on both. Concerning procedural transparency the literature is not decisive. This might explain why, in practice, the score on procedural transparency is relatively low (the average score is 1,9). But central banks score the lowest on operational transparency (1,8 on average). Only the Swedish Riksbank scores the maximum of 3. This can be explained by the fact that the theoretical literature is not decisively in favor of more operational transparency. In addition, although the empirical literature is in favor of it, relatively little empirical research focuses on this aspect of transparency, and it originates only from 2003 onwards.

We can now briefly summarizing our findings: 1) The theoretical literature does not come to a unanimous conclusion. Although the more recent theoretical literature argues in favor of more transparency, exceptions are procedural and political transparency. 2) Differences in outcomes occur because of differences in the models used. More recent, micro-directed, research tends to favor transparency. 3) The empirical literature shows that more transparency is indeed desirable. The only remaining question mark is procedural transparency. 4) There is still scope for some more research on transparency. Now that most central banks have already become more transparent, it is likely that the research will shift more towards the limits to transparency and towards communication, a trend that is already observable (see Blinder et al. 2008).[11] As Winkler (2002) points out, the abolition of asymmetric information is not enough: communication should provide clarity to make sure that the release of information leads to common understanding between the public and the central bank. However, it is not easy to do so, as is illustrated by Kafka (1917): "Prescribing is so easy, understanding people so hard.".[12] In Chapter 5 it is shown that this applies also to central banking. A discrepancy between transparency perceptions and the actual transparency practice of the European Central Bank exists. This misalignment is the result of psychological biases and lack of knowledge about the actual central bank disclosure practice, which differs for different groups of people (e.g. laymen versus economic experts). Therefore, the best communication strategy is likely to depend on who the receiver is.

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[11]For a discussion of the limits to transparency we refer to Cukierman (2008).

[12]We would like to thank Vitor Gaspar for suggesting to use this quote.

5. Appendix to Chapter 2

A Theoretical summary table

Author	Aspect	Model	Description	Outcome
Cukier-man and Meltzer (1986)	opera-tional	ML	Infinite horizon. Based on optimal policy models of KP (1977) and BG (1983b). Multi-period state dependent objective function (weights shift in unpredictable ways), that is linear in output. Rational expectations. Noisy monetary control: public cannot separate persistent shifts in objectives from transitory control deviations.	might be undesirable (lower inflation bias, but worse stabilization of shocks)
Dotsey (1987)	policy	RTM	Equilibrium model of the federal funds rate in case of non-borrowed reserve targeting. Cbt about its monetary targets.	trade-off (lower variance of forecast errors, but higher variability of the federal funds rate)
Tabellini (1987)	policy	RTM	Based on Dotsey (1987). Lack of information is parameter uncertainty. Cb has a constant non-borrowed reserves target. Opacity: the financial market uses the inter-bank rate to update their prior of the policy target.	desirable (lower variability of interest rates)
Rudin (1988)	policy	RTM	Based on Dotsey (1987). Only part of the agents engage in Fed watching.	undesirable (worse predictability of the inter-bank rate)
Stein (1989)	political	Open economy model, cheap talk game theoretic mechanism.	2-periods. Cb cares about period 1 interest rate (target is zero and known) and the real exchange rate (unknown target, same in both periods, drawn from uniform distribution). Price stickiness. Fed can not pre-commit. Time-inconsistent policy then higher utility. Different types of cb-ers with different preferences.	desirable, but statements should be imprecise: providing a range within which the targets lies (more swift market reactions)
Lewis (1991)	political	ML	Infinite horizon. Based on CM (1986). Cb is intransparent about the weights attached to the objectives.	might be desirable

Author	Aspect	Model	Description	Outcome
Sørensen (1991)	political	2-stage model with a cb and a labor union	Labor union sets the nominal wage rate before the policymaker sets the inflation rate, and cares about the unbiasedness of inflation expectations and risk aversion. Cb knows the actual shock to unemployment and its own weights (on unemployment and inflation stabilization) in the objective function, the union does not.	might be undesirable (lower variance of inflation and unemployment, but higher level of inflation and unemployment)
Cosimano and Van Huyck (1993)	policy	RTM	Dynamic rational expectations model of the federal funds and deposit market. Secrecy reduces the effect of monetary control policy on interest rates which is valued by the Trading Desk.	undesirable
Garfinkel and Oh (1995)	economic	ML	Static model. Based on Stein (1989). Cb wants to stabilize both output and inflation, and stimulate output above the natural output. Cb has private forecasts about the money demand disturbance before wages are set. Public cannot distinguish between the forecast and the forecast error.	desirable, but should be noisy by giving a range on the cb's forecast of the money demand disturbance (improved predictability of mp and lower variability of output)
Schaling and Nolan (1998)	political	ML	Based on CM (1986). Standard mp-game extended with uncertainty about the cb's preferences for inflation stabilization. Wage-setters unilaterally choose the nominal wage every period and the cb controls mp.	might be beneficial (could reduce the inflation bias)

Author	Aspect	Model	Description	Outcome
Walsh (1999)	political	ML	Static mp-model based on CM (1986), but simplified (all random elements are serially uncorrelated). Cb has private info about shocks. Relative weight on output target is unknown. Reputational considerations ignored. Focus on information revealed by announcements of a target instead of the past history of actions of the cb. Penalty for deviations from the target. Economic information can be revealed by the announced target. A low target would be desirable for creating surprise inflation but not for evaluation.	might be beneficial (lower inflation bias without distorting stabilization policy)
Cukierman (2001)	economic	ML & Neo-Keynesian	Cbt: info about shocks provided before inflation expectations are formed.	might be undesirable
Eijffinger et al. (2000 and 2003)	political	ML	Mp-game with uncertainty about the relative weights in the objective function. Nominal wage contracts are signed before shocks to cb preferences realize (only the variance is known by wage setters and taken into account when forming expectations). The productivity shocks occur (also unknown when signing contracts). Cb sets mp, output is determined. Cb loss function is quadratic in output.	trade-off (lower level and volatility of inflation, higher output volatility)
Faust and Svensson (2001)	operational, political	ML	Infinite-horizon. Based on CM (1986). Standard quadratic cb loss function. Time-varying, serially correlated preferences of cbers. Distinction between imperfect monetary control and operational transparency (the extent to which the monetary control errors are disclosed to the ps).	-operational transparency is likely to be desirable (via more concern about reputation) -political transparency is not (because actions do not affect its reputation).

Author	Aspect	Model	Description	Outcome
Cukier-man (2002)	political	NK	The cb is a flexible it-er and intransparent about its loss-function and the weight attached to output gap stabilization.	undesirable (detri-mental for credibil-ity)
Eijffinger and Hoe-berichts (2002)	political	ML	Based on Lohmann (1992), Schal-ing and Nolan (1998), Eijffinger et al. (2000). Conservative cb-er. Weight on output stabiliza-tion unknown to government and society. After the cb proposes its preferred rate of inflation, the government is able to override the cb at a fixed cost.	trade-off (improved credibility, but worse flexibility)
Faust and Svens-son (2002)	opera-tional	ML	Infinite horizon model. Based on CM(1986). Cbt: the de-gree to which cb preferences (se-rially correlated) can be inferred by the public. Control: extent to which outcomes match inten-tions. Standard cb loss function. More cbt then inflation expecta-tions are more sensitive to policy actions. Current policy decisions influence future inflation expecta-tions. No implication for current aggregates (not forward looking). Cbt introduces a constant mar-ginal cost of loose m, but the marginal costs of current inflation are the same. Given that the cb is aiming at an output level above the natural level, resulting in a BG (1983b) inflation bias, cbt is beneficial. It implies that no costs are incurred in terms of stabilization policy.	might be desirable (for cb's with a bad inflation record)
Grüner (2002)	political	2-stage model with a cb and a labor union	Union sets nominal wage before cb sets inflation. Crucial distinc-tion between uncertainty about the objectives (influenced by dis-closure of information) and un-certainty about inflation (affected by cb's objectives, and actions of all players).	might be undesir-able (higher wages, average inflation and unemploy-ment, possibly higher variance of inflation)

Author	Aspect	Model	Description	Outcome
Jensen (2002)	operational	NK	Infinite-horizon model. Shocks to the preferred value of the output gap (time-varying, serially correlated) of cb-ers are unknown. Cb has imperfect control about its policy outcomes. Cbt: error is made known. Full information: price setters get direct information about the preferences.	trade-off (improved credibility, but worse flexibility)
Morris and Shin (2002)	economic	Coordination	Agents face a coordination motive (coordination does not improve social welfare) as well as a wish to match the fundamentals, about which there is public and private information	might be undesirable
Sibert (2002)	political	Expectations augmented Phillips curve	Basic model: 2-periods. Either nominal wage contracting and rational expectations as in BG (1983a) or Lucas (1973) expectations view of aggregate supply. Continuum of policymaker types (weights in objective function differs) which is unknown. Public forms expectations. Then stochastic shocks occur. Then mp is made.	undesirable (higher inflation and worse stabilization)
Beetsma and Jensen (2003)	political	ML	Based on Eijffinger et al. (2000). Model preference uncertainty somewhat different (isolating the effects of preference uncertainty on policy uncertainty).	might be beneficial (even when the flexibility problem is relatively large)
Chortareas et al. (2003)	economic	ML	Based on BG. Simple model of disinflation costs under incomplete information. Cb has private info about the control error (demand shock), which it partly forecasts.	desirable (lower sacrifice ratio)
Gersbach (2003)	economic	ML	One-period model. Based on BG (1983a). 2 agents: cb and ps. Cb's objectives are known to the ps (and the same as theirs). Supply shocks should be stabilized around a set goal. Cbt: the ps receives the economic information (economic judgement, forecasts, models) before forming expectations.	undesirable (eliminates the possibility to stabilize employment)

Author	Aspect	Model	Description	Outcome
Hughes Hallett and Viegi (2003)	political	ML	2-period. Based on BG (1983a). Micro-foundations of monopolistic competition, sticky prices (Calvo contracts), quadratic adjustment costs. The government and the cb (independent) simultaneously decide about inflation and net tax revenues (which is assumed to have a positive effect on output). The government and the ps both have asymmetric information about the relative weights in the cb´s objective function or the output target.	Cbt about the relative weight put on output is desirable for the ps (better informed decisions), but undesirable for the cb (cannot manipulate expectations). Cbt about the output target is desirable for the ps. For the cb it does not affect its ability to manipulate expectations, but secrecy could still be desirable as it works as a substitute for credibility.
Sibert (2003)	procedural	Committee	Based on a standard time-inconsistency framework. Two cb-ers: one in his first term and one in its second, last, term. Voting signals whether they are opportunistic or not. Because there is some utility attached to keeping the job, an opportunistic junior member will want to pretend that he is not.	might be desirable to publish individuals' votes immediately (lower incentive to inflate raises the expected social welfare)
Angeletos and Pavan (2004)	total	Coordination	Investment complementarities: the individual gain from investment increases in the aggregate level. More effective coordination is socially valuable.	depends on circumstances
Cornand and Heinemann (2004)	total	Coordination	MS(2002) with the possibility of intermediate degrees of cbt.	desirable (but sometimes only to part of the ps)

Author	Aspect	Model	Description	Outcome
Gersbach and Hahn (2004)	proce-dural	Com-mittee	Cb-ers: different preferences. Incentive to misrepresent them (when different from the public) to be re-elected in period 2. But utility loss of strategically voting in period 1 is larger. Adjustment to this model: national governments appoint the national cb-ers that decide on mp within a monetary union.	desirable (but it might not be in case of a monetary union)
Hoe-berichts et al. (2004)	economic	NK	Cb is sufficiently conservative. Cbt: about cb's assessment of the expectations of the ps.	desirable (the increase in output stabilization > the decrease in inflation stabilization)
Cone (2005)	economic	Learning	Canonical time-inconsistency mp-model.	depends on circumstances
Eusepi (2005)	political	Learning	Micro-funded general equilibrium model with nominal rigidities. The cb and ps have to learn the correct model of the economy. Cbt: then no uncertainty about the policy strategy.	desirable (reduces uncertainty, stabilizes inflation expectations)
Geraats (2005)	economic	Real interest rate trans-mission mech-anism with backward-looking pricing.	2-periods. Based on BG (1983a). The ps tries to infer the intentions of the cb by looking at the long term nominal interest rate (=policy instrument). Cbt: the publication of (truthful) cb forecasts, which contain information about demand and supply shocks that influence their mp decisions.	desirable (lower inflation bias)
Gersbach and Hahn (2005)	proce-dural	Com-mittee	2-period. Monetary union with members appointed by national governments.	may be undesirable

Author	Aspect	Model	Description	Outcome
Morris and Shin (2005)	economic	Coordination	Based on MS (2002). Dynamic. The quality of public information is endogenous.	unclear (trade-off: improved steering of expectations but worse signal value of prices)
Orphanides and Williams (2005b)	political	Learning	Ps has the correct reduced form model but uses a truncated sample of the data	desirable
Pearlman (2005)	economic	Coordination. Townsend's (1983) model of an industry.	Heterogeneous agents with different levels of information. They know the prices of other firms, but not their current output. Idiosyncratic demand shocks and aggregate demand (money supply) shocks. A noisy public information signal is given about the money supply. Firms need to find out their own information by guessing the information of other firms.	desirable
Westelius (2005)	operational	Neo-classical expectations augmented Phillips curve. Learning.	Combining BG (1983a) with incomplete information and learning.	desirable (lower inflation and unemployment persistence during periods of disinflation)
Gersbach and Hahn (2006)	economic	ML	One-period model. Based on BG (1983a) and KP (1977). Cb's objectives are representative for the public. Cbt: publication of private information about macroeconomic shocks.	desirable (lower difference between targeted and realized inflation)

Author	Aspect	Model	Description	Outcome
Hughes Hallett and Libich (2006)	political	ML	Based on BG (1983b) and KP (1977). Cb, ps and the government (strong or weak) are rational and have common knowledge of rationality. Extensions: monitoring costs, authorities dislike accountability punishments, control over mp depends on degree of goal-independence enjoyed by the cb. Focus on goal cbt: how explicit goals are stated in legislation or statutes.	desirable (lower inflation)
Lindner (2006)	economic	Coordination	2-period model of currency attack based on global games. Period 0: cb provides its assessment of the current economic strength. Period 1: traders decide whether to attack the currency. Success depends on economic strength in period 1 assessed by cb. This is unobservable but estimated based on cb's assessment of period 0, and private information).	desirable (currency markets more stable)
Morris et al. (2006)	economic	Coordination	MS (2002).	desirable (for reasonable parameter values)
Sibert (2006a)	operational	Expectations augmented Phillips curve	2-periods. Either nominal wage contracting and rational expectations as in BG (1983a), or Lucas expectations view of aggregate supply. Building on CM (1986). For a simple stochastic structure it is possible to solve the model analytically, for a different stochastic structure this is done numerically. Cbt: control errors observed. Private information: about the weights in the objective function.	desirable (lower inflation, same ability to stabilize shocks)
Svensson (2006)	economic	Coordination	MS (2002).	desirable (for reasonable parameter values)

Author	Aspect	Model	Description	Outcome
Berardi and Duffi (2007)	political	Learning. NK.	The ps uses a misspecified reduced form forecast model when cb's policy is not transparent, but is not aware of this misspecification. Distinction between a discretionary and a commitment regime (possible to disentangle transparency from the time-inconsistency problem).	might be desirable under discretion (depends on targets), desirable under commitment
Demertzis and Hoeberichts (2007)	economic	ML. Coordination.	Mp-game based on Demertzis and Viegi (2005) and MS(2002). Costs introduced.	might be desirable (depends on circumstances, trade-off between public and private information)
Demertzis and Hughes Hallett (2007)	political	ML	Mp-model based on Rogoff (1985). Look at two forms of cbt: 1) about the relative weight in the cb's objective function, and 2) about the output target of the cb.	desirable (lower variability of inflation and the output gap, averages unaffected)
Eijffinger and Tesfaselassie (2007)	economic	NK	Cb has private information on the state of the economy, which under a transparent regime is disclosed. Cbt: cb discloses forecasts of future shocks.	desirable (stabilization of current inflation and output, prerequisite: no credibility problem and/or preferences of the cb known)
Geraats (2007)	political / economic	Keynesian (robust to the use of ML or NK)	Imperfect common knowledge about the degree of cbt. Both actual and perceived transparency affect economic outcomes.	Actual transparency is desirable, perceived transparency only about the inflation target not about the output target and supply shocks.
Gosselin et al. (2007)	economic / policy	Coordination	Allow for more than one economic fundamental. Intermediate cbt => interest rate is a tool to steer market expectations. Uncertainty about the precision of information (which creates fog) is modelled. Results are independent of the social welfare criterion.	Full cbt is desirable when the cb's fog is large. Partial cbt is desirable when the cb's fog is thin or absent. Secrecy is only desirable when the cb's information is poor.

Author	Aspect	Model	Description	Outcome
Walsh (2007)	economic	NK & coordination	Focus on cb's that have a good inflation reputation. Economic information that individual firms receive is diverse.	Optimal degree is increasing when cost shocks are less persistent or better forecastable and decreasing when demand shocks are less persistent or better forecastable.
Demertzis and Viegi (2008)	political	Coordination	MS (2002) with Bacharach's variable universe games approach. The latter provides a description of how players evaluate the alternatives they can choose from by taking into account what all other players might believe about them.	desirable
Gersbach and Hahn (2008)	procedural	Committee	Cb-ers have different degrees of economic knowledge (ps is unaware of this). Cb-ers can participate actively in the discussion and decision making or wait and listen to the information and views provided by other cb-ers before voting. Cbt: various interest rate proposals and the individual voting records are made public.	undesirable
Rudebusch and Williams (2008)	economic	NK	ps and cb know the structure and parameters of the equations describing output, inflation and the inflation target, and the functional form of the equation describing mp. Publication of interest rate forecasts might help reducing either policy rule uncertainty or inflation target uncertainty.	desirable (prerequisite: emphasize conditionality and uncertainty)

Note: Column 2: aspects of transparency based on Geraats (2002). Political transparency=information about the cb's goals, how they are prioritized, and quantified, and explicit institutional arrangements or a contract with the government. Economic transparency=information about the economy for example by providing economic data, the models used, and the economic forecast made. Procedural transparency=openness about the procedures used within the central bank to make a monetary policy decision (strategy, voting record, minutes). Policy transparency=the absence of asymmetric information regarding the policy of the central bank (policy decisions are clearly explained, changes are immediately announced, and future policy paths are indicated).

Note (cont.): Operational transparency=when there is a regular assessment of how well the central bank performed by looking at the achievement of operating targets, policy outcomes, and when the central bank is open about the macroeconomic disturbances that influence the policy transmission process. Column 3: ML=A model in which output is increasing in unexpected inflation (Monetarist Lucas type transmission mechanism), NK=New-Keynesian model, RTM=reserve targeting model. Columns 4 and 5: cbt= central bank transparency, cb=central bank, ps=private sector, mp=monetary policy, it=inflation target, BG=Barro and Gordon, KP=Kydland and Prescott, MS= Morris and Shin.

B Empirical summary table

Author	Aspect	Country	Period	Index	Conclusion
Kuttner and Posen (1999)	political	UK, CA, NZ	1984-99, 1984-98, 1982-98	-	desirable (decreased level and persistence of inflation)
Muller and Zelmer (1999)	total	CA	1994-99	-	desirable (improved anticipation of mp = future mp is better incorporated by financial asset prices)
Siklos (1999)	political	7 IT & 3 non-IT	1958-97	-	desirable (inflation persistence an lt interest rates sign. lower after the adoption of inflation targets for a majority of IT countries, no evidence for effect on inflation performance/inflation expectations)
Haldane and Read (2000)	political, policy	UK, US	1984-97, 1990-97	-	desirable (less yield curve surprises at the short end for the UK after 1992 and US after 1994)
Chadha and Nolan (2001)	total	UK	1987-99	-	no effect (increased financial market volatility cannot be attributed to more cbt since May 1997)
Clare and Courtenay (2001)	political	UK	1994-99	-	desirable (increased speed of reaction of financial prices to interest rate announcements, but the size of the reaction remained the same or decreased, indicating that the news content of macroeconomic announcements may have fallen)
Demiralp (2001)	policy	US	1994	-	desirable (improved market anticipation (adjustment of market rates to future mp actions before policy announcement) and credibility (immediate reaction to surprise mp announcement without waiting for the actual mp move))
Cechetti and Krause (2002)	total	22	1995-99, 1990-97, 1990-97	F	desirable (-lower average inflation (sign.) -better macroeconomic performance and less policy inefficiency (not. sign.), measured using the inflation-output variability trade-off).

Author	Aspect	Country	Period	Index	Conclusion
Chortareas et al. (2002a)	economic	87	1995-99	own based on F	desirable (lower average inflation (for countries with a domestic nominal anchor based on an inflation or a money target, not for those with an exchange rate target) and unchanged output volatility)
Chortareas et al. (2002b)	economic, procedural, policy	87	1995-99	own based on F	desirable (lower average inflation, lower sacrifice ratio (=unemployment costs of disinflation))
Poole et al. (2002)	policy	US	1987-2001	-	desirable (improved anticipation after 1994, response of lt treasury rates to unexpected funds rate target changes has become lower)
Rafferty and Tomljanovich (2002)	policy	US	1983-98	-	desirable (improved predictability (lower forecasting error interest rates on US bonds), lower interest rate volatility)
Chortareas et al. (2003)	economic, procedural, policy	21 OECD	1990-2000	own based on F	desirable (lower sacrifice ratio)
Coppel and Connolly (2003)	total	AU	1986-2002	-	desirable (improved anticipation of mp: less interest rate volatility at the short end and quicker reactions to mp decisions)
Fracasso et al. (2003)	economic / operational	20	2000-02	own measure	desirable (using short term interest rates to show improved predictability of mp through higher quality inflation reports)
Lange et al. (2003)	political, policy	US	1983-2000	-	desirable (improved predictability of monetary policy/lt and futures rate now incorporate changes in the federal funds rate a couple of months in advance)
Kohn and Sack (2003)	policy	US	1989-93	-	desirable (use various financial variables to show improved anticipation of future policy and economy, which improves policy effectiveness)
Poole and Rasche (2003)	policy	US	1988-2002	-	desirable (show lower market surprises using the federal funds futures rate)

Author	Aspect	Country	Period	Index	Conclusion
Siklos (2003)	political, economic /operational	5 non IT & 6 IT	1988-99	-	desirable (lower inflation expectations (survey data), improved predictability of inflation)
Gerlach-Kristen (2004)	procedural	UK	1997-2003	-	desirable (improved predictability of mp (=repo rate changes))
Levin et al. (2004)	political	5 IT & 7 non-IT	1994-2003	-	desirable (lower inflation persistence, better anchored inflation expectations (weaker link between changes in survey inflation expectations to changes in realized inflation), especially for the lt horizons)
Lildholdt and Wetherilt (2004)	all	UK	1975-2003	-	desirable (use a simple term structure model to show improved predictability of monetary policy, especially after the introduction of IT)
	total	CA, UK	1994-2001, 1997-2001	-	desirable (decreased market volatility and uncertainty using daily financial asset prices and interest rate spreads)
Meade and Stasavage (2004)	procedural	US	1989-97	-	undesirable (decreased quality of the FOMC´s discussion and debate)
Siklos (2004)	political	20 OECD	1967-99	-	desirable (sign. lower nominal interest rates)
Ehrmann and Fratzscher (2005)	procedural	UK, US, EU	1999-2004	-	desirable (cbt about different points of views about the economic outlook improves anticipation of monetary policy, only for the US) and undesirable (cbt about disagreement about monetary policy could worsen it). Two methods used to measure surprise: 1) absolute value of difference between the actual mp decision and the mean of Reuters survey expectations and 2) absolute change of the one-month interest rate on the day of the mp meeting.

Author	Aspect	Country	Period	Index	Conclusion
Chapter 3	all	8	1993-2002	EG	most of the times desirable (lower policy, short and long interest rates indicating increasing flexibility and reputation), although several times no effect, detrimental, or a trade-off
Fujiwara (2005)	economic	JP	1998-2003	-	desirable (less uncertainty, improved understanding of future monetary policy (using forecasts obtained from newspapers and the internet))
Bauer et al. (2006)	policy	US	1986-2004	-	desirable (more synchronized private sector forecasts about the economy and policy decisions (survey data), but common forecast error unchanged)
Gürkaynak et al. (2006)	political	US, UK, SE	1994-2005, 1993-2005, 1996-2005	-	desirable (better anchored inflation expectations = forward inflation compensation insensitive to economic news)
Swanson (2006)	total	US	1985-2003	-	desirable (improved predictability of monetary policy using financial market data and private sector forecasts)
Biefang-Frisancho Mariscal and Howells (2007)	political, procedural	UK	1984-2003	-	desirable (improved policy anticipation after 1992 (inflation targeting), and more interest rate consensus among forecasters after 1997 (independence + procedural transparency), although this is more likely caused by a fall in the dispersion of inflation rate forecasts. Money market data is used.
Chapter 4	all	9	1989-2004	EG, BSG, S, and D	desirable (better anchored inflation expectations (=weaker relationship between changes in inflation expectations and changes in realized inflation) and less inflation persistence)

Author	Aspect	Country	Period	Index	Conclusion
Demertzis and Hughes Hallett (2007)	all	9	early 90s-end2001	EG	desirable (not sign. correlated with average levels of inflation and output, and variability of output, but total, economic, and operational transparency are sign. correlated with lower inflation variability, 95% confidence level)
Dincer and Eichengreen (2007)	total	100	1998-2005	own	desirable (better macroeconomic outcomes, e.g. lower inflation and output volatility)
Ehrmann and Fratzscher (2007)	policy	US	1994-2004	-	desirable (ps anticipates monetary policy decisions earlier). Daily treasury rates are used.
Fatás et al. (2007)	political	42	1960-2000	-	desirable (lower inflation rates and output volatility)
Reeves and Sawicki (2007)	procedural, economic /operational, policy	UK	1997-2004	-	desirable (Minutes and the inflation report have a significant effect on near term interest rate expectations. The timeliness with which the minutes get published seems to matter. It is harder to find significant effects of speeches and testimony to parliamentary committees, perhaps because these provide information covering a larger array of topics, its effect is more subtle and more difficult to pick up.)
Tomljanovich (2007)	total	7	1990-2003	-	desirable (using interest rates on government bonds with various maturities shows slightly larger reductions in volatility and increased efficiency of financial markets)
Swank et al. (2008)	procedural	US	1989-97	-	undesirable (move of some deliberations to pre-meetings)

Note: Column 2: aspects of transparency based on Geraats (2002). Political transparency=information about the cb´s goals, how they are prioritized, and quantified, and explicit institutional arrangements or a contract with the government. Economic transparency=information about the economy for example by providing economic data, the models used, and the economic forecast made. Procedural transparency=openness about the procedures used within the central bank to make a monetary policy decision (strategy, voting record, minutes). Policy transparency=the absence of asymmetric information regarding the policy of the central bank (policy decisions are clearly explained, changes are immediately announced, and future policy paths are indicated).

Note (cont.): Operational transparency=when there is a regular assessment of how well the central bank performed by looking at the achievement of operating targets, policy outcomes, and when the central bank is open about the macroeconomic disturbances that influence the policy transmission process. BSG=Bini-Smaghi and Gros (2001), D=De Haan et al. (2004), EG=Eijffinger and Geraats (2006), F=Fry et al. (2000) and S=Siklos (2002). IT=inflation targeting, cbt=central bank transparency, lt= long term. Country codes: AT (Austria), AU (Australia), CA (Canada), CH (Switzerland), DE (Germany), DK (Denmark), ES (Spain), FI (Finland), FR (France), IT (Italy), JP (Japan), NL (Netherlands, NZ (New Zealand), SE (Sweden), UK (United Kingdom), US (United States).

CHAPTER 3

Does central bank transparency reduce interest rates?

Abstract[1][2]

Central banks have become increasingly transparent during the last decade. Theoretical models show that monetary policy transparency could lead to lower short-term and long-term nominal interest rates by enhancing flexibility and reputation. This chapter exploits a detailed transparency data set to investigate this for eight major central banks. It appears that many transparency enhancements are associated with significant effects on interest rates, controlling for macroeconomic conditions. In most of these cases, interest rates are lower, often by over 50 basis points, although in some instances transparency appears to have had a detrimental effect on interest rates.

1. Introduction

Central banks have become increasingly transparent and consider transparency a key feature of their monetary policy framework. Since central banks tend to be far more forthcoming than is needed to meet statutory accountability requirements, it is widely believed that transparency has considerable economic benefits. Theoretical models show that monetary policy transparency could lead to lower interest rates by enhancing the credibility, reputation and flexibility of central banks. The contribution of this chapter is to investigate this using a unique transparency data set for major central banks from 1998 to 2002. We find evidence that many increases in transparency have indeed been associated with significant reductions in interest rates when controlling for macroeconomic conditions.

Intuitively, transparency may have an effect on the level of interest rates. Transparency clarifies when monetary policy decisions are intended to offset economic shocks. This simplifies it for the private sector to infer the central bank's inflation goal from monetary policy decisions and outcomes and allows central banks that suffer from a reputation problem to improve their credibility. Central banks have a

greater incentive to build reputation because under transparency because private sector inflation expectations are more sensitive to monetary policy actions and outcomes that are not driven by economic shocks. Enhanced reputation results via lower inflation expectations in a lower long-term interest rate. At the same time, transparency could provide the central bank with greater flexibility to stabilize economic shocks by reducing the short-term interest rate without risking a loss of reputation in the form of higher long-term nominal rates. This chapter tests empirically for the presence of such flexibility and reputation effects on interest rates, exploiting changes in the degree of central bank transparency over time based on the index by Eijffinger and Geraats (2006).

In many instances, greater transparency tends to be accompanied by lower interest rates, when controlling for the macroeconomic situation using inflation and output. The empirical results show significant reductions in interest rates for all central banks in our sample: the Reserve Bank of Australia (RBA), the European Central Bank (ECB), the Bank of Japan (BoJ), the Reserve Bank of New Zealand (RBNZ), the Swedish Riksbank (SRB), the Swiss National Bank (SNB), the Bank of England (BoE) and the Federal Reserve (Fed). Some transparency events have not significantly influenced interest rates, whereas others have actually had a detrimental effect on flexibility and/or reputation. In a few cases, there appears to be a trade-off between flexibility and reputation.

There is an increasing number of empirical studies that analyze the effect of central bank transparency on interest rates. Most focus on the short-lived (daily or even intraday) effects of monetary policy decisions and communications. The move towards greater transparency during the last decade appears to have reduced the effect of monetary policy actions on financial markets in Canada (Muller and Zelmer 1999), the UK (Haldane and Read 2000, Clare and Courtenay 2001) and Australia (Coppel and Connolly 2003). A common finding is that the impact of monetary policy decisions on the short end of the yield curve has become smaller. In line with this, bond market volatility has declined (Rafferty and Tomljanovich 2002) and monetary policy actions have become more predictable, as is shown for instance by Poole and Rasche (2003) and Swanson (2006) for the US.

There is also evidence that these benefits are directly related to central bank communication. Using data for 20 inflation targeters, Fracasso, Genberg and Wyplosz (2003) find that higher quality inflation reports are associated with smaller market interest rate surprises from monetary policy decisions. Gerlach-Kristen (2004) shows that the publication of the BoE's voting records has made it easier to predict future monetary policy decisions. In addition, Reeves and Sawicki (2007) find that UK financial markets react significantly to the minutes of the BoE's monetary policy meetings and to its Inflation Report. For the US, Kohn and Sack (2003) establish that market interest rates are significantly affected by the Fed's policy statements and Greenspan's congressional testimony. The latter two are not only the Fed communication tools with the largest market impact, but also the most accurate ones, as shown by Reinhart and Sack (2006). Although the importance of particular communications may differ across central banks, in a comparison of the Fed, ECB and BoE Ehrmann and Fratzscher (2005) argue that different central bank communication strategies can be equally effective in terms of monetary policy predictability. Using data on the ECB

covering 1999-2002, Jansen and De Haan (forthcoming) show that there is a significant relationship between central bankers' communication on the policy rate and future inflation and their actual policy rate decisions. However, just like models based on macroeconomic data, communication-based models have problems predicting interest rate changes.

In addition to these financial market effects, transparency of monetary policy also appears to have longer-lived, macroeconomic consequences. Using a panel of 11 countries, Siklos (2003) finds that inflation targeting and the release of an inflation report tend to significantly reduce inflation forecasts. Furthermore, relying on a cross-section of up to 87 countries, Chortareas, Stasavage and Sterne (2002a, 2002b, 2003) present evidence that the publication of forward-looking analyses by central banks reduces average inflation and diminishes the sacrifice ratio. Using data for 9 central banks, it is shown in Chapter 4 that greater monetary policy transparency reduces the sensitivity of inflation forecasts to inflation outcomes, which suggests that it helps to anchor inflation expectations. Gürkayanak, Levin, and Swanson (2006) demonstrate that although forward inflation compensation (measured as the difference between forward rates on nominal and inflation indexed bonds) is sensitive to economic news in the US (a non-inflation targeter) and the UK before 1997, it is insensitive in Sweden (an inflation targeter) and in the UK after its move to independence. This supports the view that a well-known and credible inflation target can help anchor inflation expectations.

The contribution of this chapter is to analyze whether transparency has enduring effects on the level of interest rates. In particular, we investigate whether transparency has improved the flexibility and/or reputation of central banks by allowing for lower policy, short- and/or long-term nominal interest rates.

The next section presents a simple model that illustrates how transparency could reduce interest rates. This is followed by a description of the data used in the empirical analysis, including the transparency data (Section 3). Subsequently, the econometric methodology is presented (Section 4) and the empirical results are discussed (Section 5). The chapter ends with some concluding remarks (Section 6).

2. Stylized model

We use a highly stylized model to illustrate how monetary policy transparency could reduce short- and long-term nominal interest rates through flexibility and reputation effects. Geraats (2000) shows how transparency enhances flexibility and reputation in a more sophisticated, dynamic model.[3] For a comprehensive survey of the literature on transparency of monetary policy, see Chapter 2.

Suppose the central bank has an inflation target τ, about which the public has imperfect information. In particular, the public has a Bayesian prior on the inflation target such that $\tau \sim N\left(\bar{\tau}, \sigma_\tau^2\right)$. Uncertainty about the target, or imperfect credibility, is reflected by $\sigma_\tau^2 > 0$. In addition, suppose that the central bank suffers from a reputation problem in the sense that the prior mean exceeds the actual inflation

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[3]It should be noted that some theoretical papers, including Cukierman (2001) and Jensen (2002), find that transparency reduces flexibility. This occurs when the private sector learns about supply shocks before forming its inflation expectations that affect the contemporaneous Phillips curve. This induces a worsening of the inflation-output trade-off.

target: $\bar{\tau} > \tau$. The monetary policy instrument set by the central bank is the short-term nominal interest rate s:

$$(2.1) \qquad s = c - \tau + \varepsilon$$

where $c > 0$ is a constant reflecting the 'neutral' policy rate, and $\varepsilon \sim N\left(0, \sigma_\varepsilon^2\right)$ is an economic shock that the central bank decides to offset, which is independent of τ. In this short-term model, a higher inflation target τ leads to expansionary monetary policy and reduces the short-term interest rate s due to the liquidity effect. The long-term nominal interest rate is determined by the long-term real interest rate r and private sector inflation expectations z, so

$$(2.2) \qquad l = r + z$$

A higher level of inflation z anticipated by the public increases the long-term nominal interest rate l due to the Fisher effect.[4] The public has rational expectations and uses the policy rate s as a signal of the central bank's inflation target τ, so that

$$(2.3) \qquad z = \mathrm{E}_P\left[\tau | s\right]$$

where $\mathrm{E}_P\left[\tau | s\right]$ denotes the private sector's posterior mean of the inflation target.

In the case of transparency (denoted by subscript T), the central bank conveys to the private sector (e.g. by publishing forecasts, minutes or policy explanations) the economic shocks ε it is responding to. This means that the public can perfectly infer the central bank's intention τ from the policy instrument s, so that the long-term nominal interest rate equals

$$(2.4) \qquad l_T = r + \tau$$

In the case of opacity (denoted by subscript O), the economic disturbance ε is not observed by the private sector. As a consequence, the public engages in Bayesian updating, or equivalently, solves a signal-extraction problem when it tries to infer the central bank's inflation target τ from the policy instrument s. So, the long-term nominal interest rate equals[5]

$$(2.5) \qquad l_O = r + \frac{\sigma_\varepsilon^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\bar{\tau} - \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\left(s - c\right)$$

This shows that a change in the short-term interest rate affects the long-term interest rate in the opposite direction, thereby tilting the yield curve. Substituting (2.1) into (2.5) gives

$$(2.6) \qquad l_O = r + \tau + \frac{\sigma_\varepsilon^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\left(\bar{\tau} - \tau\right) - \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}\varepsilon$$

A comparison of the outcomes under transparency (2.4) and opacity (2.6) reveals two differences. First, under opacity, the stabilization of economic shocks is complicated by the effect on the long-term interest rate. For instance, suppose the central bank would like to offset a negative demand shock $\varepsilon < 0$ by reducing the policy rate

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[4]Note that over time, this also increases short-term inflation expectations (which are fixed in the short-term) and thereby raises the neutral policy rate c. Thus, the policy rate s would increase in the long run, which would make (2.1) and (2.2) consistent with the expectations theory of the term structure.

[5]Use the fact that for two jointly normal variables x and y, $\mathrm{E}\left[y | x\right] = \mathrm{E}\left[y\right] + \frac{\mathrm{Cov}\{y, x\}}{\mathrm{Var}[x]}\left(x - \mathrm{E}\left[x\right]\right)$.

s. The lack of transparency causes the private sector to partly attribute the lower interest rate s to a higher inflation target τ. This increases the long-term nominal interest rate l, which hampers the central bank's ability to stimulate the economy. In contrast, in the presence of transparency, the long-term rate remains stable, thereby providing the central bank greater flexibility to offset economic disturbances without compromising its credibility.

Second, greater transparency allows the private sector to more accurately infer the central bank's inflation target τ from the policy rate s, which leads to lower inflation expectations z and reduces the long-term nominal rate l (as $\bar{\tau} > \tau$). However, under opacity, private sector expectations are less responsive to policy actions, so the central bank finds it much more difficult to improve its reputation. Similar in spirit, transparency could make it easier for the private sector to infer the inflation target τ from inflation outcomes (e.g. by publishing unanticipated transmission disturbances). This would also reduce private sector inflation expectations z and thereby the long-term nominal rate l.

To summarize, transparency could generate two beneficial effects. It could provide the central bank greater flexibility to stabilize economic shocks by reducing the short-term interest rate without risking a loss of reputation in the form of higher long-term nominal rates. In addition, it could have a desirable reputation effect that lowers inflation expectations and the long-term nominal interest rate. As a result, it is possible to distinguish between the flexibility and reputation effects of transparency.

Although the stylized model shows how transparency could reduce interest rates, its results may not apply to all the diverse ways in which central banks have become more transparent in practice. So, an empirical analysis is warranted to investigate whether transparency events have had a significant effect on interest rates, and if so, in which direction.

3. Data

This chapter exploits the rich transparency database collected by Eijffinger and Geraats (2006). In particular, changes in the Eijffinger and Geraats (2006) index are used to analyze the relation between transparency and interest rates over time. There are a few other measures of transparency of monetary policy: Fry, Julius, Mahadeva, Roger, and Sterne (2000) construct an index of "policy explanations" based on a comprehensive survey of 94 central banks; Bini-Smaghi and Gros (2001) present an indicator of central bank transparency and accountability for six major central banks; and de Haan, Amtenbrink, and Waller (2004) suggest a variation on this. However, these measures are not very useful for time series analysis because they are all static, while monetary policy transparency has changed significantly during the last decade.

The Eijffinger and Geraats (2006) index distinguishes five aspects of transparency relevant for monetary policymaking, each of which is quantified based on three criteria that refer to factual information disclosures.

 (1) Political (formal objectives, quantitative targets, and institutional arrangements).
 (2) Economic (data, models and internal forecasts used for policy decisions).
 (3) Procedural (strategy, minutes and voting records, capturing how policy decisions are made).

(4) Policy (prompt announcement and explanation of policy actions, and policy inclination).

(5) Operational (control errors, transmission disturbances, and formal evaluation of policy outcomes).

The index is available for nine major central banks (RBA, ECB, BoJ, RBNZ, SRB, SNB, BoE, Fed and Bank of Canada (BoC)) for the period 1998-2002.

The Eijffinger and Geraats (2006) index shows a great variety in the degree of transparency, both across central banks and over time. The most transparent central banks are the RBNZ, the SRB and the BoE, which are all inflation targeters. However, the adoption of inflation targeting does not guarantee a high degree of transparency, as is shown by the fact that the RBA gets one of the lowest scores in the sample. Furthermore, many central banks have experienced significant improvements in transparency over time. The SRB, which has been an inflation targeter since 1993, achieved the most impressive advance in the transparency index from 1998 to 2002. These examples also show that the adoption of inflation targeting can be a very poor proxy for the degree of central bank transparency.

For each date on which the Eijffinger and Geraats (2006) index score changes for a central bank, a transparency indicator variable $d_{MM/YY}$ is constructed, which switches from 0 to 1 on that date (coded as MM/YY) and remains 1 after that date. Only one change, a decrease of transparency of the BoJ, is coded as a change from 1 to 0 which makes sure that in the empirical analysis the signs of all the transparency dummies have a similar interpretation. Note that we use information on the timing of the transparency changes but not on how large these changes were according to Eijffinger and Geraats (2006). Since transparency is difficult to measure, we model every transparency change similarly and leave it up to the outcome of our empirical analysis to indicate the relative importance of various transparency steps. This leads to 15 indicators which are supplemented by 4 indicators that capture major transparency events that occurred before the sample of Eijffinger and Geraats (2006). The BoC was the only central bank that had no change in its transparency scores over the sample, so it was dropped. Appendix A.1 contains a list of all the transparency indicator variables, including a detailed description of the corresponding change in transparency and the aspect(s) it pertains to.

The empirical analysis investigates how the level of interest rates is affected by changes in transparency over time, controlling for the macroeconomic situation. The analysis is performed for three different interest rates, policy, short-term and long-term for the period 1993-2002. The policy rate i_p is the interest rate that the central bank employs as its policy instrument or operating target. The short-term interest rate i_s is the three-month deposit rate or the money market rate. And the long-term nominal rate i_l is the nominal yield on 10-year government bonds. End-of-quarter levels of the interest rate are used for the baseline results with quarterly data.

Two variables are used to control for macroeconomic conditions, inflation and the output gap. Inflation is measured as the annual percentage change in the Consumer Price Index (CPI). The measure for the output gap is the percentage deviation from the trend in Gross Domestic Product (GDP) computed using the Hodrick-Prescott (HP) filter. Further details about the quarterly data are in Appendix A.2.1.

To check the robustness of the results, estimations were also performed at monthly frequency. To compute the output gap, monthly production data is used, which is available for five out of the eight central banks: the ECB, BoJ, SRB, BoE and the Fed. In several cases, the interest rate data consists of monthly averages instead of end-of-month levels. Since changes in the interest rate take longer to affect average values, regressions with average rates use the one-month lagged value of the transparency indicator to facilitate comparability of the results across rates. So, for average interest rates, a transparency change in January effectively turns on an indicator variable in February. Further details about the quarterly and monthly macroeconomic data used for each central bank appear in Appendix A.2.

4. Econometric method

The empirical analysis of the effect of central bank transparency on the level of interest rates is complicated by two stylized facts: (i) interest rates tend to vary substantially over the business cycle by about 200-400 basis points; and (ii) the degree of central bank transparency has increased significantly over time but not uniformly across countries, as documented by Eijffinger and Geraats (2006). As a result, cross-section correlations between the (level or average of the) interest rate and transparency could be very misleading. Instead, we investigate how the level of the interest rate is affected by changes in transparency over time. As the interest rate i depends on macroeconomic conditions, we include inflation (π) and the output gap (y) as control variables, as well as lagged interest rates to absorb serial correlation. To control for expected future conditions as well, current and forward-looking terms for inflation and output are also included. The changes in transparency are captured by the indicator(s) $d_{MM/YY}$. This gives rise to the following forward-looking specification:

$$
\begin{aligned}
i_t \;=\;& c_0 + \sum_{l=1}^{L_\pi} c_{\pi,l}\pi_{t-l} + \sum_{l=1}^{L_y} c_{y,l}y_{t-l} + \sum_{l=1}^{L_i} c_{i,l}i_{t-l} \\
& + \sum_{k=0}^{K_\pi} c_{\pi,k}\pi_{t+k} + \sum_{n=0}^{K_y} c_{y,k}y_{t+n} + \sum_{MM/YY} c_{MM/YY}d_{MM/YY,t} + \eta_t
\end{aligned}
$$

(4.1)

where η_t is white noise. Although this resembles the so-called Taylor rule, which has a structural interpretation as a policy reaction function, we focus on the conditional expectations interpretation of (4.1). In particular, we focus on the question of whether improvements in transparency are associated with a reduction in interest rates, controlling for macroeconomic conditions.

The main challenge in estimating (4.1) is to obtain results that pass the usual diagnostic tests (especially for autocorrelation). Instead of using a trial-and-error approach to try to find a suitable specification for each country and interest rate, we decided to adopt a more systematic method and used the automatic econometric model selection program PcGets, which is based on the *general-to-specific* methodology (Hendry 1995). For all countries and interest rates, (4.1) is used as the so-called 'General Unrestricted Model' (GUM), which is the starting point of the automatic

selection of an undominated, congruent 'specific model' based on the results of diagnostic tests.[6]

The sample period runs from 1993 through 2002, covering the decade in which some of the most interesting changes in transparency practices have taken place. Ending the sample in 2002 allows for the inclusion of forward-looking explanatory variables based on more recent data (2002-2004). The number of lags in the GUM was set to $L_\pi = L_y = L_i = 5$. A selection of forward-looking terms had to be made because of the limited number of observations at our disposal. We decided to include the current, one-year ahead, and two-year ahead inflation rate, so $k \in \{0, 4, 8\}$, and the current and one-year ahead output gap, so $n \in \{0, 4\}$. These are treated as endogenous explanatory variables. For the estimations at monthly frequency, the lags and leads in the GUMs are adjusted correspondingly to make them comparable with the quarterly regression results, so $L_\pi = L_y = L_i = 15$, $k \in \{0, 12, 24\}$ and $n \in \{0, 12\}$.

For the endogenous inflation and output gap variables in the regressions, several instruments were considered, namely lags up to two years of π, y, i_p, i_s, i_l, and, if available, also of the medium-term interest rate i_m.[7] We experimented with the combination and lag lengths of the instruments in light of the following criteria: (i) the number of instruments is not too large, in the sense that they cause run time errors; (ii) the instruments are valid according to the Sargan test; (iii) the instruments have significant explanatory power for the endogenous explanatory variables; and (iv) if possible, other standard diagnostics tests pass as well (using the model selection thresholds). The Sargan test evaluates the null hypothesis that the instrumental variables are uncorrelated with the regression residuals. Since rejection of the Sargan test makes the coefficient estimates inconsistent, we used as selection criterion that this $\chi^2(q)$ test for q over-identifying instruments has a p-value of at least 0.10.

The forward-looking specifications are estimated by Instrumental Variables (using GETSIVE) based on the GUM in (4.1). In our baseline results, all transparency indicators are forced to be included in the selected specific model. The selection strategy that is chosen is the built-in "liberal" strategy, which minimizes the non-selection probability of variables that are relevant and employs sample size adjusted selection criteria.[8] To evaluate the robustness of the results, we consider a few variations on this baseline strategy with quarterly data. First, the liberal strategy is replaced by the built-in "conservative" selection strategy, which minimizes the non-deletion probability of nuisance variables. In the second variation on the baseline settings, the

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[6]According to Hendry and Krolzig (2001, p.3), "Monte Carlo experiments demonstrate that PcGets recovers the correct specification from a general model with size and power close to commencing from the data-generating process (DGP) itself."

[7]To prevent multicollinearity problems, i_p and i_s were not included simultaneously as instruments.

[8]Only two adjustments were made to this setting. In light of the relatively limited sample size, the loosest significance level for the diagnostic tests was increased from 0.01 to 0.025. In addition, a heteroskedasticity test was activated (in addition to the standard tests in PcGets, namely for structural breaks (Chow), normality, autocorrelation, and autoregressive conditional heteroskedasticity). If a diagnostic test is violated for the GUM at the set significance level, then PcGets discards this test and no longer reports it, in which case any missing diagnostics tests were obtained separately for each selected specific model.

transparency indicators are no longer forced to be included in the specific model, which means that only highly significant transparency events tend to survive this "non-forced" selection strategy. In addition, as mentioned above, the baseline estimations are also performed at monthly frequency for several central banks. The estimations in the quarterly robustness checks were performed with the same instruments as in the baseline model, except when this violated the instrument selection criteria described above, in which case more suitable instruments were chosen.

The specific models selected by PcGets under the baseline settings are reported in Tables 1 and 2 for the ECB and Fed, respectively.[9] Columns 1-3 show the coefficient estimates (with p-values in brackets) for these forward-looking specifications. The reported Wald test is for the null hypothesis that the transparency indicators $d_{MM/YY}$ have no joint effect (H_0: $c_{MM/YY} = 0$, $\forall_{MM/YY}$). Indicator variables and Wald tests that are significant at the 10% level are printed bold. The outcomes of several diagnostic tests are reported as well (again with p-values in brackets), using the default settings of PcGets.[10] AR refers to a Lagrange-multiplier (LM) test that evaluates the null hypothesis of no autocorrelation up to fourth order (for quarterly data). ARCH denotes the standard Engle test for fourth-order autoregressive conditional heteroskedasticity in the residuals. Hetero is the White test for heteroskedasticity that is quadratic in the regressors. Normality refers to the Jarque-Bera normality test based on the skewness and kurtosis of the residuals. Sargan denotes the Sargan test for instrument validity (described above). Finally, the standard error of the regression (s.e.e.) and the R^2 give an indication of the goodness of fit of the regressions.

The specifications selected by PcGets tend to have a pretty good fit with an R^2 of around 0.9, although it is sometimes lower for the long-term interest rate. The diagnostics look fine for the majority of our baseline specific models. However, in a considerable number of cases diagnostic tests yield p-values that are quite low (<0.05), which means that the results can not be considered reliable.[11] Those instances are flagged in the presentation of the transparency estimates in Section 5.

For all central banks, the specific models for the policy and short-term rate are typically increasing in the lagged interest rate, inflation and the (change in the) output gap. For the long-term rate, there is more heterogeneity in the specific models across central banks, but there is always a strong autoregressive component. It should be noted that for many central banks the forward-looking model for the long-term rate shows a significant effect of expected future inflation. This means that the transparency indicator may no longer provide a good measure for the reputation effect

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[9]The detailed results for the other central banks are included in a separate Annex, which is available on request.

[10]Detailed information about the diagnostic tests is available in the PcGets manual (section 13.7). Note that the default in PcGets is to report the F-form of the χ^2 statistics for AR, ARCH and hetero, because it has better small-sample properties.

[11]The presence of problematic diagnostics may seem surprising since PcGets is supposed to select a specific model that passes the standard diagnostic tests at adjustable threshold significance levels. However, when a diagnostic test fails in the GUM even at the sharpest significance level (0.005), PcGets simply ignores that test altogether in its model selection. Of course, this could be a symptom of a misspecified GUM, which would also make the specific model unreliable.

Table 1. European Central Bank

	i_p (1)		i_s (2)		i_l (3)	
i_{-1}	0.45	[0.00]				
y_{-2}	0.53	[0.00]				
y_{-4}	-0.64	[0.00]				
π_{-1}	-0.39	[0.06]				
π_{-4}	0.63	[0.02]				
y					-1.20	[0.00]
y_{+4}			-1.01	[0.00]	-1.69	[0.02]
π	0.62	[0.00]	0.75	[0.01]		
π_{+4}	0.33	[0.13]	1.18	[0.00]	3.32	[0.00]
π_{+8}			0.75	[0.00]		
$d_{12/00}$: economy	-0.02	[0.94]	-0.60	[0.14]	-0.51	[0.64]
$d_{11/01}$: policy	**-0.57**	[0.05]	**-1.85**	[0.00]	**-2.81**	[0.00]
EMU	-0.04	[0.89]	-0.64	[0.14]	0.28	[0.83]
Wald	4.66	[0.20]	**160.1**	[0.00]	**28.15**	[0.00]
AR	2.30	[0.10]	1.77	[0.16]	1.00	[0.43]
ARCH	0.21	[0.93]	0.43	[0.79]	0.62	[0.65]
hetero	16.60	[0.48]	13.91	[0.24]	2.00	[0.11]
normality	0.37	[0.83]	2.64	[0.27]	1.97	[0.37]
Sargan	15.71	[0.15]	20.32	[0.32]	14.36	[0.50]
s.e.e.	0.23		0.48		1.05	
R^2	0.95		0.93		0.42	

Note: Coefficient estimates (with p-values in brackets) in the specific model selected under the baseline settings using the forward-looking GUM in equation (4.1). Data period: 1993Q1-2002Q4 for i_s; 1995Q2-2002Q4 for i_p and i_l. The indicator variable EMU takes on the value 1 from 1999Q1. Instruments for π, π_{+4}, π_{+8}, y and y_{+4} in addition to exogenous variables in GUM: $\sum_{t=-5}^{t=-1} i_{l,t}$ in (1); $\sum_{t=-8}^{t=-6} \pi_t$, $\sum_{t=-8}^{t=-6} y_t$, and $\sum_{t=-8}^{t=-6} i_{s,t}$ in (2); $\sum_{t=-5}^{t=-1} i_{p,t}$ in (3).
Sources: Appendix A.2.1.

which operates through inflation expectations. As a result, transparency estimates in forward-looking specifications for the long-term nominal interest rate should be interpreted with caution.[12]

When the current and forward-looking terms in (4.1) are not significant (which is sometimes the case for i_l), estimation of a backward-looking model is more reliable. The backward-looking model is simply a restricted version of (4.1):

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[12]We tried to confirm the finding of true reputation effects by replacing the long-term interest rate with long-term inflation expectations data. Unfortunately, the inflation expectations data were not sophisticated enough to give reliable results. More details are available upon request.

Table 2. Federal Reserve

	i_p (1)		i_s (2)		i_l (3)	
c_0			0.87	[0.00]		
i_{-1}	0.89	[0.00]				
i_{-3}					-0.31	[0.03]
i_{-5}					-0.98	[0.00]
y_{-2}					0.58	[0.05]
y_{-3}			-0.21	[0.03]	0.60	[0.02]
y_{-4}	-0.37	[0.00]				
y_{-5}					-1.10	[0.00]
π_{-1}					-1.59	[0.03]
π_{-2}					1.20	[0.01]
π_{-4}					2.98	[0.00]
π_{-5}					-0.93	[0.02]
y	0.47	[0.00]	0.38	[0.00]	-0.77	[0.02]
y_{+4}	-0.23	[0.00]			0.73	[0.00]
π					1.61	[0.00]
π_{+4}	0.22	[0.00]	0.19	[0.01]	1.30	[0.00]
$d_{02/94}$: policy	0.10	[0.57]	0.22	[0.29]	**2.83**	[0.00]
$d_{05/99}$: policy	**-0.33**	[0.02]	**-0.38**	[0.02]	**-1.67**	[0.00]
Wald	**7.09**	[0.03]	**5.91**	[0.05]	**74.82**	[0.00]
AR	2.34	[0.08]	0.27	[0.89]	2.03	[0.13]
ARCH	0.31	[0.87]	1.52	[0.22]	0.11	[0.98]
hetero	1.22	[0.33]	0.93	[0.52]	29.89	[0.37]
normality	2.56	[0.28]	1.30	[0.52]	1.52	[0.47]
Sargan	23.69	[0.26]	21.26	[0.17]	4.65	[0.99]
s.e.e.	0.27		0.30		0.40	
R^2	0.97		0.95		0.88	

Note: Coefficient estimates (with p-values in brackets) in the specific model selected under the baseline settings using the forward-looking GUM in equation (4.1). Data period: 1993Q1-2002Q4. Instruments for π, π_{+4}, π_{+8}, y and y_{+4} in addition to exogenous variables in GUM: $\sum_{t=-8}^{t=-5} i_{p,t}$ and $\sum_{t=-8}^{t=-1} i_{l,t}$ in (1); $\sum_{t=-8}^{t=-6} i_{s,t}$ and $\sum_{t=-8}^{t=-6} \pi_t$ in (2); $\sum_{t=-8}^{t=-6} \pi_t$, $\sum_{t=-8}^{t=-6} y_t$, and $\sum_{t=-8}^{t=-1} i_{m,t}$ in (3).
Sources: Appendix A.2.1.

$$i_t = c_0 + \sum_{l=1}^{L_\pi} c_{\pi,l}\pi_{t-l} + \sum_{l=1}^{L_y} c_{y,l}y_{t-l} + \sum_{l=1}^{L_i} c_{i,l}i_{t-l}$$

$$(4.2) \qquad + \sum_{MM/YY} c_{MM/YY}d_{MM/YY,t} + \varepsilon_t$$

where $i \in \{i_p, i_s, i_l\}$ and ε_t white noise.

Just as in the baseline forward-looking regressions, the number of lags in the GUM was set to $L_\pi = L_y = L_i = 5$ in the regressions with quarterly data and to

$L_\pi = L_y = L_i = 15$ in the regressions with monthly data. The backward-looking specifications are estimated by Ordinary Least Squares (using the model selection tool GETS in PcGets) based on the GUM in (4.2),

The focus in this chapter is on the 19 transparency indicators $d_{MM/YY}$. Many of the transparency events exert a significant effect on the policy, short-term and/or long-term interest rate in the baseline results. For each central bank, the Wald test typically strongly rejects that the transparency indicators have no joint effect. This establishes that the changes in central bank transparency have significantly affected the level of interest rates.

5. Empirical results

The empirical estimates for the indicator variables in the selected specific model are summarized in Table 3, based on the baseline forward-looking GUM in (4.1). Our systematic econometric methodology ensures that the results in this Table are comparable in the sense that they are based on exactly the same GUM and model selection settings for all central banks. The first three columns of the tables show the coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model with the policy rate i_p, short-term nominal interest rate i_s and long-term nominal interest rate i_l, respectively. Results in the tables are flagged whenever the specific model fails to pass critical diagnostic tests with a p-value of at least 0.05. Nonnormality and/or heteroskedasticity, marked by †, make the p-values of the coefficient estimates unreliable. Autocorrelation, indicated by ‡, not only makes the p-values incorrect, but in the presence of a lagged dependent variable it also makes the coefficient estimates inconsistent. The final two columns show whether the transparency event appears to improve (+), reduce (−) or not significantly affect (0) the flexibility and reputation of the central bank.

The overview in Table 3 reveals that most of the significant transparency coefficients (printed in bold) are negative. In fact, more than two-thirds of the significant transparency events are associated with a lower policy, short-term and/or long-term nominal interest rate. Interestingly, there are a few instances in which the effects on the policy/short-term rate and the long-term rate are significant but of opposite sign, which suggests a trade-off between flexibility and reputation.

These findings also hold for the conservative and non-forced robustness checks in Tables B1 and B2 (Appendix B).[13] These robustness exercises often confirm the results based on the baseline settings. A large number of the significant transparency effects even survive the highly discriminating non-forced selection strategy. Although there are several cases in which a significant transparency effect in the baseline results is not corroborated by the robustness checks (or vice versa), it is very rare for the baseline estimates and robustness checks to actually yield contradictory significant

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[13]The majority of the significant transparency coefficients is again negative, but the percentage of significant transparency coefficients that are negative under the conservative and non-forced settings is lower than in the baseline case: 64% and 58%, respectively.

Table 3. Summary of forward-looking results

	i_p		i_s		i_l		F	R
RBA								
$d_{10/01}$: economic	**-0.83**	[0.00]	**-0.54**	[0.00]	-0.25	[0.38]†	+	0
ECB								
$d_{12/00}$: economic	-0.02	[0.94]	-0.60	[0.14]	-0.51	[0.64]	0	0
$d_{11/01}$: policy	**-0.57**	[0.05]	**-1.85**	[0.00]	**-2.81**	[0.00]	+	+
EMU	-0.04	[0.89]	-0.64	[0.14]	0.28	[0.83]	0	0
BoJ								
$d_{01/98}$: political/proc.	-0.06	[0.78]	**-0.19**	[0.04]	-0.24	[0.23]	+	0
$d_{10/00}$: economic	0.32	[0.21]	-0.26	[0.14]	0.20	[0.47]	0	0
$d_{03/01}$: operational	**-0.31**	[0.09]	-0.17	[0.35]	0.11	[0.69]	+	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.05	[0.92]‡	-0.05	[0.92]‡	0.33	[0.24]†	0	0
$d_{12/00}$: policy	**-2.10**	[0.00]‡	**-2.11**	[0.00]‡	-0.40	[0.16]†	+	0
SRB								
$d_{03/97}$: economic	**0.74**	[0.00]	**0.57**	[0.00]	0.19	[0.40]	–	0
$d_{01/99}$: political	**-0.75**	[0.00]	**-1.11**	[0.00]	**1.07**	[0.01]	+	–
$d_{10/99}$: econ/policy	-0.20	[0.57]	-0.02	[0.94]	0.09	[0.88]	0	0
$d_{03/00}$: operational	-0.33	[0.30]	0.13	[0.64]	-0.04	[0.95]	0	0
$d_{03/02}$: proc/policy	0.27	[0.16]	**0.48**	[0.01]	**-1.14**	[0.00]	–	+
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.68**	[0.00]	**0.38**	[0.01]	**-0.50**	[0.01]	?	+
BoE								
$d_{06/97}$: political	0.16	[0.34]	**1.11**	[0.02]	**-1.34**	[0.00]†	–	+
$d_{04/99}$: economic	-0.32	[0.37]	-0.49	[0.63]	0.02	[0.97]†	0	0
$d_{08/99}$: operational	0.00	[0.99]	**1.73**	[0.04]	-0.21	[0.60]†	–	0
Fed								
$d_{02/94}$: policy	0.10	[0.57]	0.22	[0.29]	**2.83**	[0.00]	0	–
$d_{05/99}$: policy	**-0.33**	[0.02]	**-0.38**	[0.02]	**-1.67**	[0.00]	+	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the baseline settings using the forward-looking GUM in (4.1) for the sample period 1993Q1-2002Q4. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility (F) and reputation (R) is positive (+), negative (–), ambiguous (?) or not significant (0).

effects.[14] This indicates that our findings are quite robust to changes in the model selection strategy.

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[14]Most differences occur for the non-forced specifications, but these tend to be less comparable because the selection of instruments sometimes had to be changed to satisfy the instrument criteria described in Section 4.

The baseline forward-looking econometric estimates of the transparency effects in Table 3 are now discussed for each of the eight central banks. They are cross-checked against the estimates based on the conservative and non-forced model selection strategies in Tables B1 and B2 (Appendix B). Whenever available, findings based on monthly data are taken into account as well. Note that in some cases, when the current and forward-looking terms turned out to be insignificant, the results of the estimations based on the backward-looking GUM (4.2) are presented. This is the case for the quarterly conservative i_l regressions of the RBA, the RBNZ, and the SNB, the quarterly non-forced i_l regressions of the ECB and the SRB, and the monthly baseline i_l regression of the ECB. However, in half of these cases (i_l conservative of the RBA and RBNZ and i_l monthly of the ECB) the selected backward-looking specifications yield exactly the same outcome as the forward-looking specification.[15]

5.1. Reserve Bank of Australia

The RBA experienced an increase in economic transparency when it clarified in October 2001 that it uses a particular macroeconometric model for policy analysis (indicated by $d_{10/01}$). This model had already been published by the RBA as a research discussion paper without receiving its formal endorsement.

The baseline estimates suggest that this transparency event ($d_{10/01}$) was associated with a significant decline in policy and short-term interest rates of over 50 basis points, which indicates increased flexibility. Long-term interest rates did not change significantly, which suggests that the reputation of the RBA was not affected. These findings are supported by the robustness checks. Nevertheless, it seems surprising that such a minor transparency change would have such a strong effect. It is likely that the October 2001 transparency indicator is picking up the policy easing following the 9/11 terrorist attacks.

5.2. European Central Bank

The ECB has become more transparent in two respects. There was an increase in economic transparency in December 2000 (indicated by $d_{12/00}$) when it introduced the release of semiannual medium-term staff projections for inflation and output.[16] In the subsequent month, the ECB first published its structural macroeconomic model of the euro zone. In addition, policy transparency was effectively enhanced in November 2001 (indicated by $d_{11/01}$), when the ECB started to provide a policy explanation after each monetary policy meeting after the reduction in the frequency of policy meetings from twice to once a month. Since then, each monetary policy meeting has been followed by a press conference in which the President provides a statement and answers questions from journalists. Considering the major change that took place

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[15]These backward-looking regressions were estimated for the same sample period as the forward-looking models (1993-2002). The findings of the quarterly regressions are supported by estimations with an extended sample (1993-2004).

[16]This had been triggered by the Committee on Economic and Monetary Affairs of the European Parliament in its quarterly Monetary Dialogue with the ECB based on Article 113(3) of the Treaty on European Union and on the advice of its Panel of Experts in their quarterly Briefing Papers (see http://www.europarl.eu.int/comparl/econ/emu/default_en.htm).

with the start of the Economic and Monetary Union (EMU) in January 1999, we introduced an additional indicator variable EMU to investigate its effect.[17]

The baseline results show that the increase in economic transparency ($d_{12/00}$) has been followed by lower interest rates, but the effect is not significant. The conservative and non-forced robustness checks do not find significant flexibility and reputation effects, either. However, the results based on monthly data show a significant decrease in the policy rate of about 30 basis points, which is some evidence that greater economic transparency has improved the flexibility of the ECB.

The increase in policy transparency ($d_{11/01}$) has been accompanied by significantly lower interest rates, with reductions of more than 180 basis points for both the short-term and long-term rate. These large significant effects find support in the robustness checks. This suggests that the greater policy transparency has been very beneficial for both the flexibility and reputation of the ECB. However, it is likely that the sizeable decrease in the interest rate captured by the November 2001 transparency indicator is at least partly attributable to the policy easing after 9/11.

The start of EMU had no significant effect in the baseline regressions. The highly selective non-forced robustness check finds a detrimental reputation effect, which is confirmed by the regressions with monthly data. The latter regressions also show a detrimental flexibility effect. This indicates that EMU might have had harmful flexibility and reputation effects.

All in all, the results suggest that the increase in economic and policy transparency have both been beneficial to the ECB, whereas EMU has exerted a detrimental effect on interest rates.

5.3. Bank of Japan

The BoJ experienced an increase in its political and procedural transparency when a new monetary policy framework was implemented in January 1998 (indicated by $d_{01/98}$), in anticipation of the entry into force of an amendment to the Bank of Japan Law on April 1, 1998. This amendment specified price stability as the explicit aim of monetary policy, increased the effective independence of the Bank, and required a semi-annual report on monetary policy to the Diet (parliament). Since January 1998, monetary policy decisions have been made at regular meetings of the newly autonomous Policy Board and the minutes of its policy meetings have been published. The BoJ also enhanced economic transparency in October 2000 (indicated by $d_{10/00}$) when it started publishing the Policy Board's semi-annual short-term forecasts for inflation and output. Finally, the BoJ actually suffered from a decrease in its transparency score in March 2001 (indicated by $d_{03/01}$ and coded as a change from 1 to 0) when it abandoned the use of the uncollateralized overnight call rate (which has been virtually zero since February 1999) as its main operating target. Instead, it adopted the outstanding balance of current accounts at the Bank, but this quantitative target proved quite loose and wide fluctuations within the target were not explained, thereby creating opacity about control errors.[18]

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[17]To ensure comparability before and after EMU, Eonia is used for the policy rate.

[18]The change in operating target has been reversed by the BoJ in March 2006, which marked the end of a five-year period of "quantitative easing".

The regression results of the baseline forward-looking model pass all diagnostic tests, something that does not apply to the robustness checks. Normality of the residuals is often strongly rejected, which is not surprising in light of the zero-interest-rate policy of the BoJ during the second half of the sample period.

The implementation of the new monetary policy framework ($d_{01/98}$) has significantly reduced the short-term rate by about 20 basis points. The non-forced variation for the policy rate also shows a significant beneficial flexibility effect, but this should be interpreted with caution due to the presence of autocorrelation.[19] The estimates for the long-term rate show a decline of about 25 basis points in all the quarterly forward-looking regressions. This beneficial reputation effect is significant in the more selective 'non-forced' variation, but this should be interpreted with care due to normality problems.

Higher economic transparency ($d_{10/00}$) has produced no significant effects on interest rates, except for an increase in the policy rate of about 70 basis points in the monthly forward-looking regression. But this sign of a detrimental flexibility effect may not be reliable due to the failure of normality.

The change in operational transparency ($d_{03/01}$) shows a significant negative effect on the policy rate of about 30 basis points in the baseline model.[20] This corresponds to a beneficial flexibility effect from greater transparency, but it appears to be contradicted by a significant positive effect on the policy rate in the conservative variation. However, the latter suffers from nonnormality, so its p-values are unreliable.

All in all, we only find tentative support that greater transparency may have increased the flexibility and perhaps also the reputation of the BoJ.

5.4. Reserve Bank of New Zealand

The RBNZ accomplished a major improvement in policy and operational transparency in March 1999 (indicated by $d_{03/99}$) when it abandoned the use of a target for the Monetary Conditions Index (MCI), which is a weighted average of the trade-weighted exchange rate and the 90-day interest rate, to convey its monetary policy stance. Instead, it introduced the Official Cash Rate, which is perfectly controlled and thereby eliminates operational uncertainty.[21] In addition, it started to release explanations of policy changes as well as quarterly, three-year ahead, unconditional forecasts for the 90-day interest rate. There was a further increase in policy transparency in December 2000 (indicated by $d_{12/00}$) when the RBNZ started to provide an explanation of policy decisions even when the Official Cash Rate was held constant.

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[19]The monthly forward-looking estimates also yield significant, yet bewildering results, with a negative estimate for the short rate, but a large positive estimate for the policy rate. However, these are based on different instruments and suffer from nonnormality.

[20]Recall that $d_{03/01}$ captures a transparency decrease and that the indicator variable is turned off in March 2001. So, the results indicate that the prevailing zero interest rate was about 30 basis points higher than macroeconomic conditions would have warranted.

[21]To ensure comparability before and after the adoption of the Official Cash Rate, the overnight interbank rate is used for the policy rate. Since it is essentially the same as the money market rate, the policy and short-term rate results are virtually identical.

The adoption of the Official Cash Rate ($d_{03/99}$) appears to have had no significant effect on interest rates. Although it should be noted that the reported p-values are not reliable due to autocorrelation and nonnormality.

The further rise in policy transparency ($d_{12/00}$) has led to a lower policy/short-term interest rates. The baseline and conservative estimates even show a significant decline in the policy/short-term rate of over 200 basis points. But this evidence of a large beneficial flexibility effect is tainted by the presence of autocorrelation. For the long-term rate, the baseline and the conservative model give no significant effect, but the non-forced forward-looking specification presents a disadvantageous reputation effect of about 55 basis points, which is significant.

All in all, there are some indications that the increases in transparency may have been beneficial to flexibility but possibly harmful to the reputation of the RBNZ. However, the latter may be attributable to the gradual increase in the RBNZ's inflation target from 0-2% to 0-3% in 1997 and to 1-3% in 2002, which has probably raised the long-term nominal interest rate.

5.5. Swedish Riksbank

The SRB experienced the greatest number of transparency events in our sample. The SRB started publishing its inflation forecasts in the quarterly Inflation Report in March 1997 (indicated by $d_{03/97}$), which enhanced economic transparency. The Riksbank's institutional independence and main objective were clarified in amendments to the Constitution Act and Sveriges Riksbank Act, which entered into force in January 1999 and improved political transparency (indicated by $d_{01/99}$). The SRB introduced policy explanations for no-change decisions in October 1999 and later that quarter first released data on capacity utilization, which contributed to policy and economic transparency (indicated by $d_{10/99}$). Operational transparency was improved by an annual evaluation of past inflation forecast errors, which started in March 2000 (indicated by $d_{03/00}$). Finally, policy and procedural transparency increased when a policy inclination was introduced in March 2002, followed by clarity about the attributed voting record in the minutes of the Executive Board's monetary policy meetings (indicated by $d_{03/02}$).

The increase in economic transparency ($d_{03/97}$) has significantly increased the policy and short-term rate by about 50 basis points in all quarterly specifications, including the highly demanding non-forced robustness checks. There are no significant effects on the long-term rate in the quarterly specifications. However, in the monthly forward-looking specification a decrease of about 35 basis points is found. These results indicate that greater economic transparency has had a disadvantageous flexibility effect, while there is also some evidence of a beneficial reputation effect. This suggests a possible trade-off between flexibility and reputation.

The advance in political transparency ($d_{01/99}$) appears to have reduced policy and short-term interest rates. This favorable flexibility effect is strongly supported by all the forward-looking estimates of the short-term rate, which show a significant decrease of about 100 basis points, also in the challenging non-forced robustness

check.[22] At the same time, the long-term rate has significantly increased by about 100 basis points in the baseline forward-looking regression. The detrimental reputation effect is supported by the monthly results and even the 'non-forced' backward-looking specification. Thus, this transparency event reveals a trade-off between flexibility and reputation, as well.

The increase in policy and economic transparency ($d_{10/99}$) shows no significant effects in the quarterly models, but this may be due to collinearity with $d_{01/99}$ and $d_{03/00}$. The monthly specifications are more discriminating and detect a detrimental flexibility effect with a 20 basis point increase in the policy and short-term rate, although the latter suffers from autocorrelation and nonnormality. There no indication of a possible reputation effect.

The rise in operational transparency ($d_{03/00}$) did not generate any significant coefficient estimates in the quarterly models, again probably due to multicollinearity. Nevertheless, the results suggest a decline in the policy rate, up to about 50 basis points in the conservative specifications. The presence of an advantageous flexibility effect finds formal support in the monthly regressions.

Finally, the greater policy and procedural transparency ($d_{03/02}$) has significantly increased the short-term rate by nearly 50 basis points in all quarterly specifications, including the highly selective non-forced variation. This strong finding of a detrimental flexibility effect appears to be contradicted by a significant decrease in the policy rate in the conservative forward-looking model, but this estimate is only marginally significant with a p-value of 0.09.[23] Regarding the long-term rate, the estimates unambiguously point to a reduction. This beneficial reputation effect appears firmly supported by significant effects of up to 100 basis points in the baseline, conservative and non-forced variations. So, this transparency event provides another example of a trade-off between flexibility and reputation.

All in all, the increases in transparency have significantly affected the level of interest rates, although the benefits appear equivocal. In particular, the empirical results strongly suggest that the SRB has experienced trade-offs between flexibility and reputation.

5.6. Swiss National Bank

The SNB experienced a significant change in its monetary policy framework in December 1999 (indicated by $d_{12/99}$), with the announcement of a quantitative definition of price stability, quickly followed by the entry into force of a constitutional amendment that enshrined the Bank's independence. In addition, the SNB started to release three-year ahead inflation forecasts at semiannual frequency. On the downside, it introduced an operational target range for the LIBOR of 100 basis points, without accounting for significant fluctuations, thereby reducing operational transparency.

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[22]This appears to be contradicted by a significant increase in the short rate in the monthly regressions, but this finding is unreliable due to autocorrelation and nonnormality.

[23]The monthly regressions also yield opposite findings, with a significant positive estimate for the policy rate and negative estimate for the short rate, although the latter suffers from autocorrelation and nonnormality. Both contradictory findings may be related to the use of different instruments.

The change in the monetary policy framework ($d_{12/99}$) has been accompanied by significant effects on interest rates. The baseline and conservative models show an unclear flexibility effect. Although the policy rate significantly declined by over 100 basis points, the short-term rate increased significantly by about 40 basis points. In the highly-selective non-forced model the transparency change went along with both significantly lower policy and short-term rates. While the effect on flexibility appears ambiguous, the baseline results show a significant decline in the long-term rate of about 50 basis points and this is confirmed by the conservative robustness checks. This indicates that the different monetary policy framework has boosted the reputation of the SNB.

5.7. Bank of England

The BoE was granted operational independence in 1997 and the first interest rate decision by the new Monetary Policy Committee (MPC) was made in June 1997 (indicated by $d_{06/97}$). This greatly reduced uncertainty about potential political influences on monetary policymaking. This transparency event resulted from the surprising move by the new Labor government to grant the BoE independence, so it can be considered as exogenous. In addition, in April 1999 the BoE increased its economic transparency by publishing extensive documentation about its policy models, even including the computer code of its macroeconometric model (indicated by $d_{04/99}$). And in August 1999, operational transparency was enhanced by the introduction of an annual evaluation of the MPC's forecasting record for inflation and output (indicated by $d_{08/99}$).

The operational independence of the BoE ($d_{06/97}$) has been followed by significantly higher short-term interest rates. This finding is confirmed by the robustness checks, even by the non-forced variation. The conservative robustness check and the regression with monthly data show higher policy rates, which confirms the finding of a detrimental flexibility effect. The long-term rate, however, has significantly declined by over 100 basis points in the baseline and the conservative results. These results are marred by heteroskedasticity. The advantageous reputation effect is strongly supported by the highly demanding non-forced robustness check, which does not suffer from diagnostic problems. Overall, empirical results indicate that the independence of the BoE has generated a trade-off between flexibility and reputation.

The rise in economic transparency ($d_{04/99}$) appears to have reduced short-term rates, but the effects are not statistically significant. The latter might be due to collinearity with $d_{08/99}$. There was no significant effect on the long-term rate in the regressions with quarterly data. However, the monthly regression, which suffers less from collinearity, detects a significant increase in the long-term rate, which suggests a detrimental reputation effect.

The increase in operational transparency ($d_{08/99}$) appears to have significantly increased the short-term rate by nearly 175 basis points in the baseline regression. However, this detrimental flexibility effect is not supported by any of the robustness checks. The long-term rate seems lower in the baseline and conservative settings, though the effect is not statistically significant and red flags for heteroskedasticity

are raised. However, the monthly forward-looking regression picks up a significant decrease, which indicates a beneficial reputation effect.

All in all, the transparency changes have had a mixed effect on interest rates and there is evidence that the BoE has experienced a trade-off between flexibility and credibility, especially after its independence in 1997.

5.8 Federal Reserve

The Fed introduced a prompt announcement of its Federal Funds rate decision in February 1994 (indicated by $d_{02/94}$), thereby contributing to greater policy transparency. In addition, it became more forthcoming about its policy stance in May 1999 when it started to provide a brief explanation of every policy decision at the time of announcement, as well as an explicit policy inclination (indicated by $d_{05/99}$).

The first increase in policy transparency ($d_{02/94}$) has led to higher interest rates. There is a significant rise in the long-term rate of up to 280 basis points in all the forward-looking estimates based on quarterly data, including the non-forced robustness check. In addition, there is a significant increase in the policy and short-term rate of about 20 basis points in the monthly regression results. Although this seems detrimental to flexibility and reputation, the strong increase in interest rates was actually the Fed's intention. After a long 1.5 year spell of a constant Federal Funds rate target of 3%, the Fed decided on a 50 basis point hike in February 1994, accompanied by a prompt announcement to achieve maximum effect. So, this transparency event was endogenous to the interest rate decision. Nevertheless, it seems remarkable that the higher level of interest rates has been so persistent. However, an alternative interpretation of the significant positive effects of $d_{02/94}$ is that interest rates in 1993 (the first year of the sample) were relatively low in view of economic conditions.

The introduction of an explicit policy inclination in 1999 ($d_{05/99}$) has been followed by lower interest rates. The policy and short-term rate are significantly reduced by about 35 basis points in the baseline estimates. The long-term rate has also significantly declined by 170 basis points in the baseline estimation and 130 basis point in the highly selective non-forced robustness exercise. These results point to a beneficial flexibility and reputation effect for the Fed, which are confirmed by the regressions with monthly data.

All in all, the increases in policy transparency at the Fed have been associated with significant effects on interest rates, which appear to have been in a desired direction.

6. Concluding remarks

Central bank transparency has become one of the key features of monetary policy frameworks during the last decade. Transparency is often alleged to be beneficial and contribute to lower interest rates due to reputational advantages and greater flexibility to stabilize the economy. However, empirical evidence of such benefits has been sparse so far. This chapter has systematically analyzed the relation between changes in transparency and the level of interest rates for eight major central banks from 1993 until 2002. It finds that many increases in monetary policy transparency have been accompanied by persistently lower policy, short-term and/or long-term

nominal interest rates, controlling for macroeconomic conditions. Although in some instances transparency seems to have had a detrimental effect on interest rates.

To obtain a suitable econometric specification we have applied the same general-to-specific methodology to each central bank. Extensive robustness checks indicate that our findings are generally not affected by reasonable variations in the model selection criteria. The baseline forward-looking results in Table 3, which are the most encompassing, show that the majority of transparency events have been followed by significant changes in interest rates. In most of these cases, higher transparency is associated with a significant reduction in the policy, short-term and/or long-term rate, although sometimes there is a significant increase in the interest rate. In a few instances the effects on policy/short-term and long-term rates are of opposite sign, which suggests a trade-off between flexibility and reputation.

The negative relationship we find between transparency and interest rates should be interpreted with care since transparency changes could be endogenous. For instance, the greater policy transparency by the Federal Reserve in February 1994 appears to be motivated by the decision to suddenly raise the policy rate by 50 basis points. On the other hand, there are also transparency changes that are clearly triggered by external events, such as the surprise move by the new Labor government to grant the Bank of England operational independence in 1997. Such exogenous events provide a more reliable estimate of the effect of transparency on interest rates. When focusing on such increases in (political) transparency due to legal changes, there is clear evidence of a reduction in interest rates, although there tends to be a trade-off between flexibility through policy/short-term rates and reputation through long-term rates.

All in all, this chapter establishes that there tends to be a negative relationship between central bank transparency and the level of interest rates, controlling for macroeconomic conditions. It is remarkable that higher transparency is often accompanied by economically significant reductions in the interest rate, sometimes of over 100 basis points. Thus, our empirical findings suggest that central banks that become more transparent could benefit from sizeable flexibility and reputation effects.

7. Appendix to Chapter 3

A Data

This appendix provides details about the variables used in the empirical analysis, namely the transparency indicators $d_{MM/YY}$ (in Appendix A.1) and the macroeconomic data used for the interest rates i_p, i_s and i_l, inflation π, and the output gap y (in section A.2).

A.1 Transparency indicators

This section contains a detailed description of the transparency events for each central bank that are captured by the indicators $d_{MM/YY}$ that represent changes in transparency according to the Eijffinger and Geraats (2006) index. In square brackets is (in reverse order) the date of change, the change in the Eijffinger and Geraats (2006) index score, and the aspect it pertains to: (1) political, (2) economic, (3) procedural, (4) policy, and (5) operational.

The data from 1998 to 2002 are taken from Eijffinger and Geraats (2006). In addition, a few transparency events outside the 1998-2002 sample of Eijffinger and Geraats (2006) have been included (BoJ $d_{01/98}$, SRB $d_{03/97}$, BoE $d_{06/97}$, Fed $d_{02/94}$). Note that the size of these transparency changes is not measured, which is indicated by a question mark. This is not relevant for our empirical analysis, however, since we only use information on the timing of transparency changes and not on their size.

Finally, several transparency indicators (ECB $d_{12/00}$; RBNZ $d_{03/99}$; SRB $d_{10/99}$ and $d_{03/02}$; SNB $d_{12/99}$) capture multiple changes in the transparency scores to avoid exact multicollinearity.

Reserve Bank of Australia (RBA)
· $d_{10/01}$: [(2) **+1**, 10/2001] The speech "The Monetary Policy Process at the RBA" by Glenn Stevens, Assistant Governor, Melbourne, October 10, 2001 (available from www.rba.gov.au) clarifies that the Reserve Bank uses the following macroeconomic model for policy analysis: Meredith Beechey, Nargis Bharucha, Adam Cagliarini, David Gruen, Christopher Thompson, "A small model of the Australian macro economy", *Reserve Bank of Australia Research Discussion Paper* 2000-05.

European Central Bank (ECB)
· $d_{12/00}$: [(2) **+0.5**, 12/2000; and (2) **+1**, 1/2001] Since December 2000, conditional inflation and output projections for the medium term have been published twice a year in the June and December *Monthly Bulletin*. In addition, publication of a structural macroeconomic model used by the ECB for policy analysis: G. Fagan, J. Henry and R. Metez, "An Area-Wide Model (AWM) for the Euro Area", *European Central Bank Working Paper* 42, January 2001.
· $d_{11/01}$: [(4) **+0.5**, 11/2001] Since November 2001, monetary policy meetings of the Governing Council have taken place once a month, followed by a press conference in which the President provides an introductory statement with an explanation of the policy decision. Before that, there were two policy meetings every month, only the first of which was followed by such a press conference.

Bank of Japan (BoJ)

· $d_{01/98}$: [(1) and (3) +?, 01/1998] An amendment of the Bank of Japan Law specifies that monetary policy "shall be aimed at, through the pursuit of price stability, contributing to the sound development of the national economy" (Art. 2), it affirms the autonomy of the Bank of Japan over monetary policy (Art. 3.1) and increases its effective independence. In addition, the Bank is required to be transparent about "the content of its decisions, as well as its decision making process" (Art. 3.2), and in particular, publish the minutes and transcripts of the monetary policy meetings of the Policy Board (Art. 20) and submit a semi-annual report on monetary policy to the Diet (Art. 54.1). The amendment entered into force April 1, 1998, but the regular monetary policy meetings by the Policy Board and the publication of minutes started in January 1998.

· $d_{10/00}$: [(2) +**0.5**, 10/2000] Since October 2000, the semiannual *Outlook and Risk Assessment of the Economy and Prices* has contained the Policy Board's short-term conditional forecasts for inflation and output.

· $d_{03/01}$: [(5) -**0.5**, 3/2001] On March 19, 2001 the main operating target was changed from the average uncollateralized overnight call rate (which had been effectively zero since February 12, 1999) to the outstanding balance of the current accounts at the Bank. In contrast to the previous target, it is a very rough range and the targeted variable shows significant fluctuations within it, but there are no explanations for these control errors.

Note that $d_{03/01}$ is the only indicator that solely pertains to a reduction in transparency. To facilitate the interpretation of the results, $d_{03/01}$ changes from 1 to 0 on 03/01, so that the sign on $d_{03/01}$ can be interpreted in the same way as the signs on the transparency increases.

Reserve Bank of New Zealand (RBNZ)

· $d_{03/99}$: [(4) +**1.5** and (5) +**1**, 3/1999] Before March 1999, the formal operating target was the daily settlement cash target, but there were no explanations of policy decisions of it and there was no evaluation of its achievement. Since the introduction of the Official Cash Rate in March 1999, explanations have been provided for formal policy changes (see http://www.rbnz.govt.nz). In addition, since March 1999 the quarterly *Monetary Policy Statement* has included three-year ahead unconditional projections for the 90-day bank bill rate, which is very closely related to the Official Cash Rate and therefore serves as a policy inclination. Also, the Official Cash Rate is nearly perfectly controlled (e.g. see Andy Brookes and Tim Hampton, 'The Official Cash Rate one year on', *Reserve Bank Bulletin*, June 2000), thereby yielding greater operational transparency.

· $d_{12/00}$: [(4) +**0.5**, 12/2000] Since December 2000, explanations for policy decisions have also been provided when it was decided not to adjust the Official Cash Rate (see http://www.rbnz.govt.nz).

Note that one event has not been included due to considerable uncertainty about the precise timing, namely: [(2) +**0.5**, 2002?] Data on capacity utilization have become publicly available in Excel spreadsheets that accompany the quarterly *Monetary Policy Statements* on the web site (www.rbnz.govt.nz), at least since June 2002.

Swedish Riksbank (SRB)

· $d_{03/97}$: [(2) +?, 03/1997] Publication of inflation forecasts in the quarterly Inflation Report since March 1997.

· $d_{01/99}$: [(1) **+1**, 1/1999] Amendments (effective from January 1999) to the *Constitution Act* and the *Sveriges Riksbank Act* clarify the Riksbank's institutional independence and main objective. In particular, "The Riksbank is responsible for monetary policy. No authority may determine the decisions made by the Riksbank on issues relating to monetary policy." *Constitution Act*, Chapter 9, Art. 12; "Members of the Executive Board may not seek nor take instructions when they are fulfilling their monetary policy duties." *Sveriges Riksbank Act*, Chapter 3, Art. 2; and, "The objective of the Riksbank's operations shall be to maintain price stability. In addition, the Riksbank shall promote a safe and efficient payment system." *Sveriges Riksbank Act*, Chapter 1, Art. 2.

· $d_{10/99}$: [(4) **+0.5**, 10/1999; and (2) **+0.5**, 12/1999] Starting in October 1999, the announcement of every policy decision has been accompanied by an explanation, whereas previously this was only the case for adjustments in the policy instrument. And since December 1999, data on many economic variables, including capacity utilization (in the form of econometric estimates of the output gap), have become available for downloading from the Riksbank web site (www.riksbank.com) in Excel spreadsheets accompanying the quarterly *Inflation Report*.

· $d_{03/00}$: [(5) **+1**, 3/2000] Since 2000, the March *Inflation Report* has included a discussion of past inflation forecast errors, revealing macroeconomic transmission disturbances, and an evaluation of the inflation outcome over the last three years, including an account of the contribution of monetary policy.

· $d_{03/02}$: [(4) **+1**, 3/2002; and (3) **+1**, 5/2002] A policy inclination indicating the likely future adjustment of the policy rate was introduced in the policy decision statement in March 2002. In addition, the minutes sometimes noted attributed reservations against the policy decision, but it was not clear whether these were (the only) dissents. This was clarified in May 2002, so that the minutes now effectively provide attributed voting records.

Swiss National Bank (SNB)

· $d_{12/99}$: [(1) **+1,** (2) **+0.5** and (5) **-0.5**, 12/1999; and (1) **+0.5**, 1/2000] A quantitative definition of price stability was specified in December 1999, namely an inflation rate as measured by the national consumer price index of less than 2% per annum. Furthermore, since December 1999, an inflation forecast for the three ensuing years has been presented in the June and December *Quarterly Bulletin* (in French and German only) and at the half-yearly media news conference (in English). In addition, since the introduction of an operational target range of 100 basis points for the three-month LIBOR rate in December 1999, the operating target has still been graphically evaluated in the *Annual Report*, but there are no longer explanations for control errors in the form of significant fluctuations within the wide target range. Finally, a constitutional amendment, effective from January 2000, enshrines the Bank's independence: "As an independent central bank, the Swiss National Bank shall pursue a monetary policy serving the interests of the country as a whole", *Federal Constitution* Art. 99(2).

Bank of England (BoE)
· $d_{06/97}$: [(1) **+?**, 1997] The Bank of England (BoE) was granted operational independence in May 1997 and the new Monetary Policy Committee (MPC) made its first interest rate decision in the next month.
· $d_{04/99}$: [(2) **+1**, 4/1999] Extensive documentation on the Bank's policy models is provided in *Economic Models at the Bank of England*, April 1999 (see also the September 2000 Update), and the computer code of the macroeconometric model is available from www.bankofengland.co.uk.
· $d_{08/99}$ [(5) **+0.5**, 8/1999)] Since 1999, there has been a discussion of the Monetary Policy Committee's forecasting record for inflation and output in the August *Inflation Report*.
Note that one event has not been included due to considerable uncertainty about the precise timing, namely: [(2) **+0.5**, 2002?] Time series for relevant macroeconomic variables, including the output gap have become available from the Bank of England web site.

Federal Reserve (Fed)
· $d_{02/94}$: [(4) **+?**, 1994] The Federal Reserve (Fed) first provided a prompt announcement of its Federal Funds rate decision in February 1994.
· $d_{05/99}$: [(4) **+1.5**, 5/1999] Since May 1999, an explanation of every policy decision has been provided at the time of announcement, instead of only in case of an adjustment of the policy instrument. Furthermore, an explicit phrase that describes the policy tilt has been included in the statement released after every policy meeting, which is further explained in the Federal Reserve Board Press Release "FOMC announced modifications of its disclosure procedures", January 19, 2000 (all available from www.federalreserve.gov).

A.2 Macroeconomic data

This section gives a detailed description of the macroeconomic data that were used for each central bank. In particular, it lists the quarterly data (in Section A.2.1) and the monthly data (in Section A.2.2) that was used for the policy rate i_p, short-term nominal interest rate i_s, long-term nominal interest rate i_l, medium-term nominal interest rate i_m, inflation π, and the output gap y, for each of the eight central banks in the sample.

A.2.1 Quarterly data

Policy Rate (end of quarter values, in percent)
RBA: Cash rate target, end of the month (www.rba.gov.au)
ECB: EONIA, end of the month, 1994-1998; monthly averages, 1999-2002 (www.ecb.int)
BoJ: Uncollateralized overnight call rates, end of month (www.boj.or.jp)
RBNZ: Overnight inter-bank cash average, end of the month (www.rbnz.govt.nz)
SRB: Repo rate since June 1994, end of the month; marginal rate before June 1994, end of the month (www.riksbank.com)
SNB: Three month libor rate, end of the month (www.snb.ch)
BoE: Repo (base) rate, end of the month (www.bankofengland.co.uk)
Fed: Federal funds rate, end of the month

(www.ny.frb.org/markets/statistics/dlyrates/fedrate.html)

Short-term Nominal Interest Rate (average over the last month of the quarter, in percent)
RBA: Average rate on money market (IMF, International Financial Statistics)
ECB: Three-month money market rate (Datastream)
BoJ: Call money rate (IMF, International Financial Statistics)
RBNZ: Money market rate (IMF, International Financial Statistics)
SRB: Call money rate (IMF, International Financial Statistics)
SNB: Money market rate (IMF, International Financial Statistics)
BoE: Overnight Interbank rate (IMF, International Financial Statistics)
Fed: Treasury bill rate (IMF, International Financial Statistics)

Long-term Nominal Interest Rate (end of quarter values, in percent)
RBA: 10-year Treasury bond, last month of the quarter (www.rba.gov.au)
ECB: 10-year Government bonds, monthly first day (www.ecb.int)
BoJ: 1992Q1-1998Q3, simple yield on 10-year TSE bonds with longest remaining maturity, end of the month; for 1998Q4-2003Q4, yield on newly issued 10-year government bonds, end of the month (www.boj.or.jp)
RBNZ: 10-year secondary market government bond yield, last day of the month (www.rbnz.govt.nz)
SRB: 10-year government bond yield, monthly average (www.riksbank.se)
SNB: CHF Obligationen der Eidgenossenschaft, last day of the month (www.snb.che)
BoE: Nominal 10-year yield on British government securities, end of the month (www.bankofengland.co.uk)
Fed: 10-year yield on treasury securities, last day of the month (www.ny.frb.org/markets/statistics/dlyrates/fedrate.html)

Medium-term Nominal Interest Rate (end of quarter values, in percent; utilized as instrument)
RBA: 3-year Treasury bond yield, last month of the quarter (IMF, International Financial Statistics)
RBNZ: 2-year secondary market government bond yield, last day of the month (www.rbnz.govt.nz)
BoE: short-term government bond yield, last month of the quarter (IMF, International Financial Statistics)
Fed: 3-year government bond yield, last month of the quarter (IMF, International Financial Statistics)

Inflation (annual inflation based on quarterly data)
Inflation is computed using the Consumer Price Index (IMF, International Financial Statistics), except for the ECB for which the HICP is used (Eurostat). To be precise: $\pi_t = (CPI_t/CPI_{t-4} - 1) \times 100$, using quarterly data.

Output Gap (based on quarterly GDP data)
The output gap is computed using quarterly data for Gross Domestic Product (OECD). To be precise:

$y = (GDP/HPtrend - 1) \times 100$, where $HPtrend$ is the trend based on the Hodrick-Prescott filter, calculated with GDP data for the period 1960-2004 (using E-views). The smoothing parameter is 1600.

A.2.2 Monthly data

The interest rate data is the same as the data used in the quarterly regressions. However, the output gap data are different as the quarterly GDP data are replaced by monthly industrial production data for the central banks for which this information is available (ECB, BoJ, SRB, BoE and Fed).

Inflation (annual inflation based on monthly data)
Inflation is computed using the Consumer Price Index (IMF, International Financial Statistics), except for the ECB for which the HICP is used (Eurostat). To be precise: $\pi_t = (CPI_t/CPI_{t-12} - 1) \times 100$.

Output Gap (based on monthly industrial production data)
The output gap is computed using monthly (seasonally adjusted) industrial production data (IMF, International Financial Statistics), except for the ECB for which Eurostat data is used. To be precise:
$y = (industrial\ production/HPtrend - 1) \times 100$, where $HPtrend$ is the trend based on the Hodrick-Prescott filter, calculated with industrial production data for the period 1960-2004 (using E-views), except for the ECB for which industrial production data was only available from 1985-2004. The smoothing parameter is 14400.

B Alternative selection strategies

Table B1. Summary of forward-looking results (conservative)

	i_p		i_s		i_l		F	R
RBA								
$d_{10/01}$: economic	**-0.83**	[0.00]	**-0.40**	[0.02]	0.03	[0.93]	+	0
ECB								
$d_{12/00}$: economic	0.41	[0.33]	-0.60	[0.14]	-1.61	[0.18]†	0	0
$d_{11/01}$: policy	**-2.03**	[0.00]	**-1.85**	[0.00]	**-1.79**	[0.06]†	+	+
EMU	-0.59	[0.30]	-0.64	[0.14]	-0.50	[0.75]†	0	0
BoJ								
$d_{01/98}$: political/proc.	-0.22	[0.36]†	-0.05	[0.67]†	-0.24	[0.23]	0	0
$d_{10/00}$: economic	-0.30	[0.40]†	0.12	[0.37]†	0.20	[0.47]	0	0
$d_{03/01}$: operational	**0.35**	[0.08]†	-0.01	[0.87]†	0.11	[0.69]	–	0
RBNZ								
$d_{03/99}$: policy/oper.	-0.05	[0.92]‡	-0.05	[0.92]‡	0.31	[0.22]	0	0
$d_{12/00}$: policy	**-2.10**	[0.00]‡	**-2.11**	[0.00]‡	-0.25	[0.41]	+	0
SRB								
$d_{03/97}$: economic	**0.61**	[0.00]	**0.55**	[0.00]	-0.37	[0.42]	–	0
$d_{01/99}$: political	0.44	[0.12]	**-1.05**	[0.00]	0.62	[0.25]	+	0
$d_{10/99}$: econ/policy	-0.03	[0.94]	-0.01	[0.97]	-0.32	[0.65]	0	0
$d_{03/00}$: operational	-0.52	[0.18]	0.10	[0.74]	0.02	[0.98]	0	0
$d_{03/02}$: proc/policy	**-0.45**	[0.09]	**0.46**	[0.01]	**-0.76**	[0.09]	?	+
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.68**	[0.00]	**0.35**	[0.01]	**-0.39**	[0.01]	?	+
BoE								
$d_{06/97}$: political	**0.29**	[0.06]‡	**0.51**	[0.10]	**-1.34**	[0.00]†	–	+
$d_{04/99}$: economic	-0.32	[0.39]‡	-0.56	[0.45]	0.02	[0.97]†	0	0
$d_{08/99}$: operational	-0.24	[0.48]‡	0.51	[0.47]	-0.21	[0.60]†	0	0
Fed								
$d_{02/94}$: policy	0.10	[0.57]	0.08	[0.74]	**1.69**	[0.00]	0	–
$d_{05/99}$: policy	**-0.33**	[0.02]	-0.17	[0.27]	-0.40	[0.14]	+	0

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the conservative settings using the forward-looking GUM in (4.1) for the sample period 1993Q1-2002Q4. For RBA i_l, RBNZ i_l, SNB i_l the selected specific model contained no significant current and forward-looking variables. Therefore, these results were replaced by the more reliable estimation results of the backward-looking model (which in case of RBA i_l and RBNZ i_l were the same). Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility (F) and reputation (R) is positive (+), negative (–), ambiguous (?) or not significant (0).

Table B2. Summary of forward-looking results (non-forced)

	i_p		i_s		i_l		F	R
RBA								
$d_{10/01}$: economic	**-0.95**	[0.01]	**-0.54**	[0.00]	-	†	+	0
ECB								
$d_{12/00}$: economic	-		-	†	-		0	0
$d_{11/01}$: policy	-		-	†	**-0.26**	[0.08]	0	+
EMU	-		-	†	**0.52**	[0.00]	0	-
BoJ								
$d_{01/98}$: political/proc.	**-0.46**	[0.04]‡	-	†	**-0.34**	[0.05]†	+	+
$d_{10/00}$: economic	-	‡	-	†	-	†	0	0
$d_{03/01}$: operational	0.35	[0.13]‡	-	†	-	†	0	0
RBNZ								
$d_{03/99}$: policy/oper.	-	†	-	†	-		0	0
$d_{12/00}$: policy	-	†	-	†	**0.54**	[0.03]	0	–
SRB								
$d_{03/97}$: economic	**0.47**	[0.00]	**0.57**	[0.00]	-		–	0
$d_{01/99}$: political	-		**-1.03**	[0.00]	**0.58**	[0.00]	+	-
$d_{10/99}$: econ/policy	-		-		-		0	0
$d_{03/00}$: operational	-		-		-		0	0
$d_{03/02}$: proc/policy	-		**0.48**	[0.01]	**-0.64**	[0.05]	–	+
SNB								
$d_{12/99}$: polit./econ./oper.	**-1.23**	[0.00]	**-1.67**	[0.00]	-		+	0
BoE								
$d_{06/97}$: political	-		**0.61**	[0.01]	**-2.18**	[0.00]	–	+
$d_{04/99}$: economic	-		-		-		0	0
$d_{08/99}$: operational	-		-		-		0	0
Fed								
$d_{02/94}$: policy	-		-		**1.78**	[0.00]	0	–
$d_{05/99}$: policy	-		-		**-1.30**	[0.00]	0	+

Note: Coefficient estimates (with p-values in brackets) for the transparency indicators $d_{MM/YY}$ in the specific model selected under the non-forced settings using the forward-looking GUM in (4.1) for the sample period 1993Q1-2002Q4. For ECB i_l and SRB i_l the selected specific model contained no significant current and forward-looking variables. Therefore, these results were replaced by the more reliable estimation results of the backward-looking model. Marked results indicate autocorrelation (‡) or only nonnormality/heteroskedasticity (†). The last two columns show whether the relation between transparency and flexibility (F) and reputation (R) is positive (+), negative (–) or not significant (0).

CHAPTER 4

The impact of transparency on inflation expectations

Abstract[1][2]

We investigate how the link between inflation and inflation expectations alters with increasing transparency. Our motivation stems from the belief that changes in the institutional features or operations of the central bank affect, first and foremost, the way that private agents form their expectations about the future behavior of the central bank, and only through them, inflation. To examine the link between inflation and inflation expectations, we apply the framework used by Levin et al. (2004) and make use of the recent development of quantitative measures for transparency. We find evidence that transparency helps fixing private sector inflation expectations.

1. Introduction

In a study undertaken by Blinder (2000) in which a group of central banks and academic economists were asked to rank those features that help, in their view, build credibility in monetary policy, transparency ranked fourth. Although admittedly not very different in terms of scores, central bank transparency was preceded by "history of honesty", "central bank independence" and "history of fighting inflation". Still, transparency has attracted a significant amount of attention in the past two decades, for the following reasons. First, the literature has been very concrete about the benefits of making central banks independent from government. When central banks began to acquire greater autonomy in setting and pursuing their objectives, there was automatically a greater need for accountability. Reasons of democratic legitimacy thus provided a political economy justification for greater transparency. Second, and this time from the point of view of the central bank, the three features deemed more important than transparency in Blinder's survey do not constitute choice variables for the central bank to act upon; they are either the result of its actions or imposed. In that respect, therefore, to the extent that the central bank wishes to help improve its credibility, the level of transparency is the first of these features it can act upon

directly. Finally, the establishment of the European System of Central Banks and the creation of the European Central Bank forced policymakers to reconsider the architecture that would help establish credibility.

Despite extensive discussions on the desirability of central bank transparency[3], economic literature does not always arrive at a unique conclusion on this issue. By means of an example, regarding the publication of forecasts produced by central banks, Buiter (1999) and Issing (1999) argue at opposite ends of the spectrum. Buiter argues in favour of their publication, on grounds of accountability, such that the public can evaluate the quality of monetary policy. Issing on the other hand, argues that to the extent that actual policy decisions are not entirely based on these predictions, their publication may be misleading. Similar "disputes" arise with reference to the publication of the minutes of meetings (and indeed their timing), or on whether decisions should be accompanied by press conferences.

Although transparency is certainly desirable for reasons of accountability, it is not the sole means to enhancing central bank credibility. Inevitably the merits of transparency can only be justified through empirical validation, enabled by the recent development of explicit indices for central bank transparency. Eijffinger and Geraats (2006) (EG) construct an index for nine major central banks based on the five aspects of central bank transparency identified by Geraats (2000) and allow for changes in the index for the period 1998-2002. Other attempts to capture various aspects of central bank transparency include those by Bini-Smaghi and Gros (2001), Siklos (2002), Chortareas et al. (2002a) and De Haan et al. (2004). The limited availability of data, however, makes the empirical investigation still problematic. Demertzis and Hughes Hallett (2007) calculate correlations between the EG index and the mean and standard deviation of inflation and the output gap and discover that while greater transparency does not affect the averages, it does affect the variability of these magnitudes. While greater transparency is beneficial to inflation, it appears to be detrimental to the output gap (although weak).[4] In the previous chapter, using the same index and based on a Taylor rule type of set-up it is shown that greater transparency reduces both the level of the short-term interest rate (thus increasing flexibility in monetary policy) and the long-term interest rate levels, thus enhancing authorities' reputation.[5]

We will argue in this chapter that any change in the institutional features or operations of the central bank affects the way private agents form their expectations about the future inflation. We thus attempt to check the effect of greater transparency on the way that expectations are formed, directly. We base our analysis on the work by Levin et al. (2004) who examine the impact of inflation targeting on the way that expectations are formed. They argue that if expectations are better pinned down in an inflation targeting regime, then the relation between expectations (for difference

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[3]Inter alia Jensen, (2002), Faust and Svensson (2002), Geraats (2002), Demertzis and Hughes Hallett, (2007).

[4]It is worth noting that the authors of the index appreciate themselves how sensitive these correlations are to changes in the measure of transparency (Eijffinger and Geraats, 2006). It is therefore, difficult to draw conclusions about the empirical relevance of transparency based on such indices.

[5]See also earlier attempts by Chortareas et al. (2003).

horizons) and current inflation is weaker. While Levin et al. classify countries in inflation targeters and non-inflation targeters, we use the aforementioned indices to classify countries according to their degree of transparency. The measure for expectations we use is from Consensus Forecasts. We examine whether attempts to increase transparency have accounted for the weaker link between inflation and inflation expectations. In that respect, we are therefore aiming to see how possible gains in central bank credibility are due to efforts undertaken for greater transparency. This does not, however, necessarily imply that transparency is the only way to increase credibility.

The chapter is organized as follows. Section 2 describes how inflation, inflation expectations, and central bank transparency have evolved since 1989. Section 3 then examines whether the level of transparency has an impact on the degree of anchoring of inflation expectations to the current level of inflation. Section 4 summarizes our main findings and concludes.

2. Inflation, expectations and transparency

Our analysis is based on the methodology by Levin et al. (2004) in which inflation and inflation expectations are related as follows:

(2.1) $$\Delta\hat{\pi}_t^q = \alpha + \beta\Delta\bar{\pi}_t + \varepsilon_t$$

The regressand $\Delta\hat{\pi}_t^q$ represents the first difference of inflation expectations q years ahead, formed at period t. The regressor $\Delta\bar{\pi}_t$ is the first difference of the three-year moving average of realized CPI inflation ending at and including time t. The argument the authors put forward is that as monetary regime changes help agents form their expectations, the link between inflation and expectations is weakened and the value of β tends to zero, and the more so for longer horizons. This is tested for countries that adopt inflation targeting regimes, while we will examine whether this is true for countries with more transparent central banks.

We describe the data for inflation and inflation expectations and how they have changed from 1989 till 2004. To identify the evolution of inflation and inflation expectations we look at both the average, as well as the variability of these variables. In addition, we look at how the degree of transparency of central banks increased since 1998. We plot the way the EG index has changed from 1998 to 2002 for nine (groups of) countries.

2.1. The data

We present data for inflation and its expectations for eight industrialized countries and the Euro area. The countries in question (and their respective central banks) are Australia (RBA), Canada (BoC), the Euro area (ECB), Japan (BoJ), New Zealand (RBNZ), Switzerland (SNB), Sweden (SRB), the UK (BoE) and the US (Fed). Realized inflation is based on consumer price indices taken from the International Financial Statistics of the International Monetary Fund, (except for the ECB data which is from the OECD), presented in the form of a three-year moving average. Inflation expectations are taken from the Consensus Economic Forecasts for one, three, five and six-to-ten years ahead, with the exception of the Euro area where the one, two

Table 1. The development of inflation and inflation expectations

	AU		CAN		EURO		JPN		NZ		CH		SWE		UK		US	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
$\pi(3-year\ moving\ average)$																		
I	5	2.8	4.1	1.5	4.9	0.7	2.2	1.0	4.1	2.3	4.2	1.5	6.9	2.8	6.3	2.4	4.3	0.9
II	2.2	1.4	1.4	0.6	2.8	0.6	0.8	0.8	2.3	0.9	1.3	1.0	1.9	1.4	2.7	0.6	2.6	0.4
III	2.3	0.8	2.2	0.9	2.0	0.5	−0.5	0.5	1.8	1.0	0.8	0.5	1.2	1.1	2.2	0.7	2.4	0.7
$\pi^e(1)$																		
I	3.9	0.8	3.5	1.6	1.6	0.2	1.9	0.8	na	na	3.2	0.5	4.6	2.1	4.5	1.1	3.8	0.6
II	3.1	0.9	1.9	0.3	1.7	0.1	0.5	0.6	1.4	0.4	1.8	0.6	2.3	1.0	3.0	0.4	2.9	0.4
III	2.8	0.7	2.0	0.3	-	-	−0.4	0.3	2.1	0.2	1.2	0.3	1.9	0.3	2.3	0.1	2.3	0.3
$\pi^e(3)$																		
I	4.3	0.8	3.2	0.8	1.7*	0.1*	2.2	0.4	na	na	na	na	na	na	4.4	0.5	4.0	0.3
II	3.2	0.5	2.0	0.2	1.8*	0.1*	1.2	0.6	1.7	0.1	1.9	0.1	2.4	0.5	3.1	0.5	3.1	0.4
III	2.6	0.1	1.9	0.1	-	-	0.4	0.5	1.9	0.3	1.6	0.1	2.0	0.1	2.4	0.2	2.5	0.2
$\pi^e(5)$																		
I	4.0	0.7	3.2	0.7	1.8	0.0	2.2	0.4	na	na	na	na	na	na	4.1	0.4	3.9	0.3
II	3.0	0.7	1.9	0.2	1.9	0.0	1.5	0.4	1.7	0.1	2.0	0.2	2.3	0.5	2.9	0.3	3.0	0.4
III	2.5	0.1	1.9	0.1	-	-	0.7	0.3	2.0	0.2	1.5	0.1	1.9	0.1	2.4	0.1	2.4	0.2
$\pi^e(6-10)$																		
I	4.1	0.7	3.0	0.6	-	-	2.2	0.4	na	na	na	na	na	na	3.9	0.3	3.9	0.2
II	3.0	0.5	2.0	0.3	1.9	0.1	1.4	0.5	1.8	0.1	1.9	0.2	2.4	0.5	3.0	0.4	3.0	0.3
III	2.5	0.1	2.0	0.1	-	-	0.8	0.4	2.0	0.2	1.6	0.1	2.0	0.0	2.4	0.1	2.5	0.1

Source: IMF, OECD, Consensus Economics and ECB.
Note: *two-years ahead.

(instead of three) and five years ahead horizons are the quarterly data provided by the ECB itself.[6] Consensus inflation expectations are measured only twice a year, in April and October. We assume that the April measures represent inflation expectations in the first half of the year while the October measures are representative of inflation expectations during the second part of the year. The data period ranges from the second half of 1989 till the first half of 2004.[7]

Table 1 summarizes the evolution of the data, in terms of the mean (μ) and standard deviation (σ) of the aforementioned variables for three distinct periods. We have split the data in three periods of equal length to help summarize them: period I ranges from the second half of 1989 till the first half of 1994, period II then runs till the first half of 1999, and period III ends at the first half of 2004. Inflation expectations data for the ECB refers to a shorter period and is therefore split in two parts. Period I: 1999S1-2001S2, and period II: 2002S1-2004S1 for the six-to-ten years ahead inflation expectations data and period I: 1999Q1-2001Q4, and period II: 2002Q1-2004Q4 for the other inflation expectations horizons.

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[6]We have used quarterly data for the ECB when possible because it contains more information.

[7]See Appendix A for a detailed description of the inflation and the inflation expectations data and a comment on the bias that survey data may possibly contain.

Table 1 shows that, as a general trend, both the mean as well as the standard deviation of realized inflation have decreased during the period in question and for all countries. This change in inflation is the largest when comparing the first half of the nineties to the second. Canada and Australia are the only countries which experienced a reversal in the decreasing trend for their mean after the second period.

The general trend in inflation expectations is in line with that for realized inflation. Both the mean and the variability of inflation expectations decreased throughout the whole period. Canada's experience constitutes again an exception. Its inflation expectations decreased from period I to II, but stabilized thereafter. Interestingly, New Zealand was also faced with slightly increasing expectations across the sample for all horizons, despite it being an inflation targeter, which, generally thought, produces lower expectations.[8] The level and variability of inflation expectations in the Euro area have not changed much in the five-year period examined.

2.2. Central bank transparency

As mentioned earlier, there have been a number of attempts to measure how transparent central banks are. Using the index constructed by Eijffinger and Geraats (2006), we show changes in the degree of transparency in the period from 1998 to 2003. Figure 1 provides an overview of the development of the scores for total central bank transparency for the nine banks.[9]

Most banks have experienced increases in transparency, but they differ both in terms of the specific aspects that they had changed, as well as the timing of these changes. The average score of the nine banks examined increased from 8.9 at the start of the period to 10.7 at the end. Starting in 1998, the BoE was the most transparent central bank with a score of 11 out of 15, closely followed by the BoC and the RBNZ. The SNB had the lowest level of transparency and remained at this position at the end of the sample period, although at a higher absolute level of transparency. The BoC and the BoJ ended at the same level of transparency as they had started with whereas all other central banks saw their total level of transparency increase, with the RBNZ and the SRB having the highest score of 14 out 15 in 2002. We attempt next to link the level of transparency to the way changes in inflation expectations are linked to changes in realized inflation.

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[8]This increase is perhaps not surprising given that its target changed from 0-2% in 1990 to 0-3% in 1997 and 1-3% in 2002. We thank an anonymous referee for pointing this out to us.
[9]See Appendix B for a detailed description.
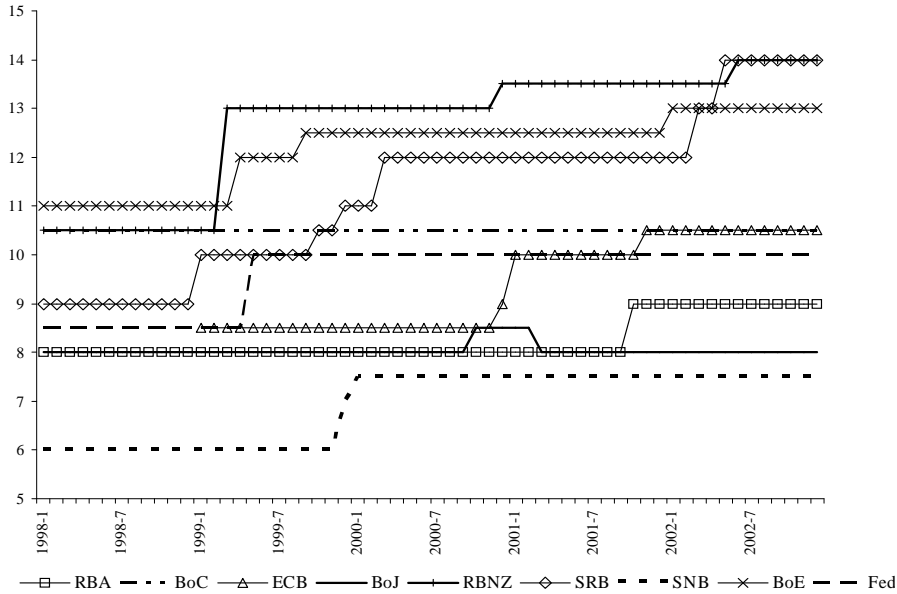
Figure 1. Eijffinger and Geraats index of transparency (1998-2002)

3. Transparency and expectations

We apply Levin et al.'s (2004) methodology in three ways. First, we perform a panel regression in which we group countries according to their degree of transparency. Second, we carry out a country-specific analysis in which we test whether particular instances of changes in transparency have had a significant impact on the relationship between the changes in inflation expectations and the changes in realized inflation. Finally, we re-group the results by Levin et al. on inflation persistence, according to the level of transparency indicated by the EG index.

3.1. Panel analysis

We use panel data to analyze the link between expectations, inflation and central bank transparency. Levin et al. (2004) distinguish between countries based on whether they follow an inflation targeting regime. We argue that the concept of central bank transparency is broader than inflation targeting alone, as the existence of a quantitative target is just one component of the measure. We expect therefore, that more transparent central banks will have a better ability to anchor inflation expectations, thus weakening their relationship with inflation. We investigate whether this is true by separating countries into two groups of "low" and "high" transparency, based on countries' score in various indices. A country that scores higher than two thirds of

Table 2. Estimates of β in equation (3.1) based on the EG index

	Low EG Index SNB (6.9), BoJ (8), RBA (8.2), ECB (9.4), US (9.7)		High EG Index BoC (10.5), SRB (11.4), BoE (12.2,)RBNZ (12.8)	
	β		β	
$q = 1$	0.04*	[0.06]	-0.09*	[0.01]
$q = 3^1$	0.09*	[0.02]	-0.03*	[0.07]
$q = 5$	0.09*	[0.00]	-0.03	[0.28]
$q = 6-10$	0.11*	[0.00]	-0.01	[0.68]

Note: p-values in square brackets.[101]two-year ahead inflation for the ECB. *Significant at 10 percent confidence level.

the maximum score is classified as one of "high" transparency, and "low" otherwise. We thus estimate the following panel data equation:

$$(3.1) \qquad \Delta\hat{\pi}^q_{j,t} = \alpha_j + \beta\Delta\bar{\pi}_{j,t} + \varepsilon_{j,t}$$

where now $j = ($"high", "low"$)$. We expect that the high transparency group will have a lower value for β, and that the relationship weakens for longer horizons. We apply the EG index as it constitutes a very comprehensive examination of all central bank characteristics. Table 2 gives an overview of the results for the slope parameter and its significance.

The results show that the value of β is positive and significant in all instances for the low transparency groups, which indicates that inflation expectations follow actual inflation. The value of β is lower for all horizons for the highly transparent group. This is an indication that countries that invest in transparent monetary policy institutions benefit from having better anchored expectations of inflation. We repeat the same exercise for three other transparency indices by Bini-Smaghi and Gros (2001), Siklos (2002) and De Haan et al. (2004) as well as experiment with different cut-off values for the splitting of the countries into high and low transparency groups. The results (available on request) support the finding that β is higher for the low transparency group. Another result that we can deduce from Table 2 is that the positive relationship between changes in inflation expectations and changes in realized inflation that we found for the low transparency group is a bit weaker for the relatively short inflation expectations horizon. One possible explanation for this observation is that it is likely that relatively short run inflation expectations react more to other factors, e.g. output shocks, than to past inflation. In contrast, longer term inflation expectations are probably based upon information about past inflation performance and what one expects for the future because shocks are more difficult to predict. We perform next the same analysis for each country individually, examining how (and whether) institutional changes that enhanced transparency during the 90s, have also affected the relationship between inflation and inflation expectations.

3.2. Country-specific analysis

We carry out a country-specific analysis to check whether distinct institutional changes that have contributed to an increase in transparency had a significant impact on the way inflation expectations follow actual inflation. Based on Chapter 3 Appendix A.1, Tomljanovich (2007), Coppel and Connolly (2003), Mishkin and Posen (1997), and Heikensten and Vredin (2002) we take into account all changes that have occurred since 1989, described in detail for the nine central banks in Appendix B. We now perform the following regression:

$$(3.2) \qquad \Delta \hat{\pi}_t^q = \alpha + \beta \Delta \bar{\pi}_t + \sum_{i=1}^{n} \gamma_{i,t} \left(D_{i,t} * \Delta \bar{\pi}_t \right) + \varepsilon_t$$

where n represents the number of institutional changes. Dummy D_i takes the following values:

$$D_i = \left\{ \begin{array}{l} 0 \text{ for } t = 1...k_i - 1 \\ 1 \text{ for } t = k_i...T \end{array} \right.$$

and k_i is the timing of institutional change i. We drop subscript j for convenience, as the regressions are now performed for the nine central banks individually. For changes that have taken place consecutively in one year, we have timed the dummy to coincide with the first, but the term may very well capture a combined effect. We expect γ_i to be negative, so that increases in the level of transparency weaken the link between inflation and expectations (i.e. $\beta > \beta + \gamma_i$) and thus decrease the degree to which inflation expectations are fixed.[11] We have adopted a general-to-specific approach in the sense that we introduce a dummy for all institutional changes listed in Appendix B to start with, dropping every time the ones that do not have a significant impact at any horizon. The Wald-test (a F-test) checks for the joint significance of the dummy variables. Table 3 gives an overview of the results, reporting the significant institutional changes only and showing the dummies with the largest impact on anchoring inflation expectations first.

We first present a number of general comments and then discuss some countries in greater detail. We observe that a number of countries have a positive and significant value for β at some horizons, and therefore a strong link between changes in inflation and changes in inflation expectations. However, some countries appear to have benefited from actions to increase their degree of transparency in the sense that this relationship is reversed by negative and significant $\gamma(s)$. Canada has very clearly benefited from introducing a regime of inflation targeting, while Sweden has clearly benefited from other institutional changes. New Zealand was an inflation targeter during the whole period and appears to have had well anchored inflation expectations to start with. The introduction of inflation targeting in the UK at the end of 1992, did not appear to have a significant impact. The UK has an insignificant relationship

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[11]We test for autocorrelation with the Langrange-Multiplier F-test. Those regressions that reject the hypothesis of no autocorrelation (p-value < 0.10) are re-estimated with extra lags of the dependent variable, $\Delta \hat{\pi}_t^q$.

Table 3. Transparency and anchoring inflation expectations

			$\hat{\pi}^{(1)}$		$\hat{\pi}^{(3)}$		$\hat{\pi}^{(5)}$		$\hat{\pi}^{(6-10)}$	
RBNZ	(14)	β	0.05	[0.87]	-0.04	[0.45]	0.05	[0.43]	0.04	[0.51]
		γ_{2000}	-0.22	[0.74]	-0.55*	[0.01]	0.17*	[0.06]	0.09	[0.22]
		γ_{2002}	-0.44	[0.22]	0.14	[0.56]	-0.35*	[0.01]	-0.19*	[0.06]
		γ_{1999}	0.02	[0.97]	0.49*	[0.00]	-0.18*	[0.06]	-0.11	[0.15]
		Wald		[0.10]		[0.01]*		[0.01]*		[0.06]*
SRB	(14)	β	-0.25*	[0.06]	0.46*	[0.01]	0.27*	[0.06]	0.63*	[0.00]
		γ_{1997}	-0.01	[0.94]	-0.66*	[0.00]	-0.25*	[0.06]	-0.59*	[0.00]
		γ_{2002}	0.63*	[0.07]	0.31*	[0.00]	0.07	[0.53]	0.04	[0.72]
		Wald		[0.16]		[0.00]*		[0.08]*		[0.01]*
BoE	(13)	β	-0.06	[0.19]	-0.06	[0.62]	-0.07	[0.31]	-0.05	[0.12]
BoC	(10.5)	β	1.12*	[0.01]	-0.29*	[0.09]	0.01	[0.95]	-0.07	[0.34]
		γ_{1991}	-1.24*	[0.01]	0.32*	[0.11]	0.01	[0.93]	0.16	[0.15]
		γ_{1996}	0.01	[0.98]	-0.14	[0.33]	-0.22*	[0.06]	-0.31*	[0.05]
		γ_{2001}	0.24	[0.26]	0.25*	[0.04]	0.36*	[0.00]	0.24	[0.12]
		Wald		[0.04]*		[0.00]*		[0.00]*		[0.02]*
ECB	(10.5)	β	-0.17*	[0.07]	0.01[1]	[0.94]	0.03	[0.44]	na	-
		γ_{2003}	0.78*	[0.08]	0.16[1]	[0.49]	-0.03	[0.50]	na	-
Fed	(10)	β	0.02	[0.82]	0.06	[0.31]	0.10*	[0.01]	0.04	[0.25]
RBA	(9)	β	0.01	[0.98]	0.24*	[0.01]	0.05	[0.67]	0.12	[0.13]
BoJ	(8)	β	0.41*	[0.00]	0.16	[0.42]	0.25	[0.32]	0.49*	[0.00]
		γ_{1998}	-0.75*	[0.00]	-0.45*	[0.04]	-0.27	[0.36]	-0.26	[0.39]
		γ_{2000}	0.65*	[0.00]	1.52*	[0.00]	0.54	[0.13]	1.08*	[0.03]
		Wald		[0.00]*		[0.01]*		[0.23]		[0.06]*
SNB	(7.5)	β	0.04	[0.71]	-0.35*	[0.10]	-1.22*	[0.03]	-1.07*	[0.01]
		γ_{1999}	0.10	[0.78]	0.44*	[0.03]	1.61*	[0.06]	1.24*	[0.03]

Source: see Appendix A.

Note: Scores based on the EG 2002 index; p-values in square brackets. Results are based on Newey-West standard errors. [1]Two year ahead inflation. *Significant at 10 percent confidence level.[12]

between changes in inflation expectations and changes in realized inflation, indicating well anchored inflation expectations throughout the whole period.

3.3. Inflation persistence

Levin et al. (2004) also examine whether inflation targeting countries have experienced less inflation persistence. They show that those countries that follow a regime of inflation targeting exhibit lower inflation persistence than the rest. Similarly, we search whether this pattern is also applicable to countries that have higher degrees of transparency. Levin et al. (2004) make a distinction between core CPI (without food

and energy prices) and total CPI and estimate a univariate autoregressive process for inflation in the following form.[13]

(3.3) $$\pi_t = \mu + \sum_{j=1}^{k} \alpha_j \pi_{t-j} + \varepsilon_t$$

The authors then present two ways of testing for the existence of a unit root.[14] First, they derive a scalar measure of persistence in the form of the largest autoregressive root, ρ, defined as the largest root of the following characteristic equation.

(3.4) $$\lambda^k - \sum_{j=1}^{k} \alpha_j \lambda^{k-j} = 0$$

The rational is that this captures the size of the impulse response $\frac{\partial \pi_{t+j}}{\partial \varepsilon_t}$, as j increases. Applying Stock's (1991) method, the authors get an estimate for the unbiased median and an upper 95th percentile (the upper bound of a two-sided 90% confidence interval) for the largest autoregressive root, estimated over 1994:Q1-2003:Q2. However, since the largest autoregressive root may be unrepresentative of the dynamics in the series, they consider as an alternative measure, the sum of the autoregressive coefficients,

(3.5) $$\alpha = \sum_{j=1}^{k} \alpha_j$$

and by using the "grid bootstrap" technique by Hansen (1999), construct the confidence intervals of the t-statistic

(3.6) $$t = \frac{\hat{\alpha} - \alpha}{SE(\hat{\alpha})}$$

Again they report the unbiased median and the value for the upper 95th percentile estimate. A value less than unity for the latter implies that a unit root can be rejected and therefore, the inflation series is white noise (at the 5 percent significance level for a one-tailed test). Our expectation is that inflation in countries having transparent central banks will fail to reject white noise processes. Table 4 gives an overview of

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[13]The error term ε_t is uncorrelated, homoskedastic and random. The amount of autoregressive lags, k, is determinded by the Akaike information criterion with a maximum lag order of 4.

[14]It is worth noting that for $k = 1$ we can re-write equation (3.3) as follows:

$$\pi_t = \mu + \alpha \pi_{t-1} + \varepsilon_t$$
$$\Delta \pi_t = \alpha \Delta \pi_{t-1} + \eta_t$$

Parameter α will not be significant unless inflation is highly persistent. This is not dissimilar to equation (2.1), if one assumes that the consensus forecast applied is a good proxy for the unbiased forecast of π_t for the given horizon, and the moving average of inflation captures the same information as the first inflation difference. Both specifications therefore, are designed to test for inflation persistence.

Table 4a. Persistence of inflation (based on ρ)

		Core CPI		Total CPI	
	Score	Median	Upper 95th perc.	Median	Upper 95th perc.
RBNZ	(14)	0.24*	0.60	0.25*	0.61
SRB	(14)	0.16*	0.54	0.04*	0.44
BoE	(13)	0.33*	0.68	0.06*	0.45
BoC	(10.5)	0.27*	0.63	-0.22*	0.21
ECB	(10.5)	0.84	1.06	0.87	1.06
Fed	(10)	1.04	1.10	0.54*	0.86
RBA	(9)	0.70	1.02	0.47*	0.80
BoJ	(8)	0.82	1.05	0.72	1.03

Source: Levin et al. (2004), part of table 3 p.59, based on OECD data.[16]
Note: No information on Switzerland available. *indicates failure to accept a unit root.

Table 4b. Persistence of inflation (based on $\Sigma\alpha_j$)

		Core CPI		Total CPI	
	Score	Median	Upper 95th perc.	Median	Upper 95th perc.
RBNZ	(14)	0.43*	0.72	0.44*	0.73
SRB	(14)	0.44*	0.70	0.28*	0.58
BoE	(13)	0.50*	0.77	0.34*	0.64
BoC	(10.5)	0.45*	0.73	0.12*	0.46
ECB	(10.5)	0.88	1.08	0.76	1.24
Fed	(10)	1.03	1.16	0.36*	0.87
RBA	(9)	0.77	1.05	0.59*	0.85
BoJ	(8)	0.81	1.10	0.5	1.14

Source: Levin et al. (2004), part of table A2 p.79, based on OECD data.
Note: No information on Switzerland available. *indicates failure to accept a unit root.

the persistence estimates (for both tests). Note that this table is taken directly from Levin et al. (2004)[15], but countries are rearranged according to the EG 2002 index scores for their central banks, in a descending order of transparency.

The two persistence tests, reported in Tables 4a and 4b, produce identical results. We see that for countries that score high in the transparency index the unit root in inflation can be rejected. These countries exhibit lower persistence for both measures of inflation. For the Fed and Reserve bank of Australia the unit root for total CPI is also rejected. Also it is worth mentioning that although Canada and the Euro area have identical transparency scores at the end of the period (reported here), the Bank of Canada scores 10.5 on average across the whole sample, whereas the ECB scores 9.4 and will therefore experience greater inflation persistence.

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[15]Inflation is the quarterly percentage change in the price index. There was no information on Switzerland available.

4. Summary and conclusions

Inflation and inflation expectations have followed a declining trend over the past 15 years. At the same time, a number of central banks have made considerable efforts to become more transparent. The rationale behind such attempts was to allow for expectations to be driven by the monetary authorities' commitment to alleviate the effects of shocks, rather than the affected level of inflation itself. In achieving that, the monetary policy authorities' task of cushioning shocks is much facilitated. The question that we have asked in this chapter is whether these observations were a coincidence or whether these apparent efforts to increase transparency were, at least in part, responsible for the weakening of the relation between inflation and expectations.

Following the approach by Levin et al. (2004) we have analyzed the relation between the two variables to the changes of the level of transparency in a number of ways. We find that those countries that are associated with lower levels of transparency experience a significant, positive link between the two variables. This is not the case for the countries with higher levels of transparency. We also show that higher transparency is associated with less inflation persistence.

5. Appendix to Chapter 4

A Data

A.1 Inflation expectations

Data restrictions imply that sample periods are not the same for all countries. In what follows we describe the data available in detail.

RBA
$\hat{\pi}(1, 3, 5 \text{ and } 6\text{-}10)$: 1991s1-2004s1
Source: Consensus Economics

BoC, BoE, Fed
$\hat{\pi}(1, 3 \text{ and } 5)$: 1989s2-2004s1 (missing 2003s1)
$\hat{\pi}(6\text{-}10)$: 1990s1-2004s1 (missing 2003s1)
Source: Consensus Economics

ECB
$\hat{\pi}(1)$: 1999q1-2004q4
$\hat{\pi}(2)$: 1999q1-2004q4
$\hat{\pi}(5)$: 1999q1, 2000q1 and 2001q1-2004q4
Source: www.ecb.int/stats/prices/indic/forecast/html/table_hist_hicp.en.html
$\hat{\pi}(6\text{-}10)$: 2003s2-2004s1
Source: Consensus Economics

BoJ
$\hat{\pi}(1, 3)$: 1989s2-2004s1
$\hat{\pi}(5)$: 1989s2-2004s1 (missing 2001s1)
$\hat{\pi}(6\text{-}10)$: 1990s1-2004s1 (missing 2001s1)
Source: Consensus Economics

RBNZ
$\hat{\pi}(1, 3, 5 \text{ and } 6\text{-}10)$: 1995s1-2004s1
Source: Consensus Economics

SNB
$\hat{\pi}(1)$: 1989s2-2004s1 (missing 2003s1)
$\hat{\pi}(3, 5 \text{ and } 6\text{-}10)$: 1998s2-2004s1 (missing 2003s1)
Source: Consensus Economics

SRB
$\hat{\pi}(1)$: 1990s1-2004s1 (missing 2003s1)
$\hat{\pi}(3, 5 \text{ and } 6\text{-}10)$: 1995s1-2004s1 (missing 2003s1)
Source: Consensus Economics

Consensus Economics forecast data is the average of the expectations of a group of experts. These forecasts are likely to perform better than the individual forecasts that make the consensus. Although there will be some individuals that perform better,

they are difficult to identify a priori and their performance is not the same in each period. Pooling the forecasts deletes various behavior biases.

Batchelor (2001) compares, among other variables, inflation forecasts produced by the IMF and Consensus Economics, during the 90s. He finds that average forecasts were too high in both cases and the longer the forecast horizon the higher this bias. Although the mean absolute forecast error is higher in the Consensus Economics inflation forecasts, the root mean squared error is in all cases lower, which indicates that Consensus Economics forecasts were better suited to avoid large forecast errors. Nevertheless testing for differences in mean square errors, indicates that IMF inflation forecasts are significantly less biased. On the other hand, the Consensus Economics forecasts have a higher information content.

A.2 Inflation

Period: 1989s2-2004s1

RBA
Source: www.rba.gov.au
Quarterly data

BoC, BoJ, SNB, SRB, BoE and Fed
Source: IMF, International Financial Statistics inflation data
Monthly data

RBNZ
Source: IMF, International Financial Statistics inflation data
Quarterly data

ECB
Source: OECD, Main Economic Indicators
Monthly data

B Transparency changes (since 1989)

Table B Institutional changes

CB	Date	Source	Transparency change
RBA	01/1990	CC (2003)	Introduction of announcements for changes to the target cash rate. (This change is not used in the regressions because it occured prior to the inflation expectations data period we have.)
	08/1996	T (2007)	Formalization of inflation-targeting framework.
	10/2001	Chapter 3	The model is clarified.
BoC	02/1991	T (2007)	Inflation Targets first announced.
	07/1994	T (2007)	50 basis point operating band for overnight rate announced.
	05/1995	MP (1997)	Publication of monetary policy report.
	02/1996	T (2007)	Announcement of Official Overnight Rate target. Press release whenever change in band occurs, including explanation for change.
	01/2001	MP (1997)	Policy decision dates are from now on predetermined.
ECB	12/2000	Chapter 3	The June and December Monthly Bulletin contain conditional inflation and output projections for the medium term.
	01/2001	Chapter 3	Publication of a structural macroeconomic model used for policy analysis.
	11/2001	Chapter 3	All monetary policy meetings of the Governing Council (once a month) are followed by a press conference with an explanation of the policy decision. Previous to that there were two meetings each month of which only half were followed by a press conference.
	05/2003		Change in the inflation target from positive below 2% to an inflation rate of below, but close to, 2% over the medium term.
BoJ	04/1998	Chapter 3, T (2007)	Central Bank granted operational independence through the Bank of Japan Act. Publication of minutes and transcripts of monetary policy meetings and submission of a semi-annual report on monetary policy to the Diet.
	10/2000	Chapter 3	Short-term conditional forecasts for inflation and output by the Policy Board are part of the semiannual Outlook and Risk Assessment of the Economy and Prices.
	03/2001	Chapter 3	The main operating target changed from the average uncollateralized overnight call rate (which has been effectively zero since February 12, 1999) to the outstanding balance of the current accounts at the Bank. The latter is a very rough range and the targeted variable shows significant fluctuations within it, but there are no explanations for these control errors.

Table B Institutional changes (cont.)

CB	Date	Source	Transparency change
RBNZ	01/1989	T (2007)	Adoption of Inflation Targeting, via the Reserve Act of 1989. Operational independence also granted through the Act. (This change is not used in the regressions because it occured prior to the inflation expectations data period we have.)
	03/1990	MP (1997)	Introduction of Policy Target Agreements. (This change is not used in the regressions because it occured prior to the inflation expectations data period we have.)
	03/1999	Chapter 3	Explanations of policy changes are provided. In addition, unconditional projections of the 90-day bank bill rate (closely related to the Official Cash Rate) in the quarterly Monetary Policy Statement (policy inclination). Initially, there was opacity about control errors because there was no evaluation of the achievement of the daily settlement cash target. The main operating target changed to the Official Cash Rate, which is almost perfectly controlled.
	12/2000	Chapter 3	Explanations were provided for non-adjustement of the Official Cash Rate
	06/2002	Chapter 3	The quarterly Monetary Policy Statement is accompanied by data on capacity utilization in Excel spreadsheets on the website. (precise timing is not known)
SRB	03/1997	HV (2002)	Start of the publication of Inflation forecasts (in the quarterly inflation report).
	01/1999	Chapter 3	Amendments to the Constitution Act and the Sveriges Riksbank Act clarify the Riksbank's institutional independence and main objective.
	10/1999	Chapter 3	The announcement of every policy decision, not only adjustments, is explained.
	12/1999	Chapter 3	Data on many economic variables, including capacity utilization, can be downloaded from the Riksbank Website.
	03/2000	Chapter 3	Discussion of past inflation forecast errors, macroeconomic transmission disturbances, evaluation of inflation in the last three years (including an account of the contribution of monetary policy) are in the March Inflation Report.
	03/2002	Chapter 3	First time that there was a policy inclination that indicated likely adjustment of interest rates in the near future.
	05/2002	Chapter 3	Clarified who are the dissidents, so that the minutes effectively provide attributed voting records.

Table B Institutional changes (cont.)

CB	Date	Source	Transparency change
SNB	12/1999	Chapter 3	Price stability defined as an inflation rate of less than 2% per annum. The June and December Quarterly Bulletin and the half-yearly media news conference present an inflation forecast for the next three years. The policy target changes and explanations for control errors are not given anymore in the Annual Report.
	01/2000	Chapter 3	The SNB's independence is preserved with a constitutional amendment.
BoE	10/1992	T (2007)	Announcement of an explicit Inflation Target. Minutes of policy meetings released within six weeks instead of 30 years.
	06/1995	MP (1997)	The target has no longer got an actual range. From then on there is a point target of 2.5 percent, which has to be met on an ongoing basis.
	05/1997	Chapter 3, T (2007)	Bank of England Act led to operational independence and the immediate disclosure of policy decisions.
	06/1998	T (2007)	The minutes of Policy Meetings are made public within 15 days.
	04/1999	Chapter 3	Extensive documentation of the policy models and the computer code of the macro econometric model are made available.
	08/1999	Chapter 3	The August inflation report contains a discussion of inflation and output forecasting record of the Monetary Policy Committee.
	?/2002	Chapter 3	Bank of England web site contains time series of important macroeconomic variables (including output gap). (uncertainty about the precise timing, therefore we did not use this change)
Fed	02/1994	Chapter 3, T (2007)	The FOMC started announcing changes in its policy stance. Announcements about the target are made on the day of FOMC meeting, release of minutes with 6 weeks delay and transcripts with 5 years delay.
	05/1999	Chapter 3	Provision of policy decisions even in the case of non-adjustment. The statement that is released after each policy meeting includes an explicit phrase that describes the policy tilt.
	01/2000	T (2007)	Public statements after FOMC meetings have revised language (f.e. without ´neutral bias´).

Source: Chapter 3=Chapter 3, Appendix A.1, CC= Coppel and Connolly (2003), MP=Mishkin and Posen (1997), T=Tomljanovich (2007), HV=Heikensten and Vredin (2002). Tomljanovich (2007) gives an overview of transparency changes indicated by Coppel and Connolly (2003), Muller and Zelmer (1999), King (1997) and central bank Webpages.

CHAPTER 5

Actual versus perceived transparency: The case of the ECB

Abstract[1][2]

Central banks have become more and more transparent about their monetary policy making process. In the central bank transparency literature the distinction between actual and perceived transparency is often lacking. However, as perceptions are crucial for the actions of economic agents this distinction matters. We investigate the mismatch between actual and perceived transparency and its relevance by analyzing data of a Dutch household survey on the transparency of the European Central Bank (ECB). A discrepancy between actual and perceived transparency exists because of incomplete and incorrect transparency knowledge and other (psychological) factors. We find that respondents with relatively high transparency perceptions are more likely to have more trust in the ECB and better aligned inflation perceptions and expectations. Therefore, it might be beneficial for a central bank to increase transparency perceptions, either by improving its actual disclosure practices or by focusing on its transparency strengths in its communication policy.

1. Introduction

A worldwide trend among central banks is the increasing degree of transparency about their monetary policy making process. Central bank transparency is important because it is an instrument to keep independent central banks accountable for their actions. In addition, there are likely to be economic effects from central bank transparency.[3] For example, through improved credibility more transparency may lead to better anchored inflation expectations. This might make long-term interest rates and inflation more stable (which would result in more efficient investment and pricing decisions of firms) and easier to predict.

The distinction between *actual* and *perceived* transparency is not often made in the central bank transparency literature. Some first empirical proof of the existence

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[3]Chapter 2 provides a recent overview of the central bank transparency literature.

of a discrepancy between these two measures of transparency is given by De Haan et al. (2005). We show that there are two reasons for a disparity between actual and perceived transparency. First, knowledge about the actual transparency practice of central banks might be incomplete or incorrect. If this would be the only reason for a mismatch between actual and perceived transparency then it may be resolved relatively easily by improved communication. However, psychological factors (e.g. belief perseverance, sampling memories) are complicating the link between transparency knowledge and perceptions and are not so simply resolved.

It is important to analyze the manner in which transparency perceptions are being formed. First, misaligned transparency perceptions, through their effect on the actions of economic agents, could have an effect on economic outcomes. Second, independent central banks need to be transparent to be accountable for their actions. Bringing transparency perceptions in line with reality improves the degree to which the central bank can be held accountable.

The central bank transparency literature does not pay enough attention to the causes and consequences of misaligned transparency perceptions. We contribute in several ways to the transparency literature. First, we use psychological insights to explain a potential mismatch between actual and perceived central bank transparency. Second, by holding a questionnaire among the CentERpanel, which includes over 2000 Dutch households, we collect micro data on people's knowledge and perceptions of the transparency of the ECB. We use this data set to get more insight into the central bank transparency knowledge of the public at large and its determinants. In addition, we investigate to what extent knowledge about the ECB's monetary policy transparency is relevant for people's transparency perceptions and what role other factors might play. Furthermore, we test the relevance of transparency perceptions from an economic viewpoint empirically.

Figure 1 provides a visual summary of the expected causes and consequences of perceived central bank transparency, which we analyze in this chapter. Starting with the determinants of people's transparency perceptions, we show that their knowledge about the actual disclosure practices of the central bank is likely to influence their transparency perceptions of it. In addition, other (psychological) factors might be relevant for the formation of transparency perceptions. Thereafter, we move to the lower part of Figure 1 and analyze the transmission mechanism by which transparency perceptions might affect important economic variables, such as the inflation gap (the difference between perceived and actual inflation) and the credibility gap (the difference between expected and targeted inflation).[4] More specific this transmission mechanism works as follows. Higher perceived central bank transparency is one of the possible ways in which a central bank might improve its credibility. As a result of the higher trust in its monetary policy, inflation perceptions might be well aligned and inflation expectations might be in line with the inflation goal of the central bank.

We start the remainder of this chapter by theoretically explaining Figure 1 (Section 2). We clarify in more detail why a disparity between actual and perceived central bank transparency might exist and why it is relevant for a central bank to

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[4]We define trust as "...one's belief and expectation about the likelihood of having a desirable action performed by the trustee." (Das and Teng, 1998, p.494). Here the trustee is the European Central Bank. We use this definition of trust throughout the paper.

get more insight into people's transparency perceptions. Next, we test empirically for the hypothesized relationships by reading down Figure 1 from top to bottom. In Section 3 we discuss the data and survey methodology. Thereafter, in Section 4, we first provide more insight into the self-assessed and actual knowledge about the ECB's transparency (the first box in Figure 1: "Knowledge of central bank transparency") before looking into households' transparency perceptions in Section 5 (the second box in Figure 1: "Perception of central bank transparency"). Then, in Section 6, we analyze the relevance of investigating transparency perceptions by examining its relationship with the inflation gap and credibility gap via trust (boxes "trust" and "inflation gap and credibility gap" in Figure 1). Last, we conclude (Section 7).
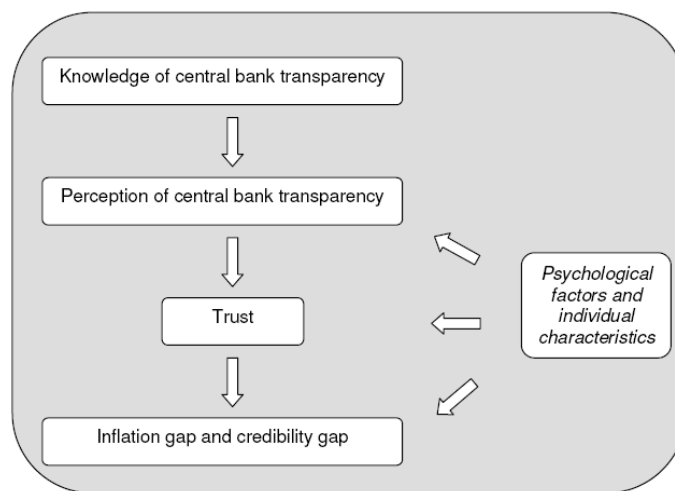
Figure 1. The causes and consequences of perceived central bank transparency

Note: Transparency knowledge influences transparency perceptions, which matter because through trust they affect the inflation gap and the credibility gap. Psychological and individual characteristics (e.g. degree of optimism, overconfidence, sampling memories) are relevant too in explaining the formation and the effects of transparency perceptions.

2. Theory

If one assumes that agents are rational, their transparency perceptions should be in line with actual transparency of the central bank. But in reality agents might not behave rationally, in the sense of knowing everything and processing information "correctly". Psychological insights are helpful to get a feeling why such a mismatch might exist.

"...Because psychology systematically explores human judgment, behavior and well-being, it can teach us important facts of how humans differ from the way they are traditionally described by economists..." (Rabin 1998: 11)

In the literature on central bank transparency it is often assumed that by giving more insight into the central bank's monetary policy the degree of *actual* central bank

transparency is enhanced. Throughout this chapter we define the actual transparency of a central bank as the degree to which it provides information about its monetary policy making process. One way in which actual transparency has been measured in the literature is by constructing indices based on disclosure practices of central banks, like whether they are open about their inflation goal and policy decisions. Several indices exist, such as the ones developed by Fry et al. (2000) and Eijffinger and Geraats (2006). It is however difficult to measure transparency because there is always some judgement involved in the construction of transparency indices. This concerns the inclusion as well as the weighing of various aspects of monetary policy making about which the central bank could be transparent. In this chapter we show that even when abstaining from problems in measuring actual central bank transparency, transparency *perceptions* might not be in line with the actual degree of central bank transparency.

2.1. Reasons for misaligned transparency perceptions

A mismatch between actual and perceived transparency may exist for two reasons: (1) psychological effects and (2) lack of knowledge or even incorrect central bank transparency knowledge.

2.1.1. Psychological reasons

The assumption that economic agents are rational, in the sense of knowing all the information provided and processing it in similar ways, is in our view too strong. Psychological factors may play a role explaining misaligned transparency perceptions and why perceptions differ between people.

First, a psychological finding is that people often disregard new information that is not in line with their previous beliefs (Rabin 1998: 26). Applied to the topic discussed here this means that if someone beliefs that the central bank is ambiguous about its monetary policy making practice then he or she may not pay sufficient attention to evidence pointing in the opposite direction. Information that confirms their prior belief is noticed more, so people are slow to adapt their beliefs.

Second, people might even suffer from what is called in psychology a *confirmation bias*, which causes some anchoring of beliefs. Now new information is interpreted in such a way that it confirms prior beliefs. This *belief perseverance* might worsen a central bank's possibility to improve its credibility through becoming more transparent. It will be difficult to teach people something new that is not in line with their previous beliefs. Although the central bank provides the same information to everyone, economic agents interpret information differently because of their dissimilar views on the environment (Babcock and Loewenstein 1997). Heuristics make it easier to perform complex tasks but they may lead people to make large mistakes (Tversky and Kahneman 1974).

Third, *sampling memories* may be relevant. As Camerer (2003) puts it:

"...much evidence suggests that human perception deviates systematically from the camera benchmark and memory deviates from the computer benchmark." (Camerer 2003: 595).

Although it is logical to use your memory to form perceptions, because memories are a sample of real life experience, it will most likely lead to "incorrect" perceptions. People give a disproportional weight to evidence that they can remember the best and the liveliest, even when better sources of information are available (e.g. Tversky and Kahneman 1973). How information is processed is likely to depend on the stock of old information that people possess. Exciting newspapers headings like "The central bank mumbles" are relatively easily retrieved from memory. In addition, media coverage is not random; unexpected steps of the central bank get relatively more attention. De Haan et al. (2004) find that information given by the central bank is distorted by the media. By comparing the Financial Times and the Frankfurter Allgemeine Zeitung they show that different newspapers give different signals based on the same information of the central bank. The public may base its opinion on this kind of media information as it can be obtained with little effort, whereas searching central bank publications and websites for information might be too cumbersome.

Last, *individual characteristics* may affect transparency perceptions. From psychological research (e.g. Babcock and Loewenstein 1997 and Malmendier and Tate 2005) we know that people are *overconfident* in what they believe and this overconfidence is pervasive. For example, individuals might get overconfident about their belief that the central bank is not transparent, which makes it more difficult to change these perceptions. As persons vary in their degree of confidence, the ease by which perceptions can be changed differs too. Another example of an individual characteristic that might be relevant is the extent to which one is *optimistic*. Intuitively one would think that those people that are relatively optimistic will have a more positive view on the degree to which the central bank is transparent.

2.1.2. Lack of transparency knowledge

The second factor that could cause a discrepancy between actual and perceived central bank transparency is the presence of lack of or even incorrect knowledge about the transparency practices of the central bank. For two reasons one could argue that misaligned transparency perceptions are not so relevant. First, by learning people will eventually form the correct perceptions. So the issue of misaligned perceptions is only a temporary problem. Second, central banks might be especially interested in economic experts (e.g. wage negotiators), as they might have a relatively strong influence on economic outcomes and they are more likely to get things right.

Let us first take a look at learning. Learning influences the degree to which the central bank is perceived to be transparent. People can learn in many different ways, which may lead to diverse perceptions. But learning can not fully evade the effect of psychological factors on the formation of transparency perceptions because people are often unaware of the psychological biases they suffer from (e.g. Babcock and Loewenstein 1997). For the central bank this might complicate getting perceptions in line with their actual transparency practice because it is not only a matter of raising transparency knowledge. The fact that people process information in different ways makes it even more difficult to construct a beneficial communication policy.

Economic experts work regularly with economic matters, so they are expected to learn faster as they would benefit more from it. Some believe that although the general public might have a low degree of knowledge about the central bank's monetary policy

Table 1. A transparency mismatch

Transparency ranking	Actual transparency	Perceived transparency
1	Bank of England	US Federal Reserve
2	European Central Bank	Deutsche Bundesbank
3	US Federal Reserve	European Central Bank
4	Deutsche Bundesbank	Bank of England

Note: Central banks are ranked according to their degree of transparency. The "actual transparency" column is based on the disclosure indicator of De Haan and Amtenbrink in De Haan et al. (2005, Table 4.2, p.101). The "perceived transparency" column is based on De Haan et al. (2005, Table 4.4, p.102).

and may possess misaligned transparency perceptions, this does not hold for economic experts. As economic experts (e.g. wage setters, economic advisors and journalists) might be making and influencing a large part of economic decisions that are made, the central bank might have a special interest in aligning the experts' transparency perceptions with the actual practice of the central bank.

The idea that experts are prone to misalignments can be dismissed based on psychological findings. Although learning might improve perceptions, psychological evidence shows that even experts suffer from biases and their beliefs might depart from reality (e.g. Babcock et al. 1996). It might be that for experts, who are confronted with a lot of information, it is even easier to, unconsciously, distill information that is in line with their previous beliefs. And it is more likely that people are overconfident when they regard themselves experts in a particular field. By combining some of the findings of De Haan et al. (2005), we can illustrate that expertise does not solve the transparency mismatch (Table 1). Financial experts were asked to rank central banks according to their level of transparency. The US Fed was perceived to be much more transparent than the Bank of England, while a transparency measure based on the actual disclosure practice of central banks demonstrates that the Bank of England was the most transparent one.

2.2. Implications of misaligned transparency perceptions

Despite the above, the distinction between actual and perceived transparency has been absent in the central bank transparency literature for a long time. Recently, Geraats (2007) theoretically showed that it is important to make a distinction between these two forms of transparency and that the desirability of transparency depends on which concept is being used. Actual transparency reduces the uncertainty faced by the private sector by reducing the noise of communication and is therefore desirable. In contrast, perceived transparency might make markets more sensitive to information and is therefore not always desirable. It is shown that although clarity about the inflation target is desirable, this does not hold for the output gap target and supply shocks.

Transparency perceptions are important as they might affect the economy. When many people perceive the central bank as transparent, this might help the central bank to become or stay credible. This trust in the monetary policy of the central bank might, for example, result in inflation expectations that are well anchored. However,

psychological factors might disturb the effect of transparency perceptions on inflation perceptions and inflation expectations via trust.

First, whether people have *trust* in the central bank is likely to depend on many psychological factors, like belief perseverance and sampling memories. In addition, individual circumstances, like unemployment, have an impact on trust in the central bank (Hudson 2006).

Second, *inflation perceptions* are affected by psychological factors. After the introduction of the Euro people perceived inflation as being much higher than it actually was and even when actual inflation reached lower levels it was still perceived as being high for a long time. Happiness research has revealed that inflation has a sizeable effect on people's happiness (Frey and Stutzer 2002). Shiller (1997) points out that the public at large worries about different effects of inflation as compared to economists. The public concentrates on the detrimental effects associated with higher inflation and forgets that their nominal income will increase as well. If people sample memories, price increases are more easily retrieved from memory because they made a bigger impression than price decreases. This will lead to incorrect perceptions of inflation. Incorrect inflation perceptions are also present when people give a disproportional weight to the products that they buy often. Unconsciously, people may use this information as a confirmation of their beliefs and not search further for more reliable information. Another good example of a potentially important psychological factor is the so-called *false contribution error*. The idea is that when inflation is low people will feel it is their own achievement (e.g. by keeping wages low), whereas when inflation is high they sense it is due to the central bank's policy. The false contribution error clouds the perceptions the public has of the central bank and its achievements.

Third, *expectations of future inflation* are most likely also influenced by most of the psychological factors mentioned before. For example, price rises are more likely to be retrievable from memory and therefore likely to bias inflation expectations upward.

To summarize, transparency perceptions might affect inflation perceptions and expectations in a desirable way through their impact on trust in the central bank, but other (psychological) factors might cloud this effect. A high degree of actual transparency is likely to be helpful to create high transparency perceptions, but it is not necessarily the only way. If transparency perceptions were to be higher than the actual transparency practice of a central bank (e.g. because of incorrect transparency knowledge or psychological factors), the central bank might not be keen to change matters. As a public institution the central bank might face a democratic obligation to the public to take care that transparency perceptions are in line with reality. However there might be a moral hazard problem. Possible economic gains from misaligned perceptions (e.g. better aligned inflation expectations, which increase the central bank's effectiveness) might hold the central bank back from clarifying matters. The central bank might face an incentive to not be too transparent about its transparency practices. Because psychological factors keep on playing a role, a mismatch between actual and perceived transparency need not be resolved as time passes by.

3. Data and survey methodology

To test whether a gap between actual and perceived transparency exists in practice and whether it matters we have performed an internet-based survey through the CentERpanel, which is a more or less continuous household panel. This panel is run by CentERdata, which is a research institute belonging to the CentER group at Tilburg University. Our questionnaire was sent out to 2534 members of the CentER-panel (16 years and older) from Friday afternoon the 1st of June 2007 until Tuesday night the 5th of June 2007. The response rate is 71%, which corresponds to 1800 people. Compared to the response rates, which are common in other forms of surveys (e.g. Baruch 1999 and Cook et al. 2000), the response rate to this continuous internet-based survey is very high. The questions in the survey, which were pre-tested on consistent comprehensiveness by CentERdata, cover various matters on the ECB's transparency. In this chapter we focus on the questions on the knowledge and perceptions of the ECB's transparency and on the possible economic effects of transparency perceptions. More information on the survey data is in Appendix A.

In the next section (Section 4) we provide more insight into people's knowledge of the transparency of the ECB. Thereafter, in Section 5, we analyze to what extent knowledge of the ECB's transparency is relevant for households' transparency perceptions and which role other (psychological) factors play. In the last empirical section, Section 6, we use survey participants' responses to questions on trust, inflation expectations and inflation perceptions to discuss the relevance of misaligned transparency perceptions for economic outcomes.

4. Knowledge of central bank transparency

We have used several ways to measure Dutch households' knowledge about the ECB's transparency. First, we asked households to make a self-assessment of their transparency knowledge (Section 4.1). Second, we measured the depth and correctness of respondents' transparency knowledge by asking questions about the actual transparency practice of the ECB (Section 4.2). As we mention in the theoretical section, the mismatch between the actual and perceived transparency by the main economic actors might be of special interest to the central bank. As poor transparency knowledge is partly responsible for this mismatch, we look at the transparency knowledge of "economic experts" into more detail (Section 4.3).

4.1. Self-assessed transparency knowledge

Before asking questions about central bank transparency we checked the share of people who are aware of the existence of the ECB which turned out to be 67%. Actually more people are aware of the existence of the Dutch central bank: 9 out of 10 people.[5] Throughout the questionnaire people could respond "I don't know" to all the knowledge questions regarding the ECB, such that guessing the correct answers is prevented and a clear picture of the lack of knowledge is achieved.

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[5]Note that after this first question we gave the survey participants a definition of the ECB, monetary policy and transparency.

We have asked people to judge their own knowledge on four aspects, which they ranked on a five point scale (from high to low assessed knowledge): 1) their own financial situation, 2) financial matters in general, 3) economic developments, and 4) the transparency of the ECB. Figure 2 provides an overview of the responses. Not surprisingly, as it is a more specialized topic, survey participants judge their knowledge of the ECB's transparency as being the worst.[6] The majority of respondents report to have bad or very bad transparency knowledge (32% and 19%), 30% give as answer "neutral", but there are some people who judge themselves as having a high knowledge (5%) or even a very high knowledge (1%). This self-assessment gives a first indication that one of the reasons for a mismatch between actual and perceived transparency, poor knowledge about transparency, is probably present.
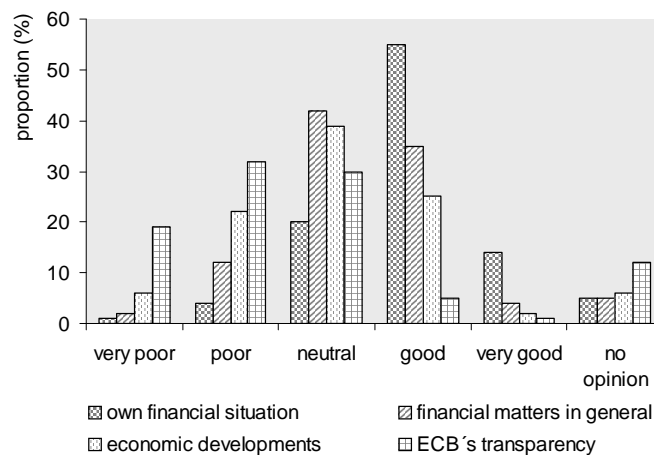
Figure 2. Respondents' self-assessed knowledge

4.2. Actual transparency knowledge

To analyze survey participants' *actual* knowledge of the ECB's transparency, we gave survey participants various questions about the ECB's transparency practice. As mentioned before, we define the actual transparency of a central bank as the degree to which it provides information about its monetary policy making process. To prevent guessing and to disentangle those persons that lack knowledge from those who have incorrect or correct knowledge we added a separate "I don't know" response option in addition to the options "yes" and "no". The questions cover the various aspects of transparency as identified by Eijffinger and Geraats (2006) (abbreviated by EG) based on the transparency definitions of Geraats (2002). We use this broad measure of transparency to get a better feeling of what people do and do not know. For this purpose the weighing of the various subcomponents is not relevant.

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[6]Knowledge about the transparency of the ECB has the strongest positive correlation with assessed knowledge about economic developments in general (0.54).

Table 2 summarizes the responses to the transparency questions. The check mark (✓) indicates which answer is correct according to EG(2006) and provides information on were there is room for more transparency by the ECB. In the majority of cases there is no doubt about what is the correct answer is, as it refers to a fact, for example that the ECB provides economic forecasts. However, in some cases, regarding some aspects of the ECB's monetary policy transparency the indices are not sophisticated enough. We will discuss these cases later on.[7]

4.2.1. Political transparency

This first aspect of transparency defined by Geraats (2002) is political transparency. It incorporates information disclosure on the central bank's goals: a formal statement of its target(s), how they are prioritized and quantified. Institutional arrangements like central bank independence raise political transparency because they reduce the pressure to deviate from these objectives.

According to the EG-index the ECB receives the maximum score for political transparency. The main objectives of the ECB are formally stated and prioritized: *"The primary objective of the ESCB shall be to maintain price stability. Without prejudice to the objective of price stability, it shall support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community as laid down in Article 2 of this Treaty."*[8] Sustainable and non-inflationary growth and a high level of employment are part of these objectives. The Governing Council clarified in a press release on 8 May 2003 what is exactly meant by price stability, namely that the year-on-year increase in the Harmonized Index of Consumer Prices (HICP) for the euro area should be below, but close to 2% over the medium term.

On most questions about political transparency about half of the respondents believe they know the correct answer. The fact that the main goals of the ECB are laid down is known very well by this "I know"-group. When asked whether supporting the economy is the ECB's most important task, a lot of people incorrectly think this is indeed the case. When asked instead whether "price stability is the ECB's main goal" more people respond and of those respondents a big majority answers "yes".

Only few people think they know whether price stability is quantified. Of these respondents 2/3 say the ECB's main goal is not quantified, while 1/3 say it is. EG(2006) argue that price stability is quantified. However, this is not so obvious. One could discuss the extent to which price stability is quantified. What is the exact meaning of "close to but below 2%"?

While seen as an important aspect of the monetary policy framework, one third of the people know that the ECB can act independently. As independence is often regarded an important tool to building up credibility any attempt to increase communication about it might be beneficial.

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[7]For a discussion of the transparency practices of other central banks, we refer to EG(2006) and Dincer and Eichengreen (2007).
[8]Protocol on the Statute of the European System of Central Banks and of the European Central Bank, Art. 2. This protocol is annexed to the Treaty establishing the European Community.

Table 2. Actual knowledge about the ECB's transparency (N=1800)
Response shares

	yes		no			?
Political transparency						
ECB's goals laid down	44%	✓	2%		**	54%
ECB's main task is supporting the economy	32%		20%	✓	**	47%
ECB's main task is supporting price stability	46%	✓	8%		**	46%
ECB's main goal expressed by a number	10%	✓	19%		**	71%
ECB is independent	35%	✓	16%		**	49%
Economic transparency						
ECB provides economic data	38%	✓	5%		**	56%
ECB provides economic forecasts	39%	✓	6%		**	55%
ECB provides economic models	24%	✓	11%		**	65%
Procedural transparency						
ECB's interest rate decisions are made in a clear fashion	17%	✓	25%		**	58%
ECB provides comprehensive minutes	10%		18%	✓	**	72%
ECB provides voting records	4%		28%	✓	**	68%
Policy transparency						
ECB announces interest rate decisions immediately	33%	✓	11%		**	57%
ECB immediately explains the interest rate decision	31%	✓	9%		**	60%
ECB tells future policy preferences	12%		20%	✓	**	68%
Operational transparency						
ECB provides information about relevant economic shocks	16%	✓	14%			70%
ECB provides information about forecasting errors	7%		23%	✓	**	70%
ECB provides information about its performance	23%		11%	✓	**	65%

Note: The table shows the share of respondents answering "yes", "no" or "I don't know" (indicated by a ?) to the various questions on the ECB's transparency. The check mark (✓) indicates which answer is correct according to EG(2006). *'s are added when there is a significant difference between the "yes and "no" response shares (Chi^2-test) (**=significant at a 1%-level).

4.2.2. Economic transparency

Economic transparency considers the disclosure of knowledge about the economy which is used for monetary policy making: the economic data, policy models and internal forecasts (Geraats 2002). The ECB provides a lot of economic information: economic data, its forecasts for inflation and output, and the economic models it uses. When compared to political transparency fewer respondents have knowledge about economic transparency. But of the ones that report to possess knowledge, about 80%

correctly respond that the ECB provides economic information and forecasts. People are less sure about economic models. This is reflected both in a higher amount of "I don't know"-answers as well as a higher amount of incorrect answers.

4.2.3. Procedural transparency

The third aspect of transparency defined by Geraats (2002) is transparency about the procedures used to make monetary policy decisions. What is needed for procedural transparency is openness about the monetary policy strategy of the central bank, the publication of its voting records and minutes.

According to the ECB's monetary policy strategy there is an important role for (1) money and (2) a broadly based judgement of future price developments and risks to price stability at a Euro area level. Although the ECB has made its so-called "Two Pillar Strategy" strategy explicit in the Monthly Bulletin of January 1999, it is obvious that the survey respondents feel interest rate decisions are not made in such a clear fashion.[9] Actually this response is in line with reality, as it is difficult to know what weights these two pillars get in reality, how these weights change over time and what these pillars exactly consist of. The unclear and changing weights may confuse people (De Haan et al. 2005: 16-25). Therefore the answer "no" may be judged to be correct.

Less people have knowledge about whether minutes and voting records are being published, but the ones that do have knowledge answer correctly that the ECB does not report what was said during the Governing Council meetings and what standpoint Council members had. Overall, a lot of the respondents lack knowledge on procedural transparency, an aspect of monetary policy making on which the ECB is relatively less transparent, both in comparison with other major central banks and in comparison with its own transparency on other aspects of monetary policy making (see EG2006).

4.2.4. Policy transparency

According to the definition of Geraats (2002), policy transparency is present when the central bank announces and explains its policy decisions immediately and when it indicates the future policy paths. The ECB announces its monetary policy decisions at a press conference which takes place immediately after the Governing Council meeting. The ECB's president then explains the decision that has been taken. The likely future policy path is not made explicit by the ECB. Most respondents lack knowledge about policy transparency (57-68%), especially about transparency about future policy preferences. There is not only lack of knowledge about policy transparency but incorrect knowledge as well. Unfortunately, of those survey participants thinking to have correct knowledge, 1 out of 3 give the incorrect answer.

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[9]In 2003 the ECB evaluated its monetary policy strategy (see the ECB press release of 8 May 2003: "The ECB's monetary policy strategy"). It concluded that the two-pillar strategy worked well as a framework for internal analysis and for the debate within the Governing Council, but it functioned less well in external communication. As a result external communication was improved upon (e.g. by changing the structure and content of the introductory statement of the President at the press conference after monetary policy meetings).

4.2.5. Operational transparency

Operational transparency considers openness about how the ECB implements it monetary policy actions by being open about the control errors in realizing its operating instrument or the goals set, and by disclosing the macroeconomic disturbances that influence the transmission process from policy instruments to outcomes (Geraats 2002).

Knowledge on this aspect of monetary policy making is very low (65-70%). Current macro-economic developments are analyzed in the ECB's Monthly Bulletin but a discussion of past forecast errors is absent. The latter is known by more people than the previous fact. Policy outcomes are discussed and evaluated in the Monthly Bulletin, but what role monetary policy has played is not made explicit. It is debatable whether people should indeed answer "yes" or "no" to the question "Does the ECB provide public information about the extent to which it achieved her goals?".

To summarize, we find both a lack of ECB transparency knowledge as well as incorrect knowledge. Unfortunately, we can not compare our results to a benchmark because, to our knowledge, there is no other research on households' central bank transparency knowledge. The general picture of low knowledge about transparency confirms the idea that monetary policy is a very difficult to explain field of expertise and does not interest everybody. Our finding is probably not ECB-specific but generic: holding for all central banks. However, findings on the relative degree of knowledge on various subaspects of transparency are likely to differ between central banks, because they depend on the specific communication strategy and monetary policy framework at practice. Next, before analyzing to what extent transparency knowledge explains transparency perceptions, we first investigate why transparency knowledge differs among respondents.

4.2.6. Explaining actual transparency knowledge

Actual transparency knowledge is measured by constructing knowledge indices (KI's). For each aspect of transparency we have constructed a KI. The higher the number of correct answers about a specific aspect of transparency, the higher the specific KI. A detailed description of the design of these KI's is presented in Appendix A, Table A2 and A3. The total KI ranges between 0 and 15. Based on a sample of 1519 persons we try to explain the degree of transparency knowledge (Table 3).[10]

Transparency knowledge depends on personal characteristics. For example, it is better for those respondents who are relatively old, earning a relatively high income, and belonging to a higher social class. The explanation for this finding could be that all three factors are related to respondents' general degree of knowledge. Not surprisingly, those respondents that knew of the existence of the ECB before receiving a definition of the ECB report higher transparency knowledge. Economic expertise is relevant in explaining actual transparency knowledge. Actual transparency knowledge is higher for those who are confronted with economic, monetary and financial matters during working hours, although this need not be on a daily basis, and for those

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[10]Appendix A contains a description of all the explanatory variables used throughout the paper.

Table 3. Actual knowledge about the ECB's transparency: OLS (N=1519)

	(1) KI_total		(2) KI_total_alt	
Constant	.02	(0.98)	.07	(0.94)
Age	.01*	(0.05)	.01	(0.10)
Gender	.24	(0.24)	.31	(0.18)
Education	-.27	(0.19)	-.33	(0.16)
Income	.13**	(0.00)	.14**	(0.01)
Job	-.20	(0.36)	-.23	(0.36)
Social class	.17*	(0.06)	.19*	(0.07)
Urbanization	-.02	(0.73)	-.02	(0.76)
Region	-.45**	(0.01)	-.48**	(0.02)
Optimist	-.05	(0.67)	-.05	(0.71)
ECB known	1.58**	(0.00)	1.76**	(0.00)
Economic job	.86**	(0.00)	1.02**	(0.00)
Economic expert	-.12	(0.70)	-.27	(0.44)
Economic knowledge (SA)	.97**	(0.00)	1.12**	(0.00)
Specific financial knowledge (SA)	.21	(0.13)	.26	(0.10)
General financial knowledge (SA)	-.08	(0.62)	-.07	(0.71)
Transparency knowledge (SA)	.75**	(0.00)	.83**	(0.00)
R^2	0.32		0.31	

Note: P-values between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. See appendix A for the definitions of the explanatory variables and the construction of KI_total and KI_total_alt.

people assessing their economic knowledge to be relatively high. Furthermore, it is found that those respondents who judge their transparency knowledge to be higher do have better transparency knowledge in practice.[11] However data inspection reveals that even those respondents who assess their transparency knowledge to be very good, lack or even have incorrect actual transparency knowledge.

The results are robust to a slight change in the manner in which actual transparency is measured. Column 2 of Table 3 shows the results based on an alternative KI, which is less stringent regarding those aspects of transparency for which the right answer is ambiguous.

Next, we provide more insight into the effect of economic "expertise" on transparency knowledge.

4.3. Transparency knowledge and learning

In the theoretical section (Section 2) we argue that even economic experts might suffer from lacking or even incorrect knowledge and psychological factors resulting

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[11]This is in line with van Rooij et al. (2007) who find that respondents' own assessments of their degree of financial literacy are a good proxy for their actual degree of financial literacy.

in a mismatch between their transparency perceptions and actual transparency. To find empirical support, we analyze the survey results in more detail. We test both the depth and correctness of the transparency knowledge of the economic "experts" among the people in the household survey. Two expert-definitions are used. According to the first definition respondents are economic experts if they consider their economic knowledge to be very good. Based on the second definition survey participants are economic experts when they deal with economic, financial or monetary matters on a daily basis.[12]

4.3.1. Economic expertise based on self-assessment

To get more of a feeling for the relevance of learning, Table 4 shows an overview of the actual transparency knowledge of people who judge their economic knowledge to be "very good" (N=36), which is the first expert definition we use.

Compared to the respondents' average transparency knowledge (Table 2), a relatively low share of respondents with good economic knowledge answered "I don't know" (the share is between 0% and 28%). This resulted in both a higher share of respondents choosing the correct answer but also a bit higher share of respondents giving the incorrect answer (except to the question on the ECB's independence).[13] Although performing the best compared to groups with a lower self-assessed degree of economic knowledge, even the most economic knowledgeable people suffer from missing and incorrect transparency knowledge and as a result are likely to have misaligned transparency perceptions.

4.3.2. Economic expertise based on work experience

Relevant work experience might cause some people to have a transparency knowledge advantage. Knowledge about the transparency of the ECB is expected to be more important for those who in their day-to-day work are confronted with economic, monetary or financial matters as they are likely to make more economic decisions. Our questionnaire contains a question which asks for this. Possible answers (and the proportion of respondents choosing the particular answer) are: "yes, every day" (11%), "yes, but not every day" (19%) and "no" (70%). The responses of the "yes, every day"-group are in Table 5. Taking a look at the 197 people in this group (so belonging to a still broadly defined expert group, from administrators to managers) several observations can be made. The category "I don't know" varies for different statements about transparency. For example, 71% of the respondents think they know whether the ECB can act independently of governments, while only 40% report to have knowledge about whether the main target of the ECB is quantified. Absence of knowledge is the least for political transparency questions (with the exception of knowledge about whether the target is quantified or not). Roughly speaking, of those

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[12]See Appendix A, Table A5 for an overview of the overlap between these two expert-definitions.

[13]A higher degree of optimism/confidence might both lead people to assess their economic knowledge to be better as well as make them feel more confident about their transparency knowledge.

Table 4. Actual knowledge about the ECB's transparency and self-assessed economic expertise

Response shares of those survey participants judging their own knowledge about economic developments to be "very good" (N=36).

	yes		no			?
Political transparency						
ECB's goals laid down	89%	✓	3%		**	8%
ECB's main task is supporting the economy	44%		53%	✓		3%
ECB's main task is supporting price stability	86%	✓	14%		**	0%
ECB's main goal expressed by a number	31%	✓	44%			25%
ECB is independent	89%	✓	3%		**	8%
Economic transparency						
ECB provides economic data	75%	✓	8%		**	17%
ECB provides economic forecasts	72%	✓	11%		**	17%
ECB provides economic models	53%	✓	22%		*	25%
Procedural transparency						
ECB's interest rate decisions are made in a clear fashion	56%	✓	39%			6%
ECB provides comprehensive minutes	36%		39%	✓		25%
ECB provides voting records	8%		72%	✓	**	19%
Policy transparency						
ECB announces interest rate decisions immediately	58%	✓	33%			8%
ECB immediately explains the interest rate decision	72%	✓	17%		**	11%
ECB tells future policy preferences	28%		47%	✓		25%
Operational transparency						
ECB provides information about relevant economic shocks	22%	✓	56%		*	22%
ECB provides information about forecasting errors	8%		64%	✓	**	28%
ECB provides information about its performance	50%		33%	✓		17%

Note: Respondents were asked to judge their own knowledge about economic developments, like price changes, economic growth and unemployment. Possible answers were: "very poor", "poor", "neutral", "good", "very good" and "I don't know". This table presents the response shares of the "very good"-group, which consists of only 2% of the respondents. The check mark (✓) indicates which answer is correct according to EG(2006). *'s are added when there is a significant difference between the "yes and "no" response shares (Chi^2-test) (**=significant at a 1%-level, *=significant at a 5%-level). ?=I don't know.

individuals responding the majority gives the correct answer. This does not hold for categories for which the correct answer is disputable, as we saw before.

Detailed inspection of the data confirms the findings based on the first expert definition. People working daily with economic matters report to have relatively more knowledge about transparency: the unknown category is often about 30% smaller than in case of the people not working with economic matters. In addition, we observe a higher proportion of correct and incorrect answers, but the increase of the amount of correct answers is higher.[14]

To summarize, experts have better transparency knowledge, but it is far from perfect. The misalignment of perceptions is likely to be a problem all over the population. In the next section we analyze to what extent transparency knowledge matters in the formation of transparency perceptions.

5. Perceptions of central bank transparency

We measure perceptions of the ECB's transparency in two ways. We have asked Dutch households questions on their perceptions of the ECB's monetary policy transparency in general (Section 5.1) and more specific, on various subaspects of transparency (Section 5.2).

5.1. General transparency perceptions

Figure 3 gives an overview of the perceptions respondents have about the transparency of the ECB.
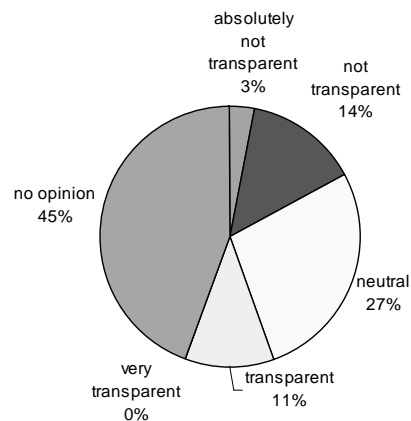
Figure 3. ECB's perceived transparency

These perceptions are measured on a 1 to 5 scale (ranging from "absolutely not transparent" to "very transparent") plus the option "no opinion". 4 out of 10 people do not report a view on the ECB's monetary policy transparency, but the ones that

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[14]The difference of the answers of the "yes, every day"-group and the "yes, but not every day"-group is smaller than the difference in the responses of the "yes, but not every day"-group and the "no"-group.

Table 5. Actual knowledge about the ECB's transparency and on the job economic expertise

Response shares of those survey participants confronted daily in their work with economic, financial or monetary affairs (N=197).

	yes		no			?
Political transparency						
ECB's goals laid down	66%	✓	4%		**	29%
ECB's main task is supporting the economy	32%		39%	✓		28%
ECB's main task is supporting price stability	57%	✓	15%		**	28%
ECB's main goal expressed by a number	18%	✓	22%			60%
ECB is independent	50%	✓	21%		**	29%
Economic transparency						
ECB provides economic data	56%	✓	8%		**	36%
ECB provides economic forecasts	58%	✓	8%		**	34%
ECB provides economic models	37%	✓	20%		**	43%
Procedural transparency						
ECB's interest rate decisions are made in a clear fashion	31%	✓	32%			37%
ECB provides comprehensive minutes	11%		26%	✓	**	63%
ECB provides voting records	7%		42%	✓	**	51%
Policy transparency						
ECB announces interest rate decisions immediately	48%	✓	15%		**	37%
ECB immediately explains the interest rate decision	45%	✓	16%		**	39%
ECB tells future policy preferences	24%		28%	✓		47%
Operational transparency						
ECB provides information about relevant economic shocks	24%	✓	25%			51%
ECB provides information about forecasting errors	10%		40%	✓	**	50%
ECB provides information about its performance	35%		22%	✓	*	43%

Note: Survey participants were asked whether they have on the job experience with economic, financial or monetary matters. Possible answers: "yes, daily", "yes, but not daily" and "no". This table presents the responses of the first group (N=197). The check mark (✓) indicates which answer is correct according to EG(2006).*'s are added when there is a significant difference between the "yes and "no" response shares (Chi^2-test) (**=significant at a 1%-level, *=significant at a 5%-level). ?=I don't know.

do give their perceptions have transparency perceptions which are slightly biased on the side of intransparency. The first finding, that a share of people do not have an opinion on the monetary policy of the central bank, confirms the general view that monetary policy making is a difficult to explain field of expertise, which is something all central banks have to cope with.

Another question tests whether people are satisfied with the ECB's amount of transparency (again measured on a 1 to 5 scale plus a "no opinion" option). Less than half of the respondents have an opinion on this matter (37%), which means that for a substantial share of people the ECB currently can not use the transmission channel looked at in this chapter. For the ECB there is room to create these transparency perceptions in the future. Of the people that do report their transparency perceptions 40% is satisfied with the degree of transparency, almost 60% say the ECB's transparency is too low and only 3% think transparency is already too high. Most people regard transparency of the ECB to be important (given answers with the share of the total population between brackets: "absolutely not important" (1%), "not important" (1%), "neutral" (12%), "important" (34%), and "very important" (27%), "no opinion" (25%)). So even when people lack knowledge about the ECB's transparency this does not imply that they don't care. They might just not want to know all the details or it might be that the information given by the ECB does not reach them.

We expect transparency knowledge to be an important, but imperfect, determinant of transparency perceptions. Ordered probit regressions test for this. Transparency knowledge is included in two ways in the regressions: 1) via the self-assessed transparency knowledge, and 2) via the knowledge indices which measure individuals' actual transparency knowledge. A detailed description of the design of these KI's is presented in Appendix A, Table A2 and A3.

First, we look at the regressions of the level of perceived ECB transparency of which the results are presented in Table 6, column 1. Based on a sample of 960 respondents that do report their transparency perceptions, we find that both transparency knowledge and psychological factors affect transparency perceptions. Starting with the latter, the more optimistic one is, the higher is the perceived ECB's transparency. In addition both *self-assessed* and *actual* transparency knowledge matter for the formation of transparency perceptions. The higher the self-assessed transparency knowledge is, the higher the transparency perceptions are. The effect of actual transparency knowledge depends on the aspect of transparency under consideration. Better knowledge about the political, economic, and policy transparency of the ECB enhances the extent to which it is perceived as a transparent institution. This is not surprising as the ECB is relatively transparent on these aspects. In contrast, more knowledge about the ECB's procedural and operational transparency reduces the extent to which it is perceived as transparent. Again this is an intuitive finding because the ECB 's degree of actual procedural and operational transparency, as defined before, is relatively low.[15]

In regression 2 (in Table 6) we use a different way to construct the political, procedural and operational KI's than in the baseline regression. Now (I) both answering the ECB having its main target quantified and answering that it has not are judged to be correct, (II) both answering that the ECB's interest rate decisions are and are not made in a clear fashion are judged to be correct, and (III) both saying that the ECB does and does not provide information about its performance are judged to be correct. We find that (I) does not make a big difference, (II) leads actual procedural transparency knowledge to be even more negatively related to perceived transparency,

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[15]However, based on cross-country correlations, Demertzis and Hughes Hallett (2007) show that for economic outcomes these forms of transparency matter the most.

Table 6. Perceived ECB transparency: ordered probit analyses

	(1)		(2)		(3)	
Optimist	.15**	(0.00)	.14**	(0.00)	.16**	(0.00)
Transparency knowledge (SA)	.43**	(0.00)	.44**	(0.00)	.51**	(0.00)
KI_political	.09**	(0.00)				
KI_economic	.10**	(0.00)	.11**	(0.00)	.11**	(0.00)
KI_procedural	-.09*	(0.06)				
KI_policy	.18**	(0.00)	.21**	(0.00)	.24**	(0.00)
KI_operational	-.16**	(0.00)				
KI_political_alt			.10**	(0.00)	.11**	(0.00)
KI_procedural_alt			-.21**	(0.00)	-.20**	(0.00)
KI_operational_alt			-.06	(0.18)	-.08*	(0.08)
Age					-.01**	(0.00)
Gender					-.05	(0.55)
Education					-.05	(0.61)
Income					.02	(0.21)
Job					-.17*	(0.09)
Social class					.02	(0.61)
Urbanization					.03	(0.30)
Region					-.13	(0.11)
ECB known					-.08	(0.40)
Economic job					.03	(0.72)
Economic expert					-.20*	(0.09)
Economic knowledge (SA)					-.09*	(0.10)
Log likelihood	-1056		-1048		-1017	
Pseudo R^2	0.09		0.10		0.11	
N	960		960		940	

Note: P-values between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. Perceptions of the ECB's transparency are measured on a scale from 1 to 5 (1="absolutely not transparent", 2="not transparent", 3="neutral", 4="transparent", 5="very transparent"). The respondents with "no opinion" (N=799) are not included in the analysis. The definitions of the explanatory variables are in Appendix A. The number of observations (N) is lower in model 3 because respondents who did not report information on the additional control variables, e.g. their self-assessed "economic knowledge", could not be included in the analysis.

and (III) results in a smaller link between actual operational transparency knowledge and transparency perceptions.

In regression 3 several control variables are added. The fit of the model slightly improves. The older respondents are, the less transparent they believe the ECB to be. People with a paid job have relatively lower transparency perceptions and transparency perceptions are negatively related to economic expertise (both daily work experience with economic, monetary or financial matters as well high self-assessed economic knowledge).

We perform a similar analysis with the results of the question that asked for people's satisfaction with the ECB's transparency. A share of 15% is satisfied, 22% is dissatisfied and the majority (64%) has no opinion. Of the dissatisfied people, the majority finds transparency too low (N=381). As only 11 people report that the ECB's transparency is too high, they could not be included in the probit analyses. The results, which are presented in Appendix B, are to a large extent similar to the above results. An important difference however is that although economic expertise is related to lower transparency perceptions it does not seem to be relevant for people's satisfaction with the ECB's transparency.

Overall, if the ECB wants to enhance (1) the extent to which it is perceived as being transparent and (2) people's satisfaction with transparency, it might benefit from focussing its communication on those aspects on which its transparency score is high: political, economic and policy transparency, but not emphasizing those aspects on which it is less transparent: procedural and operational transparency. To get more insight into transparency perceptions we investigate next whether perceptions are different for various aspects of transparency.

5.2. Detailed transparency perceptions

We asked survey participants to fill in their perceptions of the ECB's transparency on various aspects of monetary policy making (again on a scale from 1 to 5 plus the option "I don't know").[16] The share of people who report their transparency perceptions is larger than the share that report to have knowledge on the various aspects of transparency. Which means that some people form perceptions of transparency even without having actual knowledge about it. This confirms the idea that the formation of transparency perceptions is not obvious and depends on both psychological factors and individual characteristics. Figure 4 shows the public's perceived transparency.[17]

About half the people report no transparency perceptions. The share of people that view the ECB as (absolutely) not transparent ranges from 9% (economic transparency) to 17% (future policy transparency). This finding is in line with the group of people answering that the ECB is (very) transparent. The share of people choosing for this option is about the same (it varies between 9% and 20%), with the highest share going to economic transparency and the lowest share to future policy transparency. ECB transparency is perceived to be relatively high on economic, current policy and political aspects, whereas procedural, operational and future policy transparency is perceived to be relatively low. The ranking of these transparency aspects based on perceptions is roughly in line with the actual transparency practice of the ECB, although two observations are important. First, about half of the people do not have a view on transparency. Second, even on those aspects which the ECB emphasizes in its

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[16]As one would expect, these transparency perceptions are positively related to different measures of transparency perceptions based on the amount of "yes, the ECB is transparent"-answers to the knowledge questions which we discus in Section 4.2.

[17]We make a distinction between current and future monetary policy transparency as the degree of transparency of the ECB is high on the former but low on the latter because forward-looking transparency is more difficult. The findings are also summarized in Table A4 of Appendix A, which includes a ranking.

communication and on which it receives the maximum score based on the EG-index, a substantial amount of people still judge the ECB to be intransparent.
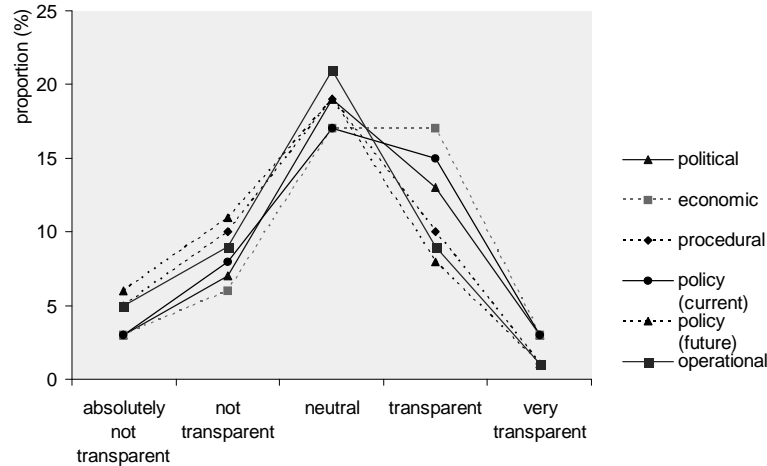

Figure 4. Detailed transparency perceptions

Note: The share of people that did not have a view on the ECB's monetary policy transparency is for all aspects about 55%.

Targeted communication may reduce the transparency misalignment by raising the transparency knowledge (reducing incomplete and incorrect knowledge) but to the extent that psychological factors cause misaligned perceptions, a revised communication policy will not be helpful because people are unaware of these biases. Before taking action it is important to know whether misaligned transparency perceptions matter, which we will discuss next.

6. The relevance of transparency perceptions

Based on our survey data we conclude that a mismatch between the actual and the perceived transparency of the ECB exists. But to what extent is such a mismatch relevant? In addition to a possible democratic obligation of the central bank as a public institution to improve the transparency knowledge of the public, and thereby bringing the transparency perceptions more in line with reality, there might be some economic arguments. We first analyze the relationship between transparency perceptions and trust in the ECB (Subsection 6.1). Thereafter we make a link to inflation perceptions and expectations (Subsection 6.2).

6.1. Trust in the European Central Bank

Survey participants have more trust in the Dutch central bank compared to the ECB, which may be explained by the presence of a familiarity bias: people have more trust in institutions they know better and that are less distant. Possible answers and the percentage of people responding it are (in case of the ECB): "absolutely no trust"

(1%), "little trust" (10%), "neutral" (36%), "quite a lot" (29%), "a lot" (7%) and "no opinion" (18%).[18] We investigated the role of transparency perceptions in explaining people's trust in the ECB by estimating ordered probit regressions, see Table 7.

In our analysis we include both a direct (Table 7, model 1a and 1b) and an indirect measure of trust (model 2). We observe that central bank transparency perceptions are indeed related to the direct measure of trust in the ECB. The higher the perceptions of the ECB's transparency, the higher the trust in the ECB.[19] This result highlights the importance of high transparency perceptions as central banks are interested in keeping up people's trust. It eases their policy making and increases their effectiveness. Other factors are also relevant in explaining trust. From the probit regression, holding other factors constant, trust in the ECB is higher the higher educated and more optimistic people are and the higher their self-assessed transparency knowledge is. Trust in the ECB is higher for those respondents that reported to know the ECB before we explained to them what the ECB is and does.

Model 1b includes transparency perceptions in an indirect manner by including transparency knowledge indices instead.[20] Political, economic and policy transparency knowledge (aspects of transparency on which the ECB scores relatively high) are significantly positively related to trust whereas operational transparency knowledge (an aspect on which the ECB degree of transparency is low) is negatively related to trust. As transparency knowledge is only one of the determinants of perceived transparency, model 1b has less explanatory power than model 1a. Therefore we prefer to include transparency perceptions in a direct way.

In addition to the direct measure of respondents' trust in the ECB, we have used an indirect measure of trust. Respondents were asked the extent to which they feel the ECB is safeguarding price stability. Quite a lot of people say they don't know (42%). A neutral standpoint is taken by 26% of people. Of the remaining, a share of 2/3 says the ECB is safeguarding price stability well while a share of 1/3 is dissatisfied. We explain this alternative measure of trust with an ordered probit model of which the results are presented in Table 7 model 2. The results confirm our earlier finding that, ceteris paribus, the higher respondents' transparency perceptions are the more trust they have in the ECB.[21]

6.2. Inflation gap and credibility gap

What matters then is if trust is indeed related to inflation perceptions and inflation expectations. When judging current inflation, opinions are almost symmetrically distributed around neutral. This is not in line with the picture we obtain when we

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[18]The results for the trust in the Dutch Central Bank are: "absolutely no trust" (0%), "little trust" (4%), "neutral" (23%), "quite a lot" (41%), "a lot" (20%) and "no opinion" (12%).
[19]Including detailed transparency perceptions instead of overall transparency perceptions reveals that political, current policy and operational transparency perceptions are significant positively related to the degree of trust. A significant relationship between economic, operational and future policy perceptions and trust was however absent. Because of a better fit we show the regressions with the overall transparency perceptions included.
[20]It is for this reason that we could include less observations in model 1b compared to model 1a.
[21]It should be noted that we cannot be sure whether and to what extent the relationship between trust and transparency perceptions is in the other direction.

Table 7. Trust in the ECB: ordered probit analyses

	Direct measure				Indirect measure	
	(1a)		(1b)		(2)	
Age	.00	(0.17)	-.00	(0.80)	-.00	(0.16)
Gender	.03	(0.77)	-.01	(0.84)	.06	(0.55)
Education	.16*	(0.06)	.16**	(0.03)	.06	(0.50)
Income	.03	(0.12)	.04**	(0.02)	.01	(0.46)
Job	.11	(0.25)	-.05	(0.54)	-.20*	(0.07)
Social class	.02	(0.67)	.04	(0.22)	.04	(0.36)
Urbanization	-.03	(0.34)	-.02	(0.42)	-.02	(0.56)
Region	-.11	(0.15)	-.18**	(0.00)	-.11	(0.18)
Optimist	.18**	(0.00)	.20**	(0.00)	.12**	(0.02)
ECB known	.33**	(0.00)	.23**	(0.00)	.08	(0.48)
Economic job	-.07	(0.41)	-.18**	(0.02)	-.03	(0.79)
Economic expert	.10	(0.37)	.15	(0.13)	.08	(0.54)
Economic knowledge (SA)	.08*	(0.09)	.05	(0.19)	.13**	(0.02)
Transparency perceptions	.57**	(0.00)			.49**	(0.00)
KI_political			.11**	(0.00)		
KI_economic			.08**	(0.00)		
KI_procedural			-.02	(0.59)		
KI_policy			.11**	(0.01)		
KI_operational			-.19**	(0.00)		
Log likelihood	-1082		-1670		-878	
Pseudo R^2	0.10		0.06		0.08	
N	936		1414		806	

Note: P-values are between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. A description of the explanatory variables can be found in Appendix A. Model 1a and 1b use a direct measure of trust in the ECB. The scale of this measure of trust ranges from 1 to 5 (1="absolutely no trust", 2="little trust", 3="neutral", 4="quite a lot" and 5="a lot"). Model 2 uses an indirect measure of trust: the extent to which people feel the ECB is safeguarding price stability (1="not" (1%), 2="not very good" (10%), 3="neutral" (26%), 4="good" (20%) and 5="very good" (0%)).

ask survey participants to quantify their transparency perceptions and expectations. Participants were asked to report their perceptions of current consumer price inflation, which we compare to current inflation, and their expectations of future inflation (in 2 years time), which we compare to the inflation goal of the ECB. The responses to both inflation questions show a peak around 2% and are skewed upwards, which is in line with previous research of Christensen et al. (2006). Responses vary a lot as is shown in Appendix C. Some people probably do not understand the concept of percentages as one would find it hard to believe that they really perceive and expect inflation to be over 50%. Respondents judge future inflation (in 2 years time) higher than current inflation and inflation expectations deviate from the inflation goal of the ECB.

To measure to what extent trust is related to inflation perceptions (π^p) and inflation expectations (π^e), we construct two variables: (1) the "inflation gap" and (2) the "credibility gap". We define the inflation gap as the absolute difference between respondents' perceptions of current inflation, at the time they filled in the questionnaire, and actual inflation. As a measure of actual inflation we take the consumer price index of May (1.8%). Because we held the questionnaire in the *first* weekend of June relating the inflation perceptions to June would mean linking them to future inflation, which is something we do with respondents' inflation expectations when constructing the credibility gap. The credibility gap is the absolute difference between respondents' expected inflation two years from now and the current inflation goal of the ECB. The larger the gap between inflation expectations and the inflation goal of the ECB is, the lower the ECB's degree of credibility is.

The regression results of the inflation gap and the credibility gap are in column (1) and (2) of Table 8, based on 1143 versus 1112 observations. We observe that trust matters: ceteris paribus, the higher the respondent's trust in the ECB is, the lower the gaps. Several personal characteristics are significantly related to the inflation and credibility gap. Inflation perceptions and expectations are more likely to be better aligned when one is older, male, has a paid job, belongs to a higher social class and knows the ECB.

Alternatively, we perform probit regressions explaining the correctness of inflation perceptions and expectations of which the results are in column (3) and (4). The sample size is now larger because those people who respond "I don't know" are included in the analysis (they belong to the group with incorrect transparency perceptions). We judge inflation *perceptions* to be correct if they are within a small range around the actual inflation rate. In the baseline case this range is: $\pi^p \in [1.5\%, 2.1\%]$, but as a robustness check we vary this range.[22] Based on this definition 1 out of 3 respondents possess correct inflation perceptions. We define inflation expectations to be "correct" when they are in line with the medium term inflation goal of the ECB which is two keep inflation close to but below 2%. As the exact meaning of "close to but below two percent" is not perfectly clear (is it 0.01%-point or a few %-points below 2%?) we use a small range ($\pi^e \in [1.8\%, 2\%]$). 19% of the respondents have inflation expectations that are in line with the inflation goal of the ECB. As before, we find that trust matters for inflation perceptions and inflation expectations. The higher a respondent's degree of trust is in the ECB, the larger the probability is that his inflation perceptions and expectations are correct. In addition to the characteristics that are significant in regression 1 and 2, we find indication that inflation perceptions and expectations are more likely to be correct for those people that have a higher degree of self-assessed economic knowledge.

To summarize, trust seems to be both a relevant factor for keeping inflation perceptions low and in line with reality and for anchoring inflation expectations around

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[22]The significant trust effect remains when the perceptions band is reduced to $\pi^p \in [1.6\%, 2\%]$ but it is absent in case of an even smaller width: $\pi^p \in [1.7\%, 1.9\%]$ (note that reducing the bandwith leads to fewer observations in the "correct"-groep, which complicates it to perform a usefull analysis). In contrast, when we include transparency perceptions instead of trust as an explanatory variable the significant effect remains for both alternative band widths.

Table 8. Alignment of inflation perceptions and inflation expectations

	(1) inflation gap		(2) credibility gap		(3) correctness of π^p		(4) correctness of π^e	
Constant	4.36**	(0.01)	5.29**	(0.00)	-1.27**	(0.00)	-1.65**	(0.00)
Age	-.04**	(0.00)	-.03**	(0.04)	.01**	(0.02)	.01	(0.11)
Gender	-.93**	(0.02)	-.67	(0.11)	.21**	(0.01)	.14	(0.12)
Education	-.26	(0.53)	-.18	(0.68)	-.07	(0.41)	-.01	(0.94)
Income	-.07	(0.40)	-.09	(0.31)	.02	(0.21)	.01	(0.69)
Job	-1.21**	(0.01)	-.95*	(0.05)	.25**	(0.01)	-.04	(0.69)
Social class	-.35*	(0.07)	-.57**	(0.00)	.08**	(0.03)	.02	(0.68)
Urbanization	.08	(0.56)	.17	(0.23)	.03	(0.35)	.01	(0.65)
Region	-.55	(0.14)	-.55	(0.16)	.03	(0.68)	-.03	(0.71)
Optimist	-.33	(0.15)	-.29	(0.22)	-.02	(0.62)	-.08	(0.15)
ECB known	-1.45**	(0.00)	-1.02**	(0.03)	.37**	(0.00)	0.21**	(0.04)
Economic job	.45	(0.29)	.71	(0.10)	.09	(0.33)	.01	(0.95)
Economic expert	-.37	(0.51)	.24	(0.68)	.04	(0.77)	.11	(0.41)
Economic knowledge (SA)	.24	(0.27)	-.05	(0.82)	.10**	(0.03)	.11**	(0.03)
Trust	-.34*	(0.10)	-.43**	(0.04)	.22**	(0.00)	.21**	(0.00)
Model	OLS		OLS		probit		probit	
R^2	0.06		0.05					
Pseudo R^2					0.08		0.05	
Log likelihood					-859		-696	
N	1143		1112		1414		1414	

Note: P-values between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. See Appendix A for an explanation of the independent variables. Explanation of the dependent variables:
(1) the inflation gap: $abs(\pi^p - \pi^a)$. The absolute difference between π^p(=perceived current inflation (percentage)) and π^a(= actual current inflation, which equals 1.8% (Consumer Price Index of May 2007));
(2) the credibility gap: $abs(\pi^e - \pi^T)$. The absolute difference between π^e(= expected inflation two years from now (percentage)) and π^T(= the ECB's medium term inflation target, which is set at 1.9%);
(3) correctness of inflation perceptions: 1 if $\pi^p \in [1.5\%, 2.1\%]$, 0 otherwise (including the "I don't know" responses).
(4) correctness of inflation expectations: 1 if $\pi^e \in [1.8\%, 2\%]$, 0 otherwise (including the "I don't know" responses).

the central bank's target.[23] Though to the extent that transparency perceptions matter for trust, they are relevant based on economic arguments as well. Our results are

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[23]We should note, however, that it is unclear whether and to what extent the relationship between inflation perceptions and trust moves in two directions.

robust to the inclusion of transparency perceptions in a direct way in the correctness of inflation perceptions and expectations regressions (see Appendix C, Table C1). However, the explanatory power of the models is lower as trust in the ECB depends on more factors than only transparency perceptions. The main way to raise and keep trust is by earning it with good monetary policy.

7. Conclusion

We argue that a mismatch between the actual degree of transparency of a central bank and its degree of transparency as perceived by the public is likely to exist and that it matters. Transparency perceptions are based on two factors: (1) actual knowledge of transparency, and (2) psychological factors.

Regarding determinant (1), based on a survey among Dutch households we show that actual knowledge on the ECB's transparency is lacking or even incorrect, which is a first indication that a mismatch between actual and perceived transparency is likely to exist. We find strong indications that this lack of depth and correctness of transparency knowledge is not only present for the public at large, but also for those agents whom the central bank is more keen on influencing: economic experts. Both expert definitions we use (having an economic job and having a very high self-assessed economic knowledge) confirm this viewpoint. Future research is needed to shed more light on (the possible lack of) transparency knowledge of parties that are of direct importance for the monetary policy transmission (financial intermediaries, the financial press, companies and labor unions).

Depending on which aspect of transparency we look at, 46%-72% of the respondents report that they have no knowledge about the current transparency practice of the ECB. This finding confirms the general idea that monetary policy making is a difficult to explain area of expertise and does not interest everybody, which is something all central banks have to cope with. Our findings indicate that for central bankers there is a huge challenge to improve the monetary policy knowledge of the public at large.

A majority of the respondents that do report to have knowledge possess the correct knowledge, whereas the rest has incorrect transparency knowledge. Transparency knowledge depends on which aspect one looks at. Dutch households know more about, for example, the goals of the central bank and the economic information it provides (aspects on which the ECB is relatively transparent) than about whether minutes are published and forecast errors are made public (aspects on which the ECB is relatively less transparent). When we correct for the fact that we have a slight overrepresentation of males, highly educated people, older people and higher income households, transparency knowledge is even a bit worse in practice. Our findings on individuals' relative degree of knowledge on various subaspects of transparency are likely to differ between central banks because they depend on the specific communication strategy and monetary policy at practice.

Regarding determinant (2), psychological factors seem to matter in the formation of transparency perceptions. For example, optimistic people are more inclined to judge ECB's transparency to be high. The share of people reporting transparency perceptions is larger than the share of people reporting to have knowledge about transparency. So even without exact knowledge people form transparency perceptions.

The finding that transparency perceptions do not only depend on actual transparency knowledge complicates it for central banks to align transparency perceptions with their actual transparency practice.

Transparency perceptions matter as they are significantly positively related to the amount of trust in the ECB. Central banks are interested in keeping up people's trust because it facilitates their policy making and increases their effectiveness. We find that when households' trust in the ECB is higher inflation perceptions are more in line with actual inflation and inflation expectations are better anchored around the inflation target of the ECB, which facilitates policy making. For the moment, the indirect transmission channel analyzed in this chapter (from transparency perceptions to economic outcomes) seems to be relevant for part of the population. It is, however, absent for most people, which leaves room for the ECB to create transparency perceptions in the future, but less so for those with relatively high economic expertise in whom the ECB might have more interest.

The central bank has an accountability obligation to the public and fulfills it by using transparency as an instrument. To do this as best as possible a closer match between the actual and perceived degree of transparency is welcomed. Despite this possible democratic reason to bring transparency perceptions in line with the central bank's practice, a central bank might feel an incentive to keep transparency perceptions misaligned in case they are higher than its actual transparency practice. We find that persons with relatively high transparency perceptions are more likely to have better aligned inflation perceptions and expectations. To benefit from higher transparency perceptions a central bank might feel tempted to stress its transparency strengths (in case of the ECB: political, economic and policy transparency) but de-emphasize its transparency weaknesses (e.g. procedural and operational transparency for the ECB). An alternative way for central banks to increase transparency perceptions might be to improve its actual disclosure practices. Which of these two ways a central bank will prefer is likely to depend on the accompanied difficulties and costs of implementation.

It might not be so easy to develop a single effective communication strategy because the manner in which perceptions are being formed is likely to differ between agents and perceptions not only depend on transparency knowledge but also on psychological factors. For central banks it will be useful to keep these findings in mind when designing an effective communication strategy.

8. Appendix to Chapter 5

A Description of the data

The CentER panel

CentERdata is specialized in performing internet-based surveys. It is made sure that the members of the CentERpanel are representative of Dutch society. CentER-data selects new members by phone. Those who do not have internet access yet can participate as well. By using their television screen as a monitor and using a set-top box which they in case of no internet access receive they can answer the questions. The CentERpanel consists of over 2000 Dutch households, which remain panel members for longer periods. Some of these households participate with more than one member, each with an own ID-number. Questionnaires on various topics are set out throughout the weekend (from Friday afternoon until Tuesday night). More details on the CentERpanel can be found on http://www.uvt.nl/center data/en/.

Asking questions through an internet survey has several advantages. For example, people can answer the questions anonymously which prevents a bias towards socially desirable answers. Survey participants can decide themselves when they have enough time to fill in the questionnaires and questions are asked in the same way to all participants. If desirable, it is possible to repeat surveys by asking the same persons again. Last, respondents do not need to answer background questions every time they fill in a questionnaire. One disadvantage compared to phone surveys is that there is less room to tailor questions to the specific respondent.

The age of the respondents in our sample is on average 49.6, with the youngest participant being 16 and the oldest 92. With a share of 53.6%, males are in the majority. On average the respondents' households earn a monthly after tax income of 2554 Euro. 34.5% of the respondents have had a high degree of education (either a higher vocational education or an university education) and 11% deals every day with financial, economic, or monetary matters during working hours. Possible implications of the slight overrepresentation of males, highly educated people, older people, and higher income households are discussed in the last section of this chapter.

Table A1. Various explanatory variables

Variable	Measurement
Age	2007-year of birth
Gender	1=male; 0=female
Education	1=higher vocational education or university education; 0=primary education/preparatory intermediate vocational education/secondary pre-university education or intermediate vocational education
Income	12 classes from gross monthly income of less than € 500 to more than € 7500
Job status	1=paid job; 0=other
Social class	scale from 1 to 5 (1= low; 5= high)
Urbanization	scale from 1 to 5 (1=not urbanised; 5=very strong urbanisation)
Region	0=North (Groningen, Friesland and Drenthe), East (Overijssel, Flevoland and Gelderland), and South (Noord-Brabant and Limburg); 1= West (Utrecht, Noord-Holland, Zuid-Holland and Zeeland).
Optimist	self-assessment, scale from 1 to 5 (1=very pessimistic; 5=very optimistic)
Economic knowledge (SA)	self-assessed knowledge about economic developments like price changes, economic growth and unemployment, scale from 1 to 5 (1=very poor; 2=poor; 3=neutral; 4=good; 5=very good)
Specific financial knowledge (SA)	self-assessed knowledge about their own financial situation, scale from 1 to 5 (1=very poor; 2=poor; 3=neutral; 4=good; 5=very good)
General financial knowledge (SA)	self-assessed knowledge about financial matters in general, scale from 1 to 5 (1=very poor; 2=poor; 3=neutral; 4=good; 5=very good)
Transparency knowledge (SA)	self-assessed knowledge about the transparency of the ECB, scale from 1 to 5 (1=very poor; 2=poor; 3=neutral; 4=good; 5=very good)
ECB known	1=ECB is known; 0=ECB is not known (before giving a definition to the respondents)
Economic job	job experience with monetary, financial or monetary matters (0=no; 1=yes)
Economic expert	daily job experience with monetary, financial or monetary matters (0=not daily or not at all; 1=yes, daily)

Note: Multicollinearity is not a problem. The mean Variance Inflation Factor (VIF) is 1.58 (the minimum is 1.03 and the maximum is 2.37 with N=1519). As a rule of thumb a VIF smaller than 10 is fine.

Table A2. Knowledge Indicators (KI)

		possible answers and the scores attached to them		
		yes	no	I don't know
Political				
KI1a	ECB's goals laid down	1	0	0
KI1b	ECB's main task is supporting the economy	0	1	0
KI1c	ECB's main task is supporting price stability	1	0	0
KI1d	ECB's main goal expressed by a number	1	0	0
KI1dalt	ECB's main goal expressed by a number	1	1	0
KI1e	ECB is independent	1	0	0
Economic				
KI2a	ECB provides economic data	1	0	0
KI2b	ECB provides economic forecasts	1	0	0
KI2c	ECB provides economic models	1	0	0
Procedural				
KI3a	ECB's interest rate decisions are made in a clear fashion	1	0	0
KI3aalt	ECB's interest rate decisions are made in a clear fashion	1	1	0
KI3b	ECB provides comprehensive minutes	0	1	0
KI3c	ECB provides voting records	0	1	0
Policy				
KI4a	ECB announces interest rate decisions immediately	1	0	0
KI4b	ECB immediately explains the interest rate decision	1	0	0
KI4c	ECB tells future policy preferences	0	1	0
Operational				
KI5a	ECB provides information about relevant economic shocks	1	0	0
KI5b	ECB provides information about forecasting errors	0	1	0
KI5c	ECB provides information about its performance	0	1	0
KI5calt	ECB provides information about its performance	1	1	0

Table A3. Transparency knowledge indices

Variable	Description	Range
KI_political	knowledge index about the ECB's policital transparency	from 0 (all questions wrong) to 5 (all questions good)
KI_economic	knowledge index about the ECB's economic transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_procedural	knowledge index about the ECB's procedural transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_policy	knowledge index about the ECB's policy transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_operational	knowledge index about the ECB's operational transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_political_alt	alternative knowledge index about the ECB's policital transparency	from 0 (all questions wrong) to 5 (all questions good)
KI_procedural_alt	alternative knowledge index about the ECB's procedural transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_operational_alt	alternative knowledge index about the ECB's operational transparency	from 0 (all questions wrong) to 3 (all questions good)
KI_total	aggregate knowledge index = 0.6*KI_political + KI_economic + KI_procedural + KI_policy + KI_operational	from 0 (all questions wrong) to 15 (all questions good)
KI_total_alt	alternative aggregate knowledge index = 0.6*KI_political_alt + KI_economic + KI_procedural_alt + KI_policy + KI_operational_alt	from 0 (all questions wrong) to 15 (all questions good)

Table A4. Perceived ECB transparency on various aspects

	"absolutely not transparent" and "not transparent"		"transparent" and "very transparent"	ranking
economic	9%	<	20%	1
policy (current)	11%	<	18%	2
political	10%	<	16%	3
procedural	15%	>	11%	4
operational	14%	>	10%	4
policy (future)	17%	>	9%	6

Note: About 55% of the people did not have a view on this issue and the rest (around 20%) has responded "neutral".

Table A5. Overlap between economic job and economic knowledge
Share of respondent (in %)

I \ II	very poor	poor	neutral	good	very good	I don't know
yes, daily	2%	7%	34%	52%	6%	0%
yes, but not daily	2%	9%	42%	42%	4%	1%
no	8%	28%	39%	16%	1%	8%

Note: I) Job experience with economic, financial or monetary matters. II) self-assessed economic knowledge.

B Satisfaction with the ECB's transparency

Table B1. Satisfaction with the ECB's transparency: probit analyses

	(1)		(2)		(3)	
Optimist	.19**	(0.01)	.17**	(0.02)	.20**	(0.01)
Transparency knowledge (SA)	.50**	(0.00)	.51**	(0.00)	.46**	(0.00)
KI_political	.14**	(0.00)				
KI_economic	.10*	(0.05)	.12**	(0.03)	.10*	(0.06)
KI_procedural	-.19**	(0.00)				
KI_policy	.22**	(0.00)	.26**	(0.00)	.24**	(0.00)
KI_operational	-.26**	(0.00)				
KI_political_alt			.17**	(0.00)	.18**	(0.00)
KI_procedural_alt			-.38**	(0.00)	-.34**	(0.00)
KI_operational_alt			-.13*	(0.06)	-.10	(0.13)
Age					-.00	(0.94)
Gender					-.09	(0.52)
Education					.05	(0.67)
Income					.04	(0.13)
Job					.17	(0.24)
Social class					.06	(0.30)
Urbanization					-.09**	(0.04)
Region					-.06	(0.62)
ECB known					-.32	(0.06)
Economic job					-.09	(0.47)
Economic expert					.15	(0.34)
Economic knowledge (SA)					-.10	(0.23)
Log likelihood	-366		-355		-395	
Pseudo R^2	0.15		0.18		0.16	
N	637		637		636	

Note: P-values are between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. Satisfaction with the transparency of the ECB is measured as follows: 1="yes, satisfied" (N=264); 0="no, not enough transparency" (N=381). "No opinion" (N=1144) and "too much transparency" (N=11) are not included in the analyses, although the results are robust to making 1="all dissatisfied people". The definitions of the explanatory variables are in Appendix A.

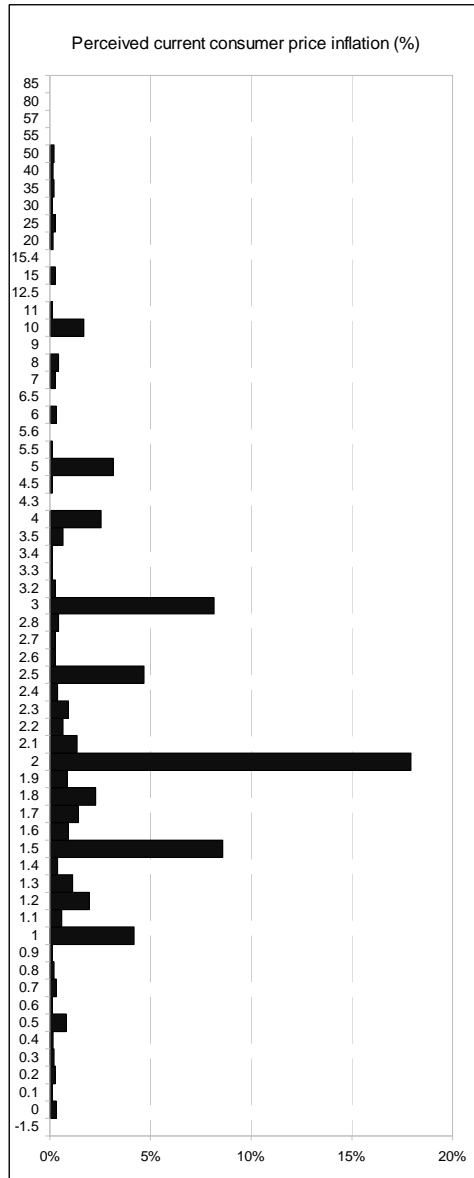## C Inflation perceptions and expectations

Figure C1. Perceived inflation

Note: The vertical axis contains all the different answers given to the question: "How high do you judge yearly inflation (the average percentage increase of the consumer price compared to a year ago) in The Netherlands at the moment?". On the horizontal axis, the percentage of people choosing a particular inflation rate is reported.
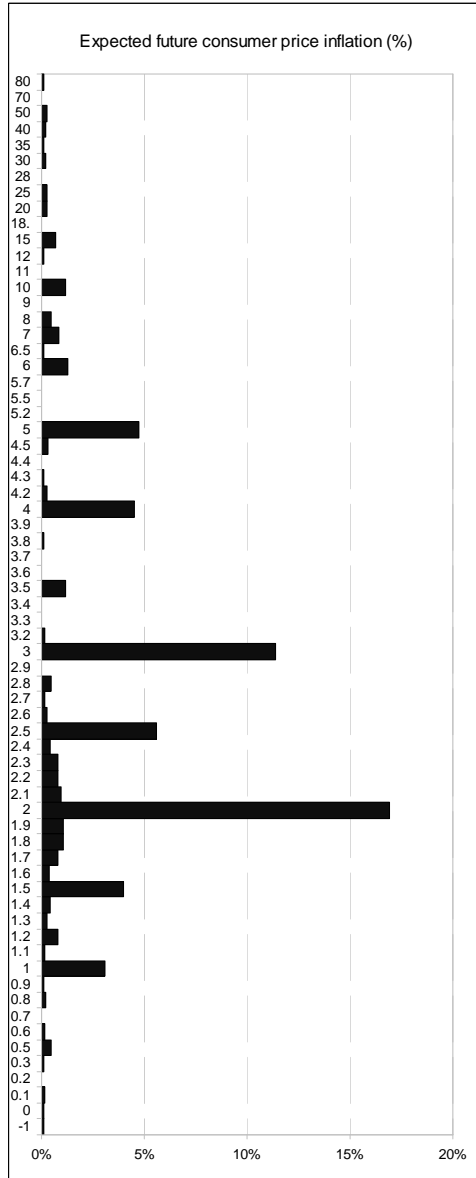
Figure C2. Expected inflation

Note: The vertical axis contains all the different answers given to the question: "How high do you judge yearly inflation (the average percentage increase of the consumer price compared to a year ago) in The Netherlands in the medium term (2 years from now)?". On the horizontal axis, the percentage of people choosing a particular inflation rate is reported.

Table C1. Correctness of inflation perceptions and expectations: Including transparency perceptions directly

	(1) correctness of π^p		(2) correctness of π^e	
Constant	-.70*	(0.10)	-1.75**	(0.00)
Age	.01	(0.12)	.01**	(0.01)
Gender	.15	(0.14)	.24**	(0.04)
Education	.01	(0.92)	.09	(0.40)
Income	.02	(0.32)	-.02	(0.35)
Job	.20*	(0.08)	-.01	(0.97)
Social class	.08*	(0.09)	.02	(0.75)
Urbanization	.03	(0.44)	-.04	(0.34)
Region	-.00	(1.00)	-.06	(0.58)
Optimist	-.01	(0.85)	-.02	(0.75)
ECB known	.41**	(0.00)	.29**	(0.03)
Economic job	.00	(0.99)	-.03	(0.78)
Economic expert	.08	(0.56)	.12	(0.41)
Economic knowledge (SA)	.09	(0.12)	.10*	(0.10)
Transparency perceptions	.13**	(0.01)	.12**	(0.03)
Model	probit		probit	
Pseudo R^2	0.05		0.04	
Log likelihood	-625		-502	
N	964		964	

Note: P-values between brackets. *=significant at a 10%-level. **=significant at a 5%-level. SA=self-assessed. See Appendix A for an explanation of the independent variables. Explanation of the dependent variables:
(1) correctness of inflation perceptions: 1 if $\pi^p \in [1.5\%, 2.1\%]$, 0 otherwise (including the "I don't know" responses).
(2) correctness of inflation expectations: 1 if $\pi^e \in [1.8\%, 2\%]$, 0 otherwise (including the "I don't know" responses).

CHAPTER 6

Optimal central bank transparency

Abstract[1]

Should central banks increase their degree of transparency any further? We show that there is likely to be an optimal intermediate degree of central bank transparency. Up to this optimum, more transparency is desirable: it improves the quality of private sector inflation forecasts. But beyond the optimum people might: (1) start to attach too much weight to the conditionality of their forecasts, and/or (2) might get confused by the large and increasing amount of information they receive. This deteriorates the (perceived) quality of private sector inflation forecasts. As a result inflation is set in a more backward looking manner resulting in higher inflation persistence. By using a panel data set on the transparency of 100 central banks we find empirical support for an optimal intermediate degree of transparency at which inflation persistence is minimized. Our results indicate that while there are central banks that would benefit from further transparency increases, some already have reached the optimal level.

1. Introduction

Only a few decades ago monetary policy making was veiled in secrecy. In 1986 Goodfriend summarized the arguments for secrecy that were used by the Federal Reserve in the Merrill versus FOMC court case. It encouraged further research on the desirability of secrecy because the theoretical arguments were inconclusive. Nowadays, central banks have made several steps towards transparent monetary policy regimes and they pay a lot of attention to day to day communication with the financial markets and the public at large.

Central banks are likely to continue their transparency enhancing practices. The most recent step of the US Federal Reserve was to increase and expand the content of the disclosed economic forecasts of the Federal Reserve Board members and the Reserve Bank presidents. Bernanke's comments on this move point out that these transparency changes:

"...represent just one more step on the road toward greater transparency at the Federal Reserve." (Bernanke, November 14th 2007).

Not only is transparency used as a tool for independent central banks to be held accountable, it is often argued that transparency is also desirable from an economic

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point of view. Policymakers and researchers have discussed the possible economic effects of central bank transparency. Theoretically, the debate on the desirability of transparency is a continuing story, although the more recent literature tends to yield outcomes in favor of more transparency. Most empirical research concludes that previous transparency enhancements were desirable from an economic standpoint. For example, they resulted in improved anticipation of monetary policy and better anchored inflation expectations (Chapter 4). For a recent overview of the transparency literature we refer to Chapter 2.

We investigate whether it is desirable for central banks to increase their degree of transparency any further. We use two theoretical arguments in the transparency debate (uncertainty and confusion/information overload) to substantiate our case for the presence of an optimal intermediate degree of transparency. While the previous theoretical literature makes a case for or against *one particular* kind of transparency, e.g. the publication of the goals of the central bank or the central banks forecasts of inflation, our analysis is about the optimal degree of *overall* monetary policy transparency.

We relate central bank transparency to the quality of private sector forecasts. At low degrees of transparency, more information provision (e.g. about the complexity of monetary policy making and the conditionality of policy and economic forecasts) might be desirable because it could improve the private sector's forecasts of inflation. However, at some degree of transparency more transparency might be detrimental because it could worsen these forecasts. We argue that for two reasons this is likely to hold.

The first reason is that a lot of transparency could lead to *uncertainty*. By providing too much information, people start to focus too much on the complexity of monetary policy making and the uncertainty surrounding forecasts. While the actual quality of their forecasts might not be affected, agents perceive the quality of their forecasts to be worse.

The second reason is that a high degree of transparency could lead to an *information overload* and *confusion*. The assumption that individuals are capable to absorb, understand, and weigh all the information that the central bank provides is probably too strong. Although some degree of transparency might help clarify matters, it is likely that a large amount of information disclosure would result in an information overload and confusion. At some level of transparency agents can not see the forest for the trees, which would deteriorate their inflation forecasts.

Since the (perceived) quality of inflation forecasts is difficult to measure we use the degree of backward lookingness of inflation as a proxy. The latter is negatively related to the (perceived) quality of inflation forecasts. Price setters are more inclined to determine price increases based on past inflation when they can not rely on their forecasts of future inflation. We use a New Keynesian model to illustrate that the higher the degree of backward lookingness of price setting is, the more persistent inflation is, which is detrimental for the society's welfare. There is an optimal degree of central bank transparency at which inflation persistence is minimized. For central banks it is relevant to have insight in inflation persistence: the speed with which inflation reacts to shocks hitting the economy. The faster inflation returns to its

equilibrium level (the inflation target in case of credible monetary policy) after the occurrence of shocks to the economy, the easier it is for central banks to perform monetary policy.

To our knowledge the empirical research on an optimal degree of central bank transparency has just started and focusses on analyzing the effects of particular aspects of transparency instead of the overall level. It shows us that most forms of transparency lead to better economic outcomes while some do not. Therefore it seems to be optimal to have an intermediate degree of transparency by limiting some forms of transparency. For example, Ehrmann and Fratzscher (2008) demonstrate that limiting the communication in the week before Federal Open Market Committee meetings is a useful way to prevent market volatility and speculation.

Theoretically both the uncertainty- and the confusion/information over- load-argument support the idea of an optimal intermediate degree of transparency. We can test this hypothesis empirically by relating transparency to inflation persistence. By allowing for a quadratic relationship between central bank transparency and inflation persistence we build further on the research of Dincer and Eichengreen (2007), who find a negative relationship between central bank transparency and inflation persistence. We find empirical support for our hypothesis by using their panel data set on the transparency of 100 central banks. Our finding that an intermediate degree of transparency (so neither full secrecy nor complete transparency) is optimal is robust to various settings. Given the nature of the data, however, it is difficult to be certain about the exact optimal degree of transparency. First, transparency is difficult to measure. Constructed indices are necessarily subjective in their choice of which aspects of transparency to include and how to weigh these components. Second, our empirical analysis has to be performed using transparency values that are observed in practice. Our baseline regressions lead to an optimum of 6, whereas theoretically it could be somewhere between 0 and 15. We have some reason to believe that the actual optimal degree of transparency might be higher. Low degrees of transparency are observed more often. The average degree of transparency in the sample is about 4 and very high transparency scores are not observed at all (13.5 is the highest value in our data set). A regression with only OECD countries results in an optimal degree of 7.5. The optimum is likely to be central bank-specific, which makes sense since the information processing capacity of its public differs too. Despite uncertainty about the exact optimum, our results do point out that while several central banks (especially those of developing countries) are likely to benefit from further transparency increases, there is a transparency level at which more public information is detrimental. Central banks would be wise to not become completely transparent.

First we will expound our theoretical case for an optimal intermediate degree of central bank transparency (Section 2). We discuss all *possible* empirical relationships between central bank transparency and inflation persistence one might observe in practice, including our hypothesis: the optimal transparency regime. Then, in Section 3, we talk through our empirical analysis and present the *actual* empirical relationship we find. Last, we conclude in Section 4.

2. Optimal central bank transparency: Theory

In this theoretical section, we first summarize the related literature on optimal degrees of transparency in Section 2.1. Then, we discuss our case for an optimal intermediate degree of transparency in four steps in Section 2.2.

2.1. Related theoretical literature

A lot of theoretical research has been conducted on the desirability of central bank transparency from an economic viewpoint. Findings both in favor and against transparency exist. Chapter 2 contains an overview of this literature and shows there is a tendency of the more recent work to favor most, although not all, forms of central bank transparency. Here we briefly discuss research that points at the desirability of an *intermediate* degree of transparency.

Jensen (2002) shows that, within a forward looking model, some intermediate degree of transparency may be optimal. In his New Keynesian model it is easier for the public to distill the intentions of the central bank when it is transparent about the control errors. Inflation expectations and, as a result, inflation become more responsive to the central bank's monetary policy. This will most likely result in more attention of the central bank to inflation. This is beneficial for a central bank that faces a low degree of credibility but it could be undesirable for a relatively credible central bank. In case of transparency, stabilizing output costs more in terms of inflation. The trade-off between credibility (and the related degree of inflation) and the flexibility to stabilize output determines which level of transparency is optimal.[2]

Another argument in favor of limiting the degree of central bank transparency is provided by Morris and Shin (2002) who show that a lot of public information might be harmful as it crowds out private information. In their model, economic agents have an incentive to match the underlying economic fundamentals, about which they can have both private and public information, and they want to coordinate their actions with other agents (no value added from an aggregate point of view). The coordination motive might lead agents to put more weight on the public signal than is justified by the level of its precision. As a result, the damage caused by noise in the public information (worsening the forecasts of economic fundamentals and as a result the actions taken) might be higher. However, Svensson (2006) argues that for empirically reasonable parameter values, more public information is desirable in the Morris and Shin (2002) model. The only exception is when: (1) each agent puts more weight on the coordination motive than on the motive to bring actions in line with economic fundamentals, *and* (2) the noise in the public signal is at least eight times higher than the noise of the private signal. This is unlikely because central banks spend a lot of resources on collecting and interpreting data.

In contrast, by introducing costs in the Morris and Shin framework Demertzis and Hoeberichts (2007) show that, for reasonable parameter values, more transparency is

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[2]If instead the central bank would reveal its preferences for output directly, then expectations do not react to central bank's actions and the central bank would remain flexible to stabilize output.

not always desirable. When it is costly for the private sector to process information, more public information reduces the incentives for the private sector to gather their own private information.

With a model in which public information is endogenous, Morris and Shin (2005) point again at the possible negative effects of public information. Providing a lot of information to steer market expectations might be undesirable because it could lower the informativeness of financial markets and prices and, therefore, worsen public information.

Several researchers argue, in contrast to Morris and Shin (2002), that coordination is useful from an aggregate viewpoint. But even then, maximum transparency need not be optimal. This is for example shown by Walsh (2007), who models that a reduction of price dispersion is desirable. His analysis shows that increased precision of central bank's forecasts of *cost* disturbances (or lower persistence of these shocks) increases the optimal degree of economic transparency. More transparency makes it easier for the private sector to distinguish between supply and demand shocks. It then becomes easier to neutralize demand shocks without destabilizing inflation and output. In addition, the detrimental effect of more transparency about the central bank's signal of supply shocks, the increase of the volatility of private sector inflation expectations and through it inflation, is lower when the central bank's forecasts of the supply shocks are more accurate. In contrast, the optimal level of transparency turns out to be higher when the errors of the central bank's forecasts of *demand* disturbances are larger (or these disturbances become more persistent) because transparency can prevent forecast errors to spill over to affect inflation.

Dale et al. (2008) show that the disclosure of *certain* information (e.g. the inflation target of the central bank) is helpful because it improves private sector expectations. However, like Morris and Shin (2002), the communication of *uncertain* information (e.g. inflation forecasts) might be detrimental because agents could put too much weight on it. The mechanism underlying this result is different than in Morris and Shin (2002). When the central bank communicates its forecasts of inflation, the private sector uses it in combination with its own forecasts to form inflation expectations. The private sector has to estimate the relative quality of the forecasts to weigh these forecasts accordingly. The more uncertain the forecasts of the central bank are, the higher the risk that mistakes in determining the weights result in poorer private sector expectations compared to the no-communication case. When the central bank communicates certain information (its inflation target), the private sector forecasts are of relatively high quality (compared to a situation without central bank communication) and the risk that additional, uncertain, information works as a source of distraction is therefore higher.

Cukierman (2008) probes the limits of central bank transparency both by looking at its feasibility and its desirability. He argues that for central bankers it is not *feasible* to be transparent about everything because of their limited knowledge about how the economy works. For example, because it is hard to measure the output gap it is difficult to be transparent about it. Even when abstaining from these feasibility constraints, Cukierman (2008) argues that it is not *desirable* for a central bank to be transparent about everything. For example, using a variant of the Diamond Dybvig

(1983) model of bank runs, the immediate disclosure of private information about threats to financial stability turns out to be undesirable.

2.2. A case for an optimal intermediate degree of transparency

Our research embroiders on this recent transparency literature. Our hypothesis is that neither secrecy nor complete transparency is optimal, but some intermediate degree is to be preferred. Figure 1 summarizes the steps we take to underpin this hypothesis.

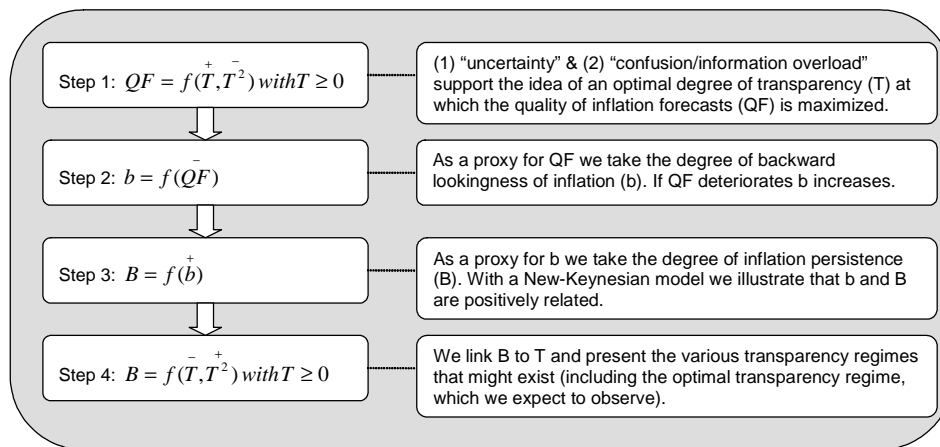|	
Step 1: $QF = f(\overset{+}{T}, \overset{-}{T^2})\, with\, T \geq 0$	(1) "uncertainty" & (2) "confusion/information overload" support the idea of an optimal degree of transparency (T) at which the quality of inflation forecasts (QF) is maximized.
Step 2: $b = f(\overset{-}{QF})$	As a proxy for QF we take the degree of backward lookingness of inflation (b). If QF deteriorates b increases.
Step 3: $B = f(\overset{+}{b})$	As a proxy for b we take the degree of inflation persistence (B). With a New-Keynesian model we illustrate that b and B are positively related.
Step 4: $B = f(\overset{-}{T}, \overset{+}{T^2})\, with\, T \geq 0$	We link B to T and present the various transparency regimes that might exist (including the optimal transparency regime, which we expect to observe).

Figure 1. A case for optimal transparency: Theoretical underpinning

We start our case for an optimal degree of transparency by relating the degree of central bank transparency (T) to the quality of private sector inflation forecasts (QF). By using two arguments in the transparency debate, uncertainty and confusion/information overload, we point out that there is likely to be an optimal degree of central bank transparency at which the quality of inflation forecasts is optimized. Note that we analyze the desirability of central bank transparency in general, whereas previous theoretical research focusses on one or a couple of particular aspect of transparency (see Chapter 2). The second step is then to find a proxy for the quality of inflation forecasts. We use the degree to which inflation is formed in backward looking way (b). Since this is also not easy to measure, we point out that the higher b is the more persistent inflation is. This is illustrated with a standard New-Keynesian model. The last step is then to relate this inflation persistence measure (B) to the degree of transparency. We show that although there are five different types of transparency regimes possible, our argumentation leads to the hypothesis that there exists an optimal transparency regime: an intermediate degree of transparency at which inflation persistence is minimized. Next, we will discuss our steps one by one in more detail.

2.2.1. Step 1: Transparency and the quality of forecasts

We present two arguments why there might be a link between central bank transparency and the quality of inflation forecasts of the private sector: the uncertainty-argument and the confusion/information overload-argument.

1) Uncertainty

The extent to which a central bank achieves its goals is very important for its credibility. For a central bank it is therefore helpful to explain the conditionality of its monetary policy steps and outcomes. Otherwise deviations from the central bank's announced goals or policy path might harm its reputation. Issing (2005) stresses that communication is not that simple: the central bank needs to find a balance between the need to be clear and the need to convey the complexity and conditionality of monetary policy making. The central bank faces uncertainty about various things, e.g. shocks hitting the economy, how well its own model explains reality and how effective it is in influencing inflation expectations (Woodford 2003). Issing (2005) argues that one good communication strategy would be to use clear wording to explain complex facts but not provide the illusion that the world is certain.

The first argument we use to establish our case for the presence an optimal degree of transparency is what we call the *uncertainty argument*. At low levels of transparency, the private sector does not have a solid basis for making inflation forecasts. Up to the optimal degree of transparency, more central bank transparency is likely to result in more insight into future inflation and its conditionality and to improve the quality of the forecasts of private agents. However, beyond the optimal degree of transparency, additional transparency is undesirable. A lot of information on the conditionality might lead people to focus too much on this conditionality which reduces the perceived quality of their forecasts.

2) Confusion/information overload

Another argument why there is likely to be an optimal degree of central bank transparency is the *confusion/information overload argument*. At low levels of transparency, additional information provision by the central bank might be a helpful tool for the private sector to improve the quality of their inflation forecasts. However, at some degree of transparency additional transparency (defined as providing additional information) is likely to cause confusion instead of clarity. With a lot of information communicated it will become unrealistic to assume that individuals are capable to absorb, understand and weigh all this information. They are therefore likely to suffer from an overload of information. The resulting confusion would worsen the quality of their inflation forecasts. Previous research supports this confusion/information overload argument.

The idea that a share of the population forms inflation expectations in a bounded rational way is supported by the outcomes of a survey among 1800 Dutch households, which are presented in Chapter 5. For example, when asked for their inflation expectations persons are more inclined to report round numbers. In addition, some respondents report inflation expectations that are very unlikely (e.g. 80%) which casts

doubt on their understanding of the concept of inflation. Most respondents already suffer from an information overload, indicated by the fact that their knowledge about the European Central Bank's transparency practices is lacking or even incorrect. This supports the idea of limited processing capability (in line with Sims 2003).[3]

Deviation of behavior from full rationality is shown by behavioral economics research. Psychological factors might affect the formation of inflation expectations. For example, people often disregard new information that is not in line with their previous beliefs (Rabin 1998: 26). This would make the gradual adjustment towards the rational value of inflation expectations slower as people are slower to adapt their beliefs. In addition, people might suffer from a *confirmation bias*: they interpret information in such a way that their prior beliefs are confirmed. This *belief perseverance* also explains slow adjustments of inflation expectations. Economic agents interpret information differently because of their dissimilar views on the environment (Babcock and Loewenstein 1997). These heuristics make it easier to perform complex tasks but they may lead people to make large mistakes (Tversky and Kahneman 1974). An overload of information could lead people to, unconsciously, rely more on these heuristics. Assuming learning agents, at some point of transparency more public information might reduce the learning speed, because people have to process more (confusing instead of clarifying) information. An information overload is therefore likely to result in worse inflation forecasts.

The "sticky-information"-model of Mankiw and Reis (2002) encompasses the idea that macroeconomic information spreads slowly through the population. Mankiw and Reis (2002) mention two reasons why only a share of price setters updates its prices: 1) the costs of acquiring information, and 2) the costs of re-optimization. Those that do adjust their prices realize that not everybody does so and this awareness will limit the size of their adjustment. In this model expectations are formed in a rational way, but this does not happen so often. We believe that at a low degree of transparency, more transparency could lead to a reduction of the costs of acquiring information. But if transparency becomes too high it becomes more difficult to interpret all the provided information correctly which instead raises the costs of distilling useful information. Assuming the resources spend on gathering useful information remain constant, then the higher information costs worsen the inflation forecasts. Zbaracki et al. (2004) show that these costs of gathering and processing information are much more relevant when deciding whether to change prices than the costs of making new price lists.

Another explanation for inflation persistence is given by Amato and Laubach (2003). They show that when not all price setters are optimizing but some have rule-of-thumb behavior (like, e.g., in Gali et al. 2001) then there is endogenous inflation persistence. Some agents have limited capacity to form rational expectations. These rule-of-thumbers imitate the behavior of all agents one period earlier. Depending on the random optimization costs price setters either behave optimally or as a rule-of-thumber. The higher the number of rule-of-thumbers the higher inflation persistence will be. We argue that too much transparency could result in an information overload,

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[3]Alternatively, it could be that, although the information is freely available, it does not reach the public (either because of disinterest on the side of the public or not enough effort on the side of the central bank).

therefore higher optimization costs, which would lead to a larger share of rule-of-thumb price setters and eventually in higher inflation persistence.

Roberts (1998) analyzes survey inflation expectations data and finds support for an intermediate degree of rationality: inflation expectations are neither formed in a purely rational way nor by only using lagged inflation. Two models fit the data. The first is a "partly adaptive model" where a share of the population forms inflation expectations by looking at lagged inflation, while others form expectations in a rational way. In the second model Roberts assumes a model with "habit persistence" in inflation expectations. Inflation expectations are described as "stubborn" in the sense that they adjust only gradually towards the rational value. Professional forecasters might be hesitant to change their forecasts of inflation for two reasons. First, they could be afraid to look foolish when making large adjustments in their forecasts in response to new information. Therefore, they would prefer smaller adjustments. Second, they might want to make forecast that do not differ that much from those of other professionals. This would result in backward looking behavior, as forecasters would base their forecasts partly on the previously published forecasts of other professionals. These forecasts of professionals are likely to affect the inflation expectations of, e.g., households. Carroll (2001) shows that the inflation expectations of the public at large follow those of professional forecasters with a lag.

Let us now relate these findings to central bank transparency. When agents care about coordination with other agents (argued by Morris and Shin 2002, too) then they are more likely to respond to new information by the central bank not only when they believe it would improve the quality of their inflation forecasts but also when they believe other forecasters will look at the *same* information. This behavior would increases the likelihood that they adjust their expectations in a similar way. Now assume that the central bank becomes very transparent. In that case a lot of information is produced and for agents it is more difficult to know which kind of information other forecasters will pick up. In this information overload-situation they might be more induced to have a higher degree of backward looking expectations formation since it is difficult to form good quality inflation forecasts and to predict the inflation forecasts of other agents. Agents are more hesitant to react to news because they are not sure whether their forecast will remain close to those of other agents. In addition, with a lot of public information it is more easy to pick up the wrong information and to make mistakes, which makes people careful to put too much weight on inflation forecasts. Furthermore, it will be more difficult to process all the information. The gradual adjustment process towards the rational value of inflation expectations that Roberts (1998) describes, is then likely to take longer. Alternatively, referring to Roberts' "partly adaptive model", the share of people forming inflation expectations by looking at lagged inflation is probably higher in case of an information overload because the quality of the inflation forecasts is worse.

Examples

One example of a case in which transparency might have led to more confusion and uncertainty is transparency about the European Central Bank's "Two Pillar Strategy". This strategy puts an important role on (1) money and (2) a broadly based

judgement of future price developments and risks to price stability at a Euro area level. According to common used transparency measures more information provision results in a higher degree of transparency. The fact that the European Central Bank communicates it follows a two-pillar strategy is transparency enhancing (e.g. Eijffinger and Geraats 2006). However, in reality it need not be that more information leads to more clarity. De Haan et al. (2005: 16-25) argue that the unclear and changing weights of the pillars may confuse people. The conclusion of an 2003 evaluation of the ECB's monetary policy strategy was that, although it was helpful internally as a framework for analysis and debate, it was difficult to communicate externally.[4] This is confirmed by the research presented in Chapter 5. A share of 1/6 of Dutch households members feel interest rate decisions are not made in a clear fashion. This share is even up to 1/2 for those respondents that can be qualified as "economic experts".[5] An unclear strategy results into a worse quality of the inflation forecasts of the public via more confusion.

Another example is the publication of inflation fan charts by the Bank of England By showing how uncertain it actually is about future inflation in a graph, people might not only start to put too much weight to the uncertainty of central banks, but they might also get confused. As a response the actual and perceived quality of their own forecast might deteriorate.

As a last example we would like to mention the Financial Stability Reports. They are often so long that readers can not see the forest for the trees. Therefore it might be difficult to grasp a clear measure and it might be easy to make mistakes when weighing all the included information. Also it is more easy to interpret information incorrectly and in line with previous believes. This is detrimental for the private sector forecasts.

Ehrmann and Fratzscher (2005) support the idea that too much transparency might cause confusion. In contrast to transparency about different points of views about the economic outlook, transparency about committee members' disagreement about monetary policy worsens the extent to which monetary policy decisions are anticipated.

2.2.2. Step 2: The degree of backward lookingness of inflation as a proxy for the quality of forecasts

Because we can not measure the quality of forecasts directly, we take the degree of backward lookingness of inflation (b) as a proxy. If price setters are unable to forecast inflation very well, they are likely to set prices by putting much weight to something they are certain about, namely inflation in the past. The lower the quality of the inflation forecasts is, the larger the degree to which inflation will be set in a backward looking manner (either by lowering the frequency of price updating behavior of all agents or by increasing the share of rule-of-thumbers). Note that even a change in the

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[4]See the ECB press release of 8 May 2003: "The ECB's monetary policy strategy" for more details. The evaluation led to improved external communication (e.g. the introductory statement of the President at the press conference after monetary policy meetings).
[5]Two different expert-definitions are used: (1) respondents with very good economic knowledge (self-assessment) and (2) respondents that deal with economic, financial or monetary matters on a daily basis.

perceived quality of private sector forecasts is enough to shift the degree of backward lookingness. When people start to realize that the central bank is uncertain about future policy outcomes the *actual* quality of their inflation forecasts need not change, but it does change the *perceived* quality of their forecasts, which is relevant for price-setting behavior.

2.2.3. Step 3: Inflation persistence as a proxy for the degree of backward lookingness of inflation

Since it is difficult to measure the private sector's weight that is put on inflation forecasts when forming current inflation, we use inflation persistence instead. The higher the degree of backward lookingness, the more persistent inflation will be. We illustrate this with a standard hybrid New-Keynesian model:

$$(2.1) \qquad\qquad x_t = E_t(x_{t+1}) - a(i_t - E_t(\pi_{t+1})) \qquad a > 0$$

$$(2.2) \qquad \pi_t = (1-b)E_t(\pi_{t+1}) + b(\pi_{t-1}) + cx_t + e_t \qquad e_t \sim idd(0, \sigma^2); \ 0 \leq b \leq 1$$

Where x is the output gap, i is the nominal interest rate, π is the inflation rate, b measures the degree to which inflation formation is backward looking, t is the time indicator, E is the expectations operator and e is and exogenous shock to inflation. Equation (2.1) is the forward-looking IS-curve. When b=0 equation (2.2) is the traditional New Keynesian Phillips curve and there is no endogenous inflation persistence (the term $b(\pi_{t-1})$ falls out). Instead when b>0 we get a modified version of the New-Keynesian Phillips curve with endogenous inflation persistence. The higher b is, the higher the endogenous inflation persistence will be.

In addition to endogenous inflation persistence (b>0), it is possible to add exogenous inflation persistence to the model by making the shock to inflation (e_t) persistent ($e_t = \rho e_{t-1}$). Then even when inflation is fully forward looking (b=0), it is possible to have inflation persistence. In case b>0, the persistence resulting from price shocks is even higher. In addition to the exogenous persistence these shocks create (via e_t), they cause additional endogenous inflation persistence (via $b(\pi_{t-1})$). Assuming persistent shocks would only amplify the difference in inflation persistence between the cases b=0 and b>0 but not change the qualitative insight that the higher b is, the higher inflation persistence is.

The central bank is minimizing the following loss function when determining its monetary policy:

$$(2.3) \qquad\qquad V_t = E_t \sum_{i=0}^{\infty} \beta^i \{\pi_{t+i}^2 + \lambda x_{t+i}^2\}$$

V_t is the expected loss of the central bank, β is the discount factor and λ measures the central bank's preference for output stabilization relative to its preference for price stability. Note that the choice of this loss function can be justified by referring to a representative agent maximizing expected utility (with a slight modification, see Woodford 2003).

Inflation persistence is lower when inflation is less backward looking (b is lower). A lower degree of backward lookingness leads to a lower expected loss for the central bank. For the central bank it then becomes easier to bring inflation faster and better

in line with its inflation goal via the management of inflation expectations. The output costs of reducing inflation will be lower resulting in a better inflation output trade-off. For the central bank more insight into the Phillips curve is relevant since it provides information about the effectiveness of its policy. As Yellen (2007) argues, it would improve central banks' inflation forecasts and help them get more understanding of which policy they should follow.

2.2.4. Step 4: Linking central bank transparency to inflation persistence

Both uncertainty and confusion/information overload suggest the presence of an optimal intermediate amount of central bank transparency at which inflation persistence is minimized. Each theory can be expressed by one equation that relates central bank transparency (T) to inflation persistence (B).

$$(2.4) \qquad\qquad B_1 = j_1 T + h_1 T^2 + Z \quad T \geqq 0$$

$$(2.5) \qquad\qquad B_2 = j_2 T + h_2 T^2 + Z \quad T \geqq 0$$

In equation (2.4) and equation (2.5) Z is a vector of control variables. Both arguments are in favor of an optimal degree of central bank transparency and imply the presence of a parabola ($j_n<0$ and $h_n>0$). When we weigh these (n) theories according to their relevance (α_n) to get the overall relationship between central bank transparency and inflation persistence (see equation (2.6)), we still expect to observe a parabola ($\sum_{n=1}^{n=2} \alpha_n j_n<0$ and $\sum_{n=1}^{n=2} \alpha_n h_n>0$).

$$B = jT + hT^2 + Z$$

$$(2.6) \qquad with\ T \geqq 0;\ j = \sum_{n=1}^{n=2} \alpha_n j_n;\ h = \sum_{n=1}^{n=2} \alpha_n h_n;\ and\ \sum_{n=1}^{n=2} \alpha_n = 1$$

In equation (2.6) B is an index of inflation persistence, T is an index of transparency, Z is a vector of control variables. On the basis of the values of the coefficients for h and j, we can distinguish five possible transparency regimes:

I) *Secrecy* (h≥0; j>0 or h>0; j≥0). In this case complete secrecy results in the lowest degree of inflation persistence.

II) *Optimal transparency* (h >0;j<0). This is our hypothesis.

III) *Maximum transparency* (h≤0; j<0 or h<0; j≤0). Here more transparency is always better.

IV) *One low and one high transparency equilibrium* (h<0; j>0).

V) *Transparency is irrelevant* (h=0; j=0). In this case transparency is not related to inflation persistence.

Table 1 and Figure 2 give an overview of the various transparency regimes that result from different values for h and j.

Table 1. Transparency regimes

j\ h	0	+	-
0	irrelevance	secrecy	maximum transparency
+	secrecy	secrecy	two equilibria
-	maximum transparency	optimal transparency	maximum transparency

Note: This table gives an overview of the various transparency regimes that result from different settings of j and h in equation (2.6).
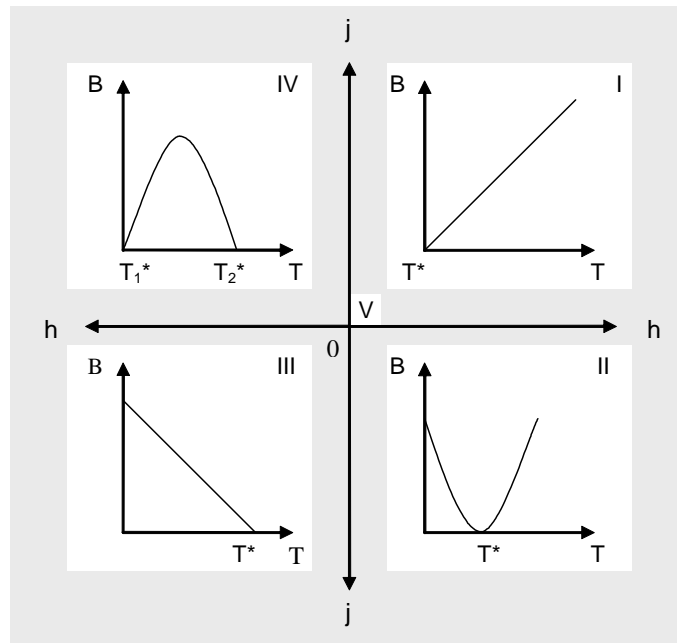

Figure 2. Various transparency regimes

Note: This figure gives an overview of the various transparency regimes that result from different settings of j and h in equation (2.6). B=index for inflation persistence, T=index for transparency and T* is the optimal degree of transparency at which inflation persistence is minimized. Five different transparency regimes are possible:
I) The secrecy regime (h$\geq$0; j>0 or h>0; j$\geq$0).
II) The optimal transparency regime (h >0;j<0).
III) The maximum transparency regime (h$\leq$0; j<0 or h<0; j$\leq$0).
IV) Two optimal degrees of transparency: one low (T_1*) and one high (T_2*) (h<0; j>0).
V) Transparency is irrelevant (h=0; j=0).
We have simplified graph I and III by drawing straight lines. Note however that this holds only when h=0. Instead when h$\neq$0, these lines have curvature. We did not plot regime V (it would be a horizontal line).

Now that we know the possible empirical relationships between central bank transparency and inflation persistence we can turn to the data and investigate for which transparency regime there is empirical support.

3. Empirical analysis

Several researchers have investigated the economic effects of central bank transparency (see Chapter 2 for an overview of the transparency literature). Some of this work relates transparency to inflation persistence. For example, in Chapter 4, using the transparency data of Eijffinger and Geraats (2006), it is shown that countries with a higher degree of central bank transparency have lower inflation persistence. This result is obtained by rearranging the persistence measures obtained for several countries by Levin et al. (2004). Dincer and Eichengreen (2007) have extended the transparency data set of Eijffinger and Geraats (2006). Using this data set, they confirm the negative relationship between transparency and inflation persistence. We build further on this empirical research by investigating the presence of a quadratic relationship between transparency and persistence and by including several control variables inspired by micro studies on inflation persistence.[6]

3.1. Transparency data

For this analysis we use the transparency data set of Dincer and Eichengreen (2007), who construct transparency indices similar to Eijffinger and Geraats (2006). Dincer and Eichengreen (2007) have extended the data set of Eijffinger and Geraats (2006) in two ways: (1) the sample is extended to 100 countries instead of 9, and (2) the data period is broadened to 1998-2005. Figure 3 gives an overview of the data.
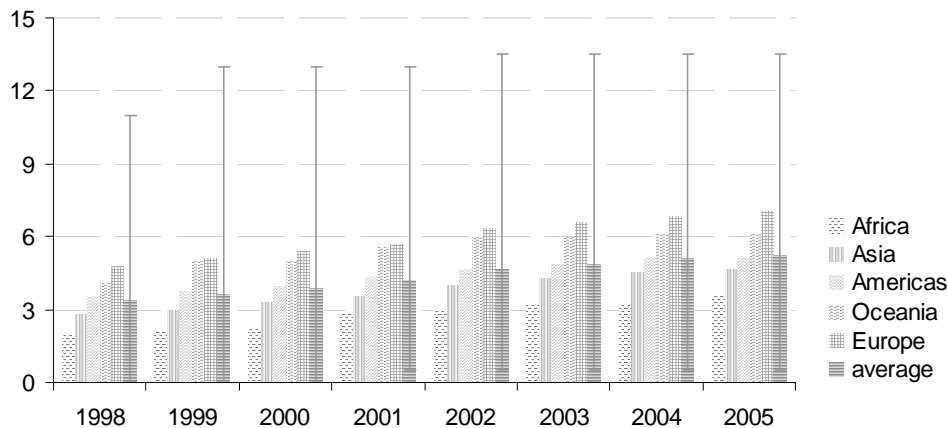

Figure 3. Central bank transparency

Source: This figure is constructed with the use of the data in Dincer and Eichengreen (2007). The gray line provides the range of observed values.

Although theoretically possible values lie between 0 and 15, in practice the highest degree of transparency observed is 13.5. Comparing continents, the central banks of

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[6]Note that Dincer and Eichengreen (2007) use two control factors (openness and financial depth).

Europe turn out to be the most transparent, closely followed by the central banks of Oceania. African central banks on average have the lowest degree of transparency. The transparency of Asian central banks is a bit higher. The transparency scores of the central banks of American countries lie between those of relatively transparent and relatively intransparent continents. In general, the level of transparency has risen over time. Only for a few countries we observe a, temporary, decrease in transparency. The range of observed degrees of transparency is broad. For example, in 2005 the central banks of Aruba and Bangladesh obtained a transparency score of 0.5, close to the minimum, while the Reserve Bank of New Zealand (with a score of 13.5) received a score that was close to the maximum. We utilize both the country and the time dimension of this transparency data set. For more details on the transparency data we refer to Appendix A.2.

3.2. Inflation data

In addition to transparency data we construct inflation persistence measures by utilizing CPI inflation data. The inflation data (q.o.q. annualized inflation rate, for more details see Appendix A.2) we use is from the International Financial Statistics (IFS) database, which is a product of the International Monetary Fund (IMF).

What we are interested in is the degree of inflation persistence. Inflation persistence is the speed with which inflation moves back towards its equilibrium level after shocks occur (e.g. a change in the inflation goal of the central bank). When inflation persistence is low this adjustment process occurs faster. For central banks it is interesting to know how inflation responds to shocks hitting the economy. If a central bank wants to follow a preemptive monetary policy strategy, insight in the reaction of inflation to changing monetary conditions is needed.

In the literature inflation persistence is measured in several ways. Marques (2004) provides a useful overview of the various methods at hand. An often used measure of inflation persistence, which we will use too, is the *sum of the autoregressive coefficients:* $\rho = \sum_{j=1}^{p} \beta_j$ which can be obtained by estimating inflation (π) on its lags:

$$(3.1) \qquad\qquad \pi_t = \alpha + \sum_{j=1}^{p} \beta_j \pi_{t-j} + \varepsilon_t$$

Other examples of measures that also give an estimate of the average speed with which inflation returns to its equilibrium level after a shock has occurred are the *largest autoregressive root* (e.g. Stock 2001) and the *half-life*. Critique on the largest autoregressive root is the fact that it does not summarize the impulse response function well, as it shape depends on all the roots. The half life is the time for which the effect of a shock to inflation is larger than 0.5. Although easy to interpret this measure has several disadvantages. For example, in case of an oscillating impulse response function this measure might underestimate the inflation persistence and it is difficult to compare series with different forms of impulse response functions.

3.3. Method

As mentioned before, we intend to relate inflation persistence to the degree of central bank transparency by using both the time content of our transparency data as well as the cross-country information. Because it is difficult to determine a different inflation persistence measure for each moment in time, we have included the transparency measure in a direct way in our estimation of the degree of inflation persistence. With equation (3.2) we test whether and how transparency is related to inflation persistence. The transparency interaction terms grasp the effect of transparency on inflation persistence.

$$\pi_{i,t} = \alpha + Z_{i,t} + \beta_1 \pi_{i,t-1} + \beta_2 T_{i,t}\pi_{i,t-1} + \beta_3 T_{i,t}^2 \pi_{i,t-1}$$

$$(3.2) \qquad\qquad + \sum_{n=1}^{N} \beta_{3+n} Y_{i,t}\pi_{i,t-1} + \varepsilon_{i,t}$$

$$(3.3) \qquad\qquad B_{i,t} = \beta_1 + \beta_2 T_{i,t} + \beta_3 T_{i,t}^2 + \sum_{n=1}^{N} \beta_{3+n} Y_{i,t}$$

With π=inflation (q.o.q. annualized), T=the degree of transparency (which in our sample is between 0 and 13.5), B=the degree of inflation persistence (which varies across countries because of different values for T) and ε=the error terms. $i = 1, 2, .., I$ indicates the cross-sectional units and $t = 1, 2, ..T$ the periods. An overall constant α is included. Z is a vector of control variables that affect the level of inflation.[7] In addition, we include a vector of control variables (Y) that affect the degree of inflation persistence.

Because the period under consideration is relatively short, we do not explicitly consider breaks in the mean of inflation, only to the extent that they might be captured by time-variation in Z.[8]

Various information criteria can be used to determine the optimal lag length to include in equation (3.2). For example, Levin et al. (2004) use the Akaike Information Criteria (AIC) to analyze for each country separately the optimal lag size. Because we perform panel data analysis, we instead pick one lag length for the whole sample. Here we present the results of our baseline case with one lag. Our transparency insights are robust to changes in the lag length (see Appendix B.2).

Previous studies have shown that several other factors besides transparency are relevant for inflation persistence too (e.g. Fabiani et al. 2005). By adding control variables to our regressions we correct for this. Detailed information on these control variables is in Appendix A.3. We take into account control factors in two ways. First,

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[7]Note that not all the control variables that we include are time variant. Therefore they grasp cross-section fixed effects.

[8]Corvoisier and Mojon (2005) show that in most OECD countries three breaks in the mean inflation rate occurred: one to a higher mean (end of the 1960s, beginning 1970s), and two to a lower mean (one in the early to mid 1980s and one in the early 1990s). Ignoring these breaks in inflation results into persistence measures that are too high (see also Gadzinski and Orlandi, 2004).

some control factors are included as an interaction term with lagged inflation (control variable*$\pi_{i,t-1}$) because they affect inflation persistence. Second, we add control factors that are relevant for the level of inflation instead of its persistence.

Labor

The first control factors that we include in our analysis are for labor. Compared to other costs, labor costs are not easy to adjust. Since labor costs are the lion share of the costs in the services sector, we expect inflation persistence of services to be higher. Previous studies show that inflation persistence differs across sectors. For example, Lunnemann and Mathä (2005) find that aggregate inflation persistence is lower when services are excluded. We correct for the role of labor by including two control variables. The first control variable is an indicator of the labor intensity of the production process (LS) while the second control variable measures the flexibility of wage setting (WF).

Regarding the first control variable, we use "Production process sophistication", which is the survey response to the statement "Production processes use (1=labor-intensive methods or previous generations of process technology, 7= the world's best and most efficient process technology)." This so-called soft indicator is taken from the yearly Global Competitiveness Report (GCR) of the World Economic Forum (WEF).

The second control variable we consider is an indicator of the degree of labor market flexibility. By modifying a New Keynesian business cycle model (by including a labor market with matching frictions and rigid wages), Christoffel and Linzert (2005) show that the more rigid wages are the more persistent inflation is. Hoeberichts and Stokman (2006, p.15) find that especially in the services sector, wages are relevant for price setting behavior of firms. As an indicator for this degree of flexibility we include "Flexibility of wage determination" (source: GCR, WEF). This series reflects the answers to the survey statement: "Wages in your country are (1=set by a centralized bargaining process, 7= up to each individual company)". The higher this variable is, the larger the degree of wage flexibility (WF).

Degree of competition

Another factor relevant for price setting behavior is the degree of competition that firms face. When competition is fierce, inflation persistence will be lower because in order to keep market shares, inflation will quickly return to its equilibrium level after a shock dies out. As a control variable we use "Intensity of local competition", which is the outcome of the following survey statement: "Competition in the local market is (1=limited in most industries and price-cutting is rare, 7= intense in most industries as market leadership changes over time)" (source: GCR, WEF). What we expect to find is a negative sign on the degree of competition interaction term ($DoC_{i,t}*\pi_{i,t-1}$). The higher this indicator of competition is, the lower the inflation persistence is. After a shock in an environment of fierce competition firms would be eager to bring inflation quickly back to their equilibrium degree.[9]

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[9]Since it could be that this soft control variable does not measure competition differences between countries that well, we consider another hard control variable: the share of exports to GDP (source: International Financial Statistics, International Monetary Fund). A more open country is likely to face more competition. This would result in lower inflation persistence.

Technology

The extent of technology usage in a country might be relevant for inflation persistence. One explanation that Dhyne et al. (2006) give for the lower price stickiness in the United States compared to Europe are the lower costs of price changes resulting from a higher level of technology in the retail sector (e.g. more superstores and e-commerce). If the costs of changing prices are low it will be easier for price setters to bring price changes back to a lower level after a detrimental inflation shock dies out.

Another reason for a link between the degree of technology and inflation persistence, is the fact that internet usage makes it easy to compare prices. In an environment without internet usage one only needs to compete with firms that are geographically close, whereas internet usage intensifies the number of competitors. Competition puts downward pressure on inflation persistence: inflation will move quickly back to its equilibrium level after the occurrence of a shock.

As an indicator for the degree of ICT intensity we consider technological readiness (TR). This pillar (based on several questions, source: GCR WEF), focusses on the agility with which existing productivity enhancing technologies are adopted.

Customer relations

Customer relations, either implicit or explicit, are an important factor in explaining price stickiness (Fabiani et al. 2005). We expect that when firms put a lot of effort in contracts with customers then current price increases will be in line with previous price increases: inflation is persistent. Instead when not much value is attached to customer relations then inflation will show more variability and less persistence. To correct for the strength of customer relations (CR) in a particular country over time we add "Degree of customer orientation" (source: GCR, WEF). This is the outcome in response to the statement "Firms in your country (1=generally treat their customers badly, 7=are highly responsive to customers and customer retention)".

In our analysis we do not only control for factors that affect the level of inflation persistence but we include controls for the level of inflation too.

Institutions

Good public and private institutions are crucial for the well-functioning of the economy. They might also indicate the quality of one particular institution: the central bank. We expect that the better these institutions are, the lower inflation will be. To correct for the quality of institutions we include the pillar "institutions" from the GCR 2007-2008 (WEF). This pillar measures the overall quality of both private and public institutions. Examples of factors that are taken into account are the security of owner rights, corruption and overregulation. Institutions are often regarded as being relevant for economic outcomes.

Globalization

Nowadays, inflation is low and stable in many countries. One explanation for this artefact is that the world has become more globalized (see e.g. Greenspan 2005). The increase in global competition puts downward pressure on prices because both

companies and employees have lower market power. To correct for the degree of globalization we include the measure of the degree of competition (DoC).[10]

Inflation targeting

Another often mentioned explanation for low inflation is the conduct of better monetary policy. The focus of monetary policy on price stability has increased; a lot of central banks now act independently from the government and several central banks have become inflation targeters. To prevent that central bank transparency is grasping up an overall better conduct on monetary policy, we correct for the fact that some countries are (or have become) inflation targeters.

3.4. Results

The results of the estimation of equation (3.2) including all control variables are in Table 2 column (1).Transparency matters for inflation persistence: the coefficient on $\pi_{t-1}T_t$ is negative and significant and the coefficient on $\pi_{t-1}T_t^2$ is positive and significant. These results support our hypothesis, that there is an optimal degree of transparency beyond which extra transparency results in more inflation persistence.

For the level of inflation several factors are relevant: the quality of institutions, the degree of competition and the presence of an inflation targeting regime. As expected, better quality of public and private institutions results in a lower degree of inflation. We can confirm previous research that globalization reduces inflation.[11] The IT-dummy is positive. Probably this is the result of the cross-country effect. That is, those countries that suffer from relatively high inflation are likely to opt for an inflation targeting regime.

As mentioned before, we have included controls for the degree of inflation persistence too. Half of these variables have a significant effect. The negative relationship between wage flexibility and inflation persistence that we predicted is confirmed. We find that inflation targeting is indeed beneficial, it results in lower inflation persistence. The positive effect of the degree of customer orientation on inflation persistence is also in line with our expectations. However, the labor-intensity of the production process, the degree of competition and technological readiness are not significantly related to inflation persistence.[12] In Appendix B.1 we compare the outcomes presented in Column (1) with those of a regression where we exclude central bank transparency. These results show that transparency is not picking up the effect of any other variable since the same control variables are significant in this alternative specification.

In our second regression, presented in Column (2), we have dropped the insignificant control variables. The signs and significances of the coefficients remain except for the intercept inflation targeting dummy. In Column (3) we present our final specification where the level effect of IT is excluded from the regression.

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[10]Note that DoC is used as a control for both the level of inflation and inflation persistence.
[11]Alternatively we included exports instead of DoC. This variable is not significant. DoC is probably not only capturing globalization but also other factors that influence the degree of competition.
[12]The alternative indicator for the degree of competition, the share of exports to GDP was not significant either.

Table 2. Central bank transparency and inflation persistence: Panel Least Squares

	(1)		(2)		(3)	
	coef.	p-value	coef.	p-value	coef.	p-value
α	14.34***	(0.00)	13.26***	(0.00)	12.76***	(0.00)
$INST_{i,t}$	-1.27***	(0.00)	-1.22***	(0.00)	-1.14***	(0.00)
$DoC_{i,t}$	-1.32***	(0.00)	-1.12***	(0.00)	-1.05***	(0.00)
$IT_{i,t}$	0.95*	(0.10)	0.77	(0.18)		
$\pi_{i,t-1}$	0.58*	(0.08)	0.80***	(0.00)	0.81***	(0.00)
$\pi_{i,t-1}T_{i,t}$	-0.14***	(0.00)	-0.13***	(0.00)	-0.13***	(0.00)
$\pi_{i,t-1}T^2_{i,t}$	0.01***	(0.00)	0.01***	(0.00)	0.01***	(0.00)
$\pi_{i,t-1}WF_{i,t}$	-0.14***	(0.00)	-0.16***	(0.00)	-0.16***	(0.00)
$\pi_{i,t-1}LS_{i,t}$	0.02	(0.61)				
$\pi_{i,t-1}DoC_{i,t}$	0.02	(0.44)				
$\pi_{i,t-1}TR_{i,t}$	0.05	(0.41)				
$\pi_{i,t-1}CR_{i,t}$	0.16***	(0.00)	0.19***	(0.00)	0.19***	(0.00)
$\pi_{i,t-1}IT_{i,t}$	-0.47***	(0.00)	-0.42***	(0.00)	-0.34***	(0.00)
R^2	0.39		0.39		0.39	
Sample	1998q1-2005q4		1998q1-2005q4		1998q1-2005q4	
Countries	70		70		70	
Total panel	2188		2188		2188	
S.E. of regression	8.26		8.27		8.27	
DW	1.94		1.93		1.94	

Note: Results of the estimation of equation (3.2) using q.o.q. inflation rates that are annualized. DoC=degree of competition, INST=quality of public and private institutions, IT=inflation targeting regime, π_{t-1} = inflation in the previous period, T=transparency index (Dincer and Eichengreen 2007), WF=wage flexibility, LS=labor share, TR= technological readiness and CR=customer relations. For more information on the variables we refer to Appendix A.

To get more insight into these results, the effect of transparency on the degree of inflation persistence is plotted in Figure 4. This figure is obtained by calculating the effect of transparency on the persistence coefficient (B) for all theoretically possible values of the central bank transparency index (T): $\beta_2 T + \beta_3 T^2$. In line with our hypothesis we observe a parabola.[13] The finding of an optimal degree of transparency is robust to different lag length specifications (see Appendix B.2).

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[13]There is no evidence for asymmetry around the optimum. We have tested this by adding the variable $\pi_{t-1}T^3$ to equation (3.2).
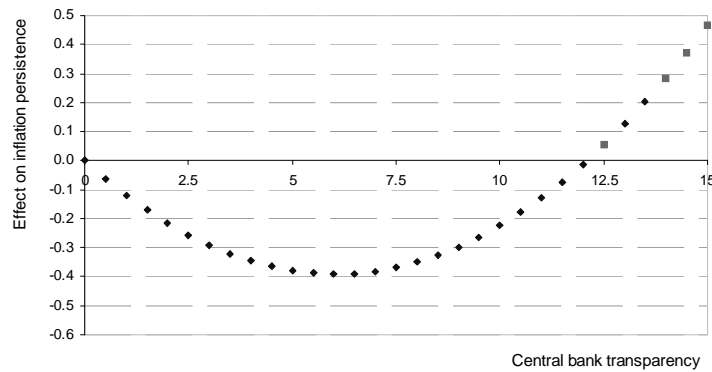
Figure 4. Effect of central bank transparency on inflation persistence

Note: This figure plots the effect of central bank transparency (T) on inflation persistence (B): $\beta_2 T + \beta_3 T^2$ using q.o.q annualized inflation rates. Note that T>13.5 and T=12.5 are not observed in our sample.

Note that, as mentioned in Section 3.1, while in theory the observed transparency degree could be 15 in our sample we observe 13.5 at the most. Starting left at the x-axis where the value of the transparency index is 0, moving along the x-axis to the right (where transparency is higher) first results in less inflation persistence. Inflation persistence is minimized at a degree of central bank transparency of 6. Turning to the range where transparency is higher than this optimum, more transparency is accompanied with higher inflation persistence. Central banks would be wise to not become fully transparent. Because most countries have a lower degree of transparency than the optimal degree, they might still benefit from further transparency increases. The lower the initial amount of central bank transparency is, the higher the benefit of additional transparency will be.

It is important to note that although our case for the existence of an optimal intermediate degree of transparency is robust to various settings, the exact value of this optimum is not. Our confusion argument highlights the importance of the capacity of the private sector to absorb information disclosed by the central bank. Because these skills are country-specific, different countries are likely to have different optimal degrees of transparency. In Appendix B.3 we illustrate this by presenting the results of two alternative regressions: one including only non-OECD-countries and one with only OECD-countries. Based on OECD-countries we find an optimum of 7.5 instead of 6. The optimal level of transparency is sensitive to the transparency levels that are observed in practice. Although theoretically transparency ranges between 0 and 15, in practice we do not observe very high levels. In addition, low degrees of transparency are observed much more frequent than high degrees of transparency. Note also that it is complicated to measure transparency, e.g. to establish which weight various manners of information disclosure should get.

4. Conclusion

We investigate whether it is desirable for central banks to increase their degree of transparency any further. While previous research analyzed the desirability of particular forms of transparency, we focus on the optimal *overall* degree of monetary policy transparency. We argue that some intermediate degree of transparency is desirable. We start our case for an optimal degree of transparency by relating transparency to the quality of private sector inflation forecasts. By using two arguments, uncertainty and confusion/information overload, we point out that there is likely to be an optimal intermediate degree of central bank transparency at which the quality of inflation forecasts is optimized. Although some degree of transparency might be helpful because it improves the quality of private sector inflation forecasts, a lot of transparency might be detrimental. First, it could lead to confusion/information overload. As an example consider the Financial Stability Reports published by various central banks. These reports contain a lot of information, which might complicate it for private agents to see the forest for the trees and harms their inflation forecasts. Second, although some information on the conditionality of intended policy and economic outcomes might improve the quality of private sector forecasts, too much information on uncertainty might lower the perceived quality of private sector inflation forecasts. As a proxy for the quality of inflation forecasts we take the degree to which inflation is formed in a backward looking way. The higher this degree of backward lookingness is the more persistent inflation is (which we illustrate with a standard New-Keynesian model).

In practice, several relationships between transparency and inflation persistence might be observed. For example, it might be that full secrecy or complete transparency is optimal. We test whether our case for an optimal intermediate degree of transparency can be confirmed by the data. We link transparency data from 1998-2005 for 100 central banks to inflation persistence and find support for our hypothesis. There is an optimal intermediate degree of transparency: neither full secrecy nor complete transparency is optimal. This result is robust to changes in the countries included and the lag specification chosen. The exact value we observe for the optimum should however be interpreted with care. Our baseline regression, including all countries, results in an optimum of 6. Theoretically, values between 0 and 15 are possible. Note that in practice, however, there is a high incidence of low degrees of central bank transparency whereas very high degrees of transparency (more than 13.5) are not observed at all. The exact value of the optimum we find depends on the countries we include. For example, when we consider only OECD-countries the optimum shifts to 7.5. Because the optimal degree of transparency hinges on the capacity of the private sector to process information (our confusion-argument) it makes sense to observe a higher optimal degree of central bank transparency for OECD-countries, since their inhabitants are better skilled to process information. In addition, we should note that there might be other ways in which transparency influences the economy, not only through affecting the quality of inflation forecasts. The optimal degree of transparency might shift when taking these effects into account.

Most central banks have quite a low degree of transparency (the median degree of transparency in 2005 was 5) and our results suggest that more transparency is likely to be beneficial for these central banks. It could lead to a better quality of

the private sector forecasts resulting in lower inflation persistence. However, several central banks (e.g. the US Federal Reserve and the European Central Bank) already have a high degree of transparency. It is good for these central banks to keep in mind that it is wise to not become completely transparent. A high degree of transparency could result in confusion and to too much awareness of the central bank's uncertainty. This might be detrimental for the effectiveness of monetary policy since inflation will be more persistent and therefore more difficult to affect.

A caveat of our research is that central bank transparency is something which is difficult to measure objectively. Perhaps central banks have invented new ways to be transparent, which are not included in the transparency measures currently at hand. Furthermore it is difficult to weigh different forms of transparency. Our analysis suggests that it might be helpful for future research to construct alternative measures of transparency that measure the clarity of information instead of the quantity.

5. Appendix to Chapter 6

A Data

A.1 Central bank transparency

Table A1. Central bank transparency data

	1998	1999	2000	2001	2002	2003	2004	2005
Minimum	0	0	0	0.5	0.5	0.5	0.5	0.5
	(B)	(B)	(B)	(A&B)	(A&B)	(A)	(A)	(A)
Maximum	11	13	13	13	13.5	13.5	13.5	13.5
	(UK)	(NZ)	(NZ)	(NZ)	(NZ)	(NZ)	(NZ)	(NZ)
Average	3.4	3.6	3.9	4.2	4.7	4.9	5.1	5.2
Stdev	2.4	2.6	2.7	2.8	3.0	3.0	3.0	3.0

Source: Based on the data set from Dincer and Eichengreen (2007), which includes 100 countries.
Note: B=Bangladesh, A=Aruba, NZ=New Zealand, UK=United Kingdom.

A.2 Inflation

Definition: quarter on quarter annualized inflation rate.
Calculation: $\pi_{i,t} = ((CPI_{i,t} - CPI_{i,t-1})/CPI_{i,t-1}) * 100 * 4$ where CPI is the Consumer Price Index of country i at time t.
Source: quarterly CPI data from the International Monetary Fund, International Financial Statistics.

A.3 Control variables

Labor share (LS)
Indicator: Production process sophistication
Definition: this is the survey response to the statement "Production processes use (1=labor-intensive methods or previous generations of process technology, 7=the world's best and most efficient process technology)
Source: The Global Competitiveness Report, World Economic Forum. Report 2002-2003 and 2003-2004 (series 10.06), 2004-2005 (series 9.06), 2005-2006 (series 8.05). For 2000 and 2001 we take the 2002-2003 value, because of a slightly different definition of the survey question (without labor). For 1998 and 1999 we take this 2002-2003 value too (also because the 1998 and 1999 report are not available in any of the Dutch libraries and on the WEF-site one can only buy reports from 2001 onwards).

Wage flexibility (WF)
Indicator: Flexibility of wage determination
Definition: this is the survey response to the statement: "Wages in your country are (1=set by a centralized bargaining process, 7=up to each individual company)".
Source: The Global Competitiveness Report, World Economic Forum. Report 2000 (series 6.11, only slightly different definition. "Wage setting. Wages are determined by each individual company. (1=strongly disagree; 7=strongly agree)"), report 2002-2003 (series 10.19), report 2003-2004 (series 10.19), report 2004-2005 (series 9.19), report 2005-2006 (series 8.18).

For 1998 and 1999 we take the 2000 value since these reports are not available in any of the Dutch libraries and on the WEF-site one can only buy reports from 2001 onwards. This question is not included in the 2001-2002 report, therefore we take the average of the 2000 and 2002-2003 as the 2001 value.

Competition (DoC and Exports)
Indicator 1: Degree of competition (DoC)
Definition: Intensity of local competition is the outcome of the following survey statement: "Competition in the local market is (1=limited in most industries and price-cutting is rare, 7= intense in most industries as market leadership changes over time)".
Source: The Global Competitiveness Report, World Economic Forum report 2000 (series 10.01), 2001-2002, 2002-2003 and 2003-2004 (all series 8.01), report 2004-2005 and 2005-2006 (both series 7.01). For 1998 and 1999 we take the 2000 value since these reports are not available in any of the Dutch libraries and on the WEF-site one can only buy reports from 2001 onwards. The definitions in the 2000 and 2001-2002 are slightly different. Definition 2000 report: "Local competition. Competition in local markets is intense and market shares fluctuate constantly. (1=strongly disagree;7=strongly agree)". Definition 2001-2002 report: "In most industries, competition in the local market is (1=limited and price-cutting is rare, 7=intense and market leadership changes over time)".
Indicator 2: Exports.
Definition: exports as a share of GDP.
Source: International Financial Statistics, International Monetary Fund.

Technology (TR)
Indicator: Technological Readiness
Source: The Global Competitiveness Report 2005-2006, World Economic Forum. Note that there is one data point for each country. We assume values to be constant over time. On p.41 of the report it is explained that technological readiness is the average of series 3.01 (Technological Readiness), 3.02 (Firm-level technology absorption), 3.15 (Laws relating to ICT), 3.04 (FDI and technology transfer), 3.18 (Cellular telephones (hard data)), 3.19 (Internet users (hard data)) and 3.21 (personal computers (hard data)).

Customer relations (CR)
Indicator: Degree of customer orientation
Definition: This is the survey response to the statement "Firms in your country (1=generally treat their customers badly, 7=are highly responsive to customers and customer retention)".
Source: The Global Competitiveness Report, World Economic Forum report 2000 (series 11.08), 2001-2002, 2002-2003 and 2003-2004 (all series 10.08), report 2004-2005 (series 9.08) and 2005-2006 (series 8.07). For 1998 and 1999 we take the 2000 value since these reports are not available in any of the Dutch libraries and on the WEF-site one can only buy reports from 2001 onwards. The definitions in the 2000 and 2001-2002 are slightly different. Definition 2000 report: "Firms generally pay close attention to customer satisfaction. (1=strongly disagree; 7=strongly agree)". Definition 2001-2002 report: "Firms in your country (1=generally treat their customers badly, 7=pay close attention to customer satisfaction)".

Institutions (INST)
Indicator: Institutions

Definition: a pillar based on various series, which measures the quality of public and private institutions (see Global Competitiveness Report 2007-2008, p.4).
Source: The Global Competitiveness Report 2007-2008, World Economic Forum.

Inflation targeting (IT)
Definition: This dummy variable is 1 for a particular central bank at a particular moment in time, if there is an inflation targeting regime. Otherwise this dummy is 0.
Source: IMF World Economic Outlook 2005: Chapter IV, Does inflation targeting work in emerging markets? Table 4.1, p.162 (source: National authorities).
IT Countries (adoption date): Israel (1997Q2), Czech Republic (1998Q1), Korea (1998Q2), Poland (1999Q1), Brazil (1999Q2), Chile (1999Q3), Colombia (1999Q3), South Africa (2000Q1), Thailand (2000Q2), Mexico (2001Q1), Hungary (2001Q3), Peru (2002Q1), Philippines (2002Q1), New Zealand (1990Q1), Canada (1991Q1), United Kingdom (1992Q4), Australia (1993Q1) and Sweden (1993Q1), Switzerland (2000Q1), Iceland (2001Q1), Norway (2001Q1).

B Specification tests

B.1 Regressions with and without transparency

Table B1. Inflation persistence: Panel Least Squares with and without transparency

	(1a)		(1b)	
	coef.	p-value	coef.	p-value
α	14.34***	(0.00)	14.03***	(0.00)
$INST_{i,t}$	-1.27***	(0.00)	-1.17***	(0.00)
$DoC_{i,t}$	-1.32***	(0.00)	-1.35***	(0.00)
$IT_{i,t}$	0.95*	(0.10)	1.04*	(0.07)
$\pi_{i,t-1}$	0.58*	(0.08)	-0.09***	(0.00)
$\pi_{i,t-1}T_{i,t}$	-0.14***	(0.00)		
$\pi_{i,t-1}T^2_{i,t}$	0.01***	(0.00)		
$\pi_{i,t-1}WF_{i,t}$	-0.14***	(0.00)	-0.09***	(0.00)
$\pi_{i,t-1}LS_{i,t}$	0.02	(0.61)	0.00	(0.94)
$\pi_{i,t-1}DoC_{i,t}$	0.02	(0.44)	0.01	(0.72)
$\pi_{i,t-1}TR_{i,t}$	0.05	(0.41)	0.01	(0.89)
$\pi_{i,t-1}CR_{i,t}$	0.16***	(0.00)	0.23***	(0.00)
$\pi_{i,t-1}IT_{i,t}$	-0.47***	(0.00)	-0.48***	(0.00)
R²	0.39		0.38	
Sample	1998q1-2005q4		1998q1-2005q4	
Countries	70		70	
Total panel	2188		2188	
S.E. of regression	8.26		8.32	
DW	1.94		1.94	

Note: Results of the estimation of equation (3.2) using q.o.q. inflation rates that are annualized. DoC=degree of competition, INST=quality of public and private institutions, IT=inflation targeting regime, π_{t-1} = inflation in the previous period, T=transparency index (Dincer and Eichengreen 2007), WF=wage flexibility, LS=labor share, TR=technological readiness and CR=customer relations. For more information on the variables we refer to Appendix A.

B.2 Additional autoregressive terms

To get an alternative measure of inflation persistence which is based on more lags (q) we need to include additional autoregressive terms in equation (3.2). The equation to estimate then becomes as follows:

$$\pi_{i,t} = \alpha + Z_{it} + \sum_{q=1}^{Q}\beta_{1,q}\pi_{i,t-q} + \sum_{q=1}^{Q}\beta_{2,q}T_{i,t}\pi_{i,t-q} + \sum_{q=1}^{Q}\beta_{3,q}T^2_{i,t}\pi_{i,t-q}$$

(5.1) $$ + \sum_{q=1}^{Q} \sum_{n=1}^{N} \beta_{3+n,q} Y_{i,t} \pi_{i,t-q} + \varepsilon_{i,t} $$

With π=inflation, α=a constant, T=the degree of transparency, and ε=the error term. $i = 1, 2, .., I$ indicates the cross-sectional units and $t = 1, 2, ..T$ the periods. Z is a vector of control variables that affect the level of inflation. In addition we include a vector of control variables (Y) that affect the degree of inflation persistence. In the baseline analysis (presented in the main text), we have included one lag ($q = 1$). Here we report the outcomes of up to four lags ($q = 4$). When more than one lag is included, the measure of inflation persistence (B) is:

(5.2) $$ B_{it} = \sum_{q=1}^{Q} \beta_{1,q} + \sum_{q=1}^{Q} \beta_{2,q} T_{i,t} + \sum_{q=1}^{Q} \beta_{3,q} T_{i,t}^2 + \sum_{q=1}^{Q} \sum_{n=1}^{N} \beta_{3+n,q} Y_{i,t} $$

The optimal transparency we find (6) turns out to be robust to the lag specification. The results are summarized by Figure B1 and Table B2.
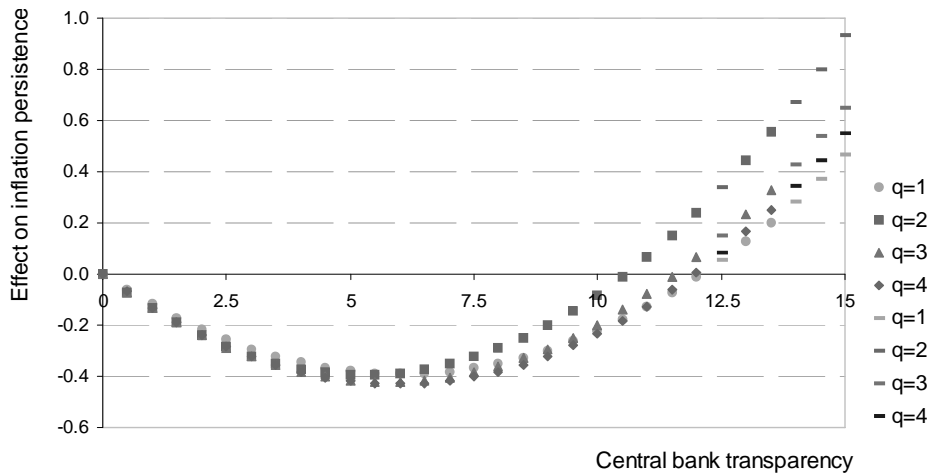

Figure B1. Effect of central bank transparency on inflation persistence: various lag lengths

Note: This figure plots the effect of central bank transparency (T) on inflation persistence (B): $\sum_{q=1}^{Q} \left(\beta_{2,q} T + \beta_{3,q} T^2 \right)$ for various lag lengths ($Q = 1$, $Q = 2$, $Q = 3$ and $Q = 4$). Note that T>13.5 and T=12.5 are not observed in our sample (indicated with -'s in the figure).

Table B2. Central bank transparency and inflation persistence: Panel Least Squares with various lag lengths

	(1)		(2)		(3)	
	coef.	p-value	coef.	p-value	coef.	p-value
α	15.58***	(0.00)	11.56***	(0.00)	10.00***	(0.00)
$INST_{i,t}$	-1.31***	(0.00)	-1.05***	(0.00)	-0.95***	(0.00)
$DoC_{i,t}$	-1.45***	(0.00)	-0.95***	(0.00)	-0.78**	(0.03)
$\pi_{i,t-1}$	0.48	(0.16)	0.46	(0.17)	0.10	(0.78)
$\pi_{i,t-1}T_{i,t}$	-0.11***	(0.00)	-0.10***	(0.00)	-0.08**	(0.03)
$\pi_{i,t-1}T^2_{i,t}$	0.00	(0.12)	0.00	(0.25)	0.00	(0.40)
$\pi_{i,t-1}WF_{i,t}$	-0.05	(0.18)	-0.02	(0.56)	0.02	(0.58)
$\pi_{i,t-1}CR_{i,t}$	0.14***	(0.00)	0.11**	(0.02)	0.12**	(0.02)
$\pi_{i,t-1}IT_{i,t}$	-0.15	(0.24)	-0.09	(0.46)	-0.19	(0.15)
$\pi_{i,t-2}$	0.28	(0.41)	0.05	(0.90)	0.14	(0.70)
$\pi_{i,t-2}T_{i,t}$	-0.03	(0.32)	-0.02	(0.69)	-0.02	(0.59)
$\pi_{i,t-2}T^2_{i,t}$	0.01**	(0.03)	0.01	(0.11)	0.01	(0.19)
$\pi_{i,t-2}WF_{i,t}$	-0.17***	(0.00)	-0.18***	(0.00)	-0.17***	(0.00)
$\pi_{i,t-2}CR_{i,t}$	0.12***	(0.01)	0.16***	(0.00)	0.14***	(0.00)
$\pi_{i,t-2}IT_{i,t}$	-0.25**	(0.04)	-0.21	(0.11)	-0.14	(0.30)
$\pi_{i,t-3}$			0.64**	(0.04)	-0.35	(0.36)
$\pi_{i,t-3}T_{i,t}$			-0.03	(0.39)	0.03	(0.39)
$\pi_{i,t-3}T^2_{i,t}$			0.00	(0.66)	-0.00	(0.62)
$\pi_{i,t-3}WF_{i,t}$			0.01	(0.79)	0.14***	(0.00)
$\pi_{i,t-3}CR_{i,t}$			-0.10***	(0.00)	-0.09**	(0.04)
$\pi_{i,t-3}IT_{i,t}$			-0.00	(0.98)	-0.12	(0.36)
$\pi_{i,t-4}$					1.63***	(0.00)
$\pi_{i,t-4}T_{i,t}$					-0.08***	(0.00)
$\pi_{i,t-4}T^2_{i,t}$					0.01	(0.12)
$\pi_{i,t-4}WF_{i,t}$					-0.19***	(0.00)
$\pi_{i,t-4}CR_{i,t}$					-0.07**	(0.04)
$\pi_{i,t-4}IT_{i,t}$					0.22*	(0.05)
R²	0.41		0.44		0.46	
Sample	1998q1-2005q4		1998q1-2005q4		1998q1-2005q4	
Countries	70		70		70	
Total panel	2185		2182		2179	
S.E. of regression	8.11		7.93		7.83	
DW	1.92		2.03		1.97	

Note: Results of the estimation of equation (5.1) using various lag lengths ($Q = 2$, $Q = 3$ and $Q = 4$). DoC=degree of competition, INST=quality of public and private institutions, $\pi =$ inflation, T=transparency index (Dincer and Eichengreen 2007), WF=wage flexibility, CR=customer relations. For more information on the variables we refer to Appendix A.

B.3 Splitting the sample: OECD versus Non-OECD

Table B3. Central bank transparency and inflation persistence: Various samples

	(1) All countries		(2) OECD		(3) Non-OECD	
	coef.	p-value	coef.	p-value	coef.	p-value
α	12.76***	(0.00)	6.55**	(0.03)	15.42***	(0.00)
$INST_{i,t}$	-1.14***	(0.00)	-1.17***	(0.00)	-1.12***	(0.00)
$DoC_{i,t}$	-1.05***	(0.00)	0.34	(0.54)	-1.63***	(0.00)
$\pi_{i,t-1}$	0.81***	(0.00)	2.65***	(0.00)	0.36	(0.24)
$\pi_{i,t-1}T_{i,t}$	-0.13***	(0.00)	-0.10**	(0.02)	-0.15***	(0.00)
$\pi_{i,t-1}T^2_{i,t}$	0.01***	(0.00)	0.01*	(0.07)	0.01*	(0.02)
$\pi_{i,t-1}WF_{i,t}$	-0.16***	(0.00)	-0.22***	(0.00)	-0.07*	(0.06)
$\pi_{i,t-1}CR_{i,t}$	0.19***	(0.00)	-0.13*	(0.07)	0.18***	(0.00)
$\pi_{i,t-1}IT_{i,t}$	-0.34***	(0.00)	-0.44***	(0.00)	-0.13	(0.40)
R²	0.39		0.71		0.31	
Sample	1998q1-2005q4		1998q1-2005q4		1998q1-2005q4	
Countries	70		18		52	
Total panel	2188		576		1612	
S.E. of regression	8.27		5.23		9.01	
DW	1.94		2.33		1.86	

Note: Results of the estimation of equation (5.1) using various samples. DoC=degree of competition, INST=quality of public and private institutions, π = inflation, T=transparency index (Dincer and Eichengreen 2007), WF=wage flexibility, CR=customer relations. For more information on the variables we refer to Appendix A.
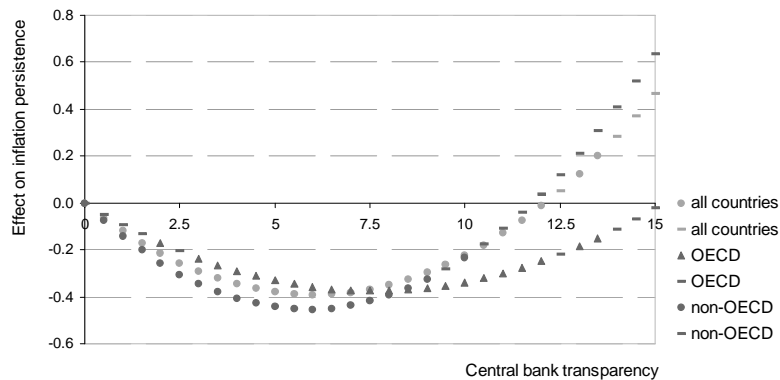

Figure B2. Effect of central bank transparency on inflation persistence: Various samples

Note: This figure plots the effect of central bank transparency (T) on inflation persistence (B): $\beta_2 T + \beta_3 T^2$ for various samples. Transparency levels that are not observed are indicated with -'s.

CHAPTER 7

Conclusion

1. Research contributions

The last two decades central banks have become increasingly transparent. Central banks tend to be far more forthcoming than is needed to meet statutory accountability requirements, which might be caused by foreseen economic benefits. For central banks it is important to know whether central bank transparency is beneficial from an economic point of view, and if so to what extent. The research presented in this book provides more insights into the desirability of transparency from an economic viewpoint and thereby contributes to the transparency literature in several ways.

The literature overview in Chapter 2 gives insight in the research currently at hand. I have identified several areas which would benefit from more research. With the research performed in Chapter 3-6 I contribute to filling these gaps in the transparency literature. First, I have used recently constructed transparency indices to perform more thorough empirical research on the economic effects of central bank transparency. Thereby I have applied new ways to analyze the desirability of central bank transparency. I have utilized both the time information and the cross-country information that these measures of transparency contain. Second, I have utilized a new micro data set on transparency which I have constructed by setting out a survey among the CentERpanel. The outcomes of this household survey shed more light on the transparency knowledge and perceptions of households and the relevance of transparency perceptions for trust in the central bank, inflation perceptions and expectations. Third, I have provided more insight into the presence of an optimal intermediate degree of transparency. Although some previous theoretical work pointed at the existence of an optimal intermediate degree of transparency too, empirical evidence was missing. I have empirically tested the hypothesis that an intermediate degree of transparency is optimal, by relating central bank transparency to inflation persistence.

2. Summary of the results

Table 1 gives an overview of the findings of the research projects presented in this book. I will discuss the main findings of each chapter one by one.

In *Chapter 2* I have provided more insight into the research on the economic effect of central bank transparency. One finding that becomes clear from the survey of the theoretical literature is the fact that the debate on the desirability of central bank transparency continues to be a lively one. Since the theoretical research on the economic effects of central bank transparency began (end of the 1980s) the literature

Table 1. Summary of the results

Chapter	Conclusion	CBT-effect
2	Theoretical research is inconclusive. Empirical research is scarce but mostly in favor of transparency.	?
3	CBT enhancements have had significant effects on the level of interest rates. In most, but not all, cases interest rates are lower, which indicates increased flexibility and reputation of the central bank.	+
4	CBT helps anchoring inflation expectations and reducing inflation persistence.	+
5	There is a discrepancy between actual and perceived CBT because of lack of knowledge about CBT and psychological factors. Higher CBT perceptions result in a higher degree of trust in the central bank, better aligned inflation perceptions and better anchored expectations.	+
6	A lot of CBT causes confusion and uncertainty. There is an optimal intermediate degree of CBT at which the quality of inflation forecasts is maximized and inflation persistence is minimized.	∩

Note: CBT= central bank transparency.

has evolved considerably. Despite extensive discussions it does not yield a decisive outcome. Differences in outcomes occur because of differences in the models used and the particular aspect of transparency that is analyzed. There is, however, a tendency that more recent work based on more sophisticated models is in favor of transparency.

The merits of transparency can only be justified through empirical research. The empirical transparency research is of a more recent origin than the theoretical work. It begins in 1999 when some data about transparency changes became available. In contrast to the theoretical research, empirical evaluations show unanimously that most forms of transparency are desirable (only a few exceptions exist). Transparency has, for example, improved anticipations of future monetary policy steps, which has made monetary policy more efficient. The limited availability of transparency data has hampered thorough analyses. Only since a few years there are several measures of transparency at hand and only very recently a large-scale data set has been made. I have utilized these newly constructed transparency indexes for more in-to-depth empirical research.

In *Chapter 3* I have analyzed the economic effects of central bank transparency on nominal interest rates. There is an increasing number of empirical studies that analyze the effect of central bank transparency on interest rates. Most of these studies focus on the short-lived (daily or even intraday) effects of monetary policy decisions and communications. Instead, I have investigated whether transparency has enduring effects on the level of interest rates. In particular, whether transparency has improved the flexibility and reputation of central banks by allowing for lower policy, short-term and long-term nominal interest rates.

Intuitively, transparency may have a beneficial effect on the level of interest rates because it makes it easier for the private sector to infer the central bank's intentions from monetary policy decisions and outcomes. This allows a central bank to improve its credibility. It also gives the central bank a greater incentive to build reputation, as private sector inflation expectations become more sensitive to monetary policy actions and outcomes that are not attributed to economic shocks. At the same time, transparency provides clarity about when monetary policy decisions are intended to offset economic shocks, so it gives the central bank greater flexibility to stabilize the economy without affecting private sector inflation expectations. Thus, a reduction in policy and short-term interest rates could be interpreted as enhanced flexibility, while a decline in long-term nominal interest rates could be viewed as a sign of improved reputation.

I have systematically analyzed the relation between changes in transparency and the level of interest rates for eight major central banks from 1993 until 2002. The empirical findings suggest that central banks that become more transparent could benefit from sizeable flexibility and reputation effects. In many instances, greater transparency tends to be accompanied by economically significant reductions in interest rates, when controlling for the macroeconomic situation using inflation and output. However, sometimes there is a significant increase in the interest rate. In a few instances the effects on policy/short-term and long-term rates are of opposite sign, which suggests a trade-off between flexibility and reputation. To obtain a suitable econometric specification I have applied the same general-to-specific methodology to each central bank. Extensive robustness checks indicate that the findings are generally not affected by reasonable variations in the model selection criteria.

In *Chapter 4* I have investigated the economic effects of central bank transparency in an alternative way by examining its impact on the link between inflation and inflation expectations. Inflation and inflation expectations have followed a declining trend over the past 15 years. At the same time, a number of central banks have made considerable efforts to become more transparent. One reason was to anchor inflation expectations, which makes it easier for central bankers to cushion shocks.

To research the effect of transparency on the link between inflation and inflation expectations, I have applied the framework used by Levin et al. (2004) and I have made use of the recent development of quantitative measures for transparency. Levin et al. (2004) argue that if expectations are better pinned down in an inflation targeting regime, then the relation between expectations (for difference horizons) and current inflation is weaker. While Levin et al. classified countries in inflation targeters and non-inflation targeters, I have categorized them according to their degree of transparency. Transparency helps fixing private sector inflation expectations. In addition, I have shown that particular attempts to increase transparency have accounted for the weaker link between inflation and inflation expectations. Higher transparency is also associated with less inflation persistence.

In *Chapter 5* I have taken a closer look at transparency perceptions and their relevance. I have argued that transparency perceptions matter for the actions that economic agents undertake and that a mismatch between the actual degree of central

bank transparency (based on the actual amount of information disclosed by the central bank) and its degree of transparency as perceived by the public is likely to exist.

First, based on a survey among Dutch households I show that actual knowledge on the ECB's transparency is far from complete or even incorrect even for those respondents with an economic job and a high self-assessed amount of economic knowledge. Individuals' knowledge depends on the central banks' specific communication strategy and monetary policy at practice. For example, Dutch households know more about the goals of the central bank and the economic information it provides (aspects on which the ECB is relatively transparent) than about whether minutes are published and forecast errors are made public (aspects on which the ECB is relatively less transparent).

Second, transparency perceptions do not only depend on the actual transparency knowledge but other, psychological, factors are relevant too. For example, optimistic people are more inclined to judge the ECB's transparency to be high. This complicates it for central banks to change transparency perceptions.

The higher the perceived transparency, the more trust a respondent has in the ECB. Central banks are interested in keeping up people's trust because it facilitates their policy making and increases their effectiveness. Furthermore, transparency helps to align inflation perceptions with actual inflation and to anchor inflation expectations around the target of the central bank. This transmission from transparency perceptions to economic outcomes is absent for a majority of respondents, which leaves ample room for the ECB to create transparency perceptions in the future. To benefit from higher transparency perceptions a central bank might feel tempted to stress its transparency strengths but de-emphasize its transparency weaknesses. Alternatively, it could improve its actual disclosure practices and communicate this well. The choice between these two options depends on the difficulties and costs of implementation.

It might not be so easy to develop a single effective communication strategy because the manner in which perceptions are being formed is likely to differ between agents and perceptions not only depend on transparency knowledge but also on psychological factors. For a central bank it will be useful to keep these findings in mind when designing an effective communication strategy.

In *Chapter 6* I have investigated whether it is always desirable for central banks to increase their degree of transparency. By focussing on the optimal overall degree of monetary policy transparency I have argued that some intermediate degree of transparency is likely to be desirable. Although some degree of transparency would be helpful because it improves the quality of private sector inflation forecasts, a lot of transparency would be detrimental because it would make it difficult for agents to see the forest for the trees (information overload/confusion-argument) and it would result in too much emphasis on the central bank's uncertainty (uncertainty-argument). When people do not rely on their own forecasts anymore, inflation will become more backward looking, resulting in higher inflation persistence.

The presence of an optimal intermediate degree of transparency is confirmed by analyzing a large-scale panel data set, and passes various robustness tests. However, the exact optimal level should be interpreted with care. Compared to non-OECD-countries, OECD-countries have a higher optimal degree of transparency, which is

not surprising since its inhabitants are likely to be better skilled in processing information and therefore would less quickly get confused. Even though an intermediate degree of transparency is optimal, increasing their transparency is beneficial for a lot of central banks, especially for those of less developed countries. However, several central banks that already have a high level of transparency (e.g. the US Fed and the ECB) should keep in mind that it is unwise to become completely transparent. The accompanied higher persistence of inflation would be detrimental for the effectiveness of their monetary policies.

Let me now come back to my over-arching research question: *"Is central bank transparency desirable from an economic viewpoint, and if so to what extent?"*. Regarding the first part of this question, the research that I have presented in this book shows that transparency increases have been beneficial from an economic standpoint. They have resulted in better anchored inflation expectations, lower inflation persistence, better aligned inflation perceptions, more trust in the central bank and lower nominal interest rates. However, coming back to the second part of my research question, my research demonstrates that central banks would be wise to not strive for full transparency. Concluding, the answer to the question is *"yes, but only up to a certain point"*.

3. Directions for future research

Although the transparency literature is already quite well developed, containing a lot of theoretical research but more recently also more and more empirical analyses, some under-studied issues still remain. I will briefly discuss some areas that warrant more research.

First, there is ample room for further *fine-tuning* of the research. Not all combinations of aspects of transparency in relation to possible economic effects are analyzed yet and research is unevenly spread across various aspects of transparency. In this regard, the large-scale data set of Dincer and Eichengreen (2007) could be exploited further. Furthermore, it would be helpful if future empirical research could provide more insight into the *robustness* of the results. This is especially important because it is difficult to measure transparency, and there are some specific drawbacks in the construction of indices. For example, it is unclear which components should be included and with what weight. Perhaps central banks have invented new ways to be transparent, which are not included in the transparency measures currently at hand. Future research could try to find out which aspects of transparency matter most and should be weighted accordingly when constructing transparency measures. Papers that abstain from using indices but use a before-after analysis face several downsides as well. It is difficult to refute the idea that other factors might have driven economic changes. Another empirical problem is reverse causality, which refers to the question which came first: good economic performance or improvements in transparency? Therefore, additional research into the determinants of transparency would be helpful.

Second, because most central banks have become more transparent over time, research is likely to shift to finding the *optimal degree of transparency*. I expect that my empirical analysis is just the first of a series of studies. In this regard, transparency might affect economic outcomes not only through influencing the quality

of private sector forecasts, which I have analyzed, but also in alternative ways which affect the optimal degree of transparency. Furthermore, research on the relevance of specific central bank characteristics (e.g. its initial level of credibility and the skills of its public) for its optimal degree of transparency would be useful. Additional data on central banks with a high degree of transparency is necessary to facilitate such research.

Third, whereas I have focused on longer-lasting transparency changes, more research on the exact manner of central banks' *day-to-day communication* would be helpful. Now that several central banks have made these steps towards more transparency and the role of communication in managing expectations has become important, research is likely to shift towards the analysis of the exact day-to-day communication of central banks, a trend which is already observable (Blinder et al. 2008). Providing a lot of information is not enough, what matters is the clarity provided by the central bank and the effect of disclosure on transparency perceptions. It would be useful if future research would construct *measures of clarity*, although these will be more difficult to build than the transparency measure currently at hand. Monetary policy making is a complex area of expertise and does not interest everybody, which is something all central banks have to cope with. The best communication strategy is likely to depend on who the receiver is (e.g. laymen versus economic experts) since their knowledge and perceptions are likely to differ but additional research is needed to clarify this.

CHAPTER 8

Summary in Dutch - Samenvatting

Transparantie. Een woord dat je de laatste jaren vaak tegenkomt. Zo ook in de wereld van de centrale bankiers. Hoewel monetair beleid vroeger nog gehuld werd in mysterie, kiezen veel centrale bankiers er tegenwoordig voor om via allerlei kanalen met het publiek te communiceren over hun beleid. Een oorzaak van deze ommekeer is de afname van politieke invloed op het centrale bank beleid. Voor onafhankelijke centrale banken vormt transparantie een middel om verantwoording af te leggen. Transparantie is echter omvangrijker dan dat de regelgeving vereist. Waarom? De verwachting is dat transparantie kan resulteren in betere economische uitkomsten en effectiever monetair beleid. In dit proefschrift ben ik nader ingegaan op de vraag of transparantie inderdaad wenselijk is vanuit economisch oogpunt. Door te kijken naar de effecten van transparantiestappen die de afgelopen decennia zijn gezet, draag ik bij aan de beantwoording van deze vraag. Daarnaast onderzoek ik of het wenselijk is dat centrale banken de trend naar meer transparantie voortzetten.

In *Hoofdstuk 2* geef ik inzicht in het onderzoek naar de economische effecten van centrale bank transparantie dat momenteel voorhanden is. Daarnaast identificeer ik openliggende onderzoeksterreinen. Door de sterke groei van de transparantieliteratuur de afgelopen jaren, de nieuwe theoretische stromingen binnen deze literatuur en het empirische onderzoek dat op gang is gekomen, is zo'n overzicht wenselijk.

Het debat over de wenselijkheid van centrale bank transparantie is nog steeds levendig. Sinds het midden van de jaren '80 zijn de economische effecten van centrale bank transparantie wetenschappelijk onderzocht. Dit onderzoek was oorspronkelijk alleen theoretisch van aard. De manier waarop de theoretische literatuur de effecten van verschillende transparantievormen heeft geanalyseerd, is divers. Zo lopen de modellen uiteen van achteruitkijkend tot vooruitkijkend, met rationele dan wel lerende agenten en met één centrale bank dan wel een comité. Het theoretische transparantieonderzoek geeft echter geen eenduidig antwoord op de vraag of meer transparantie wenselijk is, hoewel de onenigheid lijkt af te nemen.

Empirisch onderzoek biedt mogelijk wel uitsluitsel. Met het beschikbaar komen van transparantiedata is er sinds het einde van de vorige eeuw steeds meer empirisch werk verricht. Empirische analyses tonen, in tegenstelling tot het theoretische onderzoek, eensgezind dat de meeste vormen van transparantie gepaard zijn gegaan met betere economische uitkomsten. Zo heeft transparantie de anticipatie van toekomstig monetaire beleidstappen verbeterd, wat het monetaire beleid efficiënter heeft gemaakt, en geleid tot lagere inflatie als gevolg van een betere reputatie. De beperkte hoeveelheid beschikbare transparantiedata heeft diepgaande analyses echter lange tijd in de

weg gestaan. Pas sinds enkele jaren zijn er verschillende transparantiemaatstaven beschikbaar en heel recent zelfs een grootschalige transparantiedataset. Ik benut deze nieuw geconstrueerde transparantie-indices voor meer diepgaand empirisch onderzoek om zo een bijdrage te leveren aan het vinden van empirische antwoorden op de theoretische vraagtekens.

In *hoofdstuk 3* analyseer ik de effecten van meer centrale bank transparantie op de hoogte van renteniveaus. Allereerst laat het theoretische model zien dat een hogere graad van transparantie gepaard gaat met zowel een toename van de *flexibiliteit* als de *reputatie* van de centrale bank. Transparantie vereenvoudigt het voor de private sector om de intenties achter monetaire beleidsbeslissingen en -uitkomsten af te leiden. Dit biedt ruimte voor de centrale bank om haar geloofwaardigheid te verbeteren. Daarnaast geeft transparantie een prikkel aan de centrale bank om reputatie op te bouwen, omdat inflatieverwachtingen van de private sector gevoeliger worden voor monetaire beleidsacties en -uitkomsten. Onder transparantie is het duidelijk wanneer beleidsbeslissingen gericht zijn op het stabiliseren van economische schokken. Dit geeft de centrale bank de flexibiliteit om de economie weer in evenwicht te brengen zonder dat dit van invloed is op inflatieverwachtingen van de private sector. Deze voordelige effecten van meer transparantie hebben hun weerslag op het renteniveau. Een flexibiliteitstijging staat een lagere beleidsrente en korte rente toe zonder van invloed te zijn op het niveau van de lange rente. Verbeterde reputatie resulteert in lagere inflatieverwachtingen en daarmee een lager niveau van de lange rente.

Een bijdrage van dit onderzoek is dat de aanwezigheid van zulke flexibiliteits- en reputatie-effecten voor het eerst empirisch wordt geanalyseerd met behulp van een dataset met transparantiegegevens van belangrijke centrale banken. Een periode van tien jaar (1993-2002) wordt geanalyseerd, waarbij per land de effecten van de verschillende transparantiestijgingen op het niveau van de beleidsrente, de korte rente en de lange rente in kaart worden gebracht. Door het toevoegen van de inflatie en de output gap als verklarende variabelen corrigeer ik voor economische omstandigheden die van invloed zijn geweest op de rente.

Voor de meerderheid van de centrale banken lijkt de transparantietoename overwegend gunstig te zijn geweest. Iedere onderzochte centrale bank heeft minstens één transparantietoename meegemaakt die inderdaad gepaard ging met meer flexibiliteit of verbeterde reputatie, resulterende in lagere renteniveaus. Echter, niet alle transparantiestappen hebben het gewenste effect gehad en in sommige gevallen lijkt er sprake te zijn van een afruil tussen flexibiliteit en reputatie.

In *hoofdstuk 4* onderzoek ik het effect van transparantie op de manier waarop inflatieverwachtingen worden gevormd. De hypothese is dat een hogere graad van transparantie gepaard gaat met beter verankerde inflatieverwachtingen. Het startpunt van de analyse is de methode van Levin e.a. (2004). Zij laten zien dat centrale banken die een inflatiedoel nastreven dat openbaar is gemaakt, zogenoemde "inflation targeters", profiteren van beter verankerde inflatieverwachtingen; een zwakkere relatie tussen de feitelijke inflatie en (in het bijzonder lange termijn) inflatieverwachtingen. Naast het nastreven en communiceren van een inflatiedoelstelling kunnen andere transparantievormen ook meer inzicht geven in het monetaire beleid dat de centrale bank voert en daardoor van invloed zijn op verwachtingen.

Centrale bank transparantie blijkt inderdaad relevant te zijn. Met behulp van paneldata laat ik zien dat inflatieverwachtingen beter verankerd zijn in landen met relatief transparante centrale banken. Daarnaast is de inflatie ook minder persistent in deze landen. Een landenanalyse is uitgevoerd om te testen of specifieke transparanti-estappen van invloed zijn geweest op de mate waarin inflatieverwachtingen verankerd zijn. Meer transparantie heeft geresulteerd in een significante verzwakking van de relatie tussen feitelijke inflatie en inflatieverwachtingen. Een voorbeeld van een transparantiestap die vergezeld is gegaan met beter verankerde inflatieverwachtingen is, naast het vaststellen van een expliciete kwantitatieve inflatiedoelstelling, het uitbrengen van een inflatierapport.

Voor beleidsmakers is het van belang te weten dat meer transparantie gepaard kan gaan met beter verankerde inflatieverwachtingen. De relatie tussen feitelijke inflatie en inflatieverwachtingen kan afzwakken of zelfs in zijn geheel verdwijnen. Het is hierdoor voor deze centrale banken eenvoudiger om een stabiel inflatieniveau te bereiken en te behouden.

Hoewel in de voorgaande literatuur veelal wordt gekeken naar de gevolgen van de werkelijke hoeveelheid transparantie, onderbouw ik in *hoofdstuk 5* dat het zinvol is om naar transparantie*percepties* te kijken omdat percepties economisch gedrag beïnvloeden. Er bestaat een verschil tussen het werkelijke transparantieniveau (de stroom aan informatie die de centrale bank openbaart) en de graad van transparantie zoals het publiek die ervaart.

Allereerst, heb ik met behulp van de resultaten van een enquête onder Nederlandse huishoudens aangetoond dat de kennis over de transparantie van de Europese Centrale Bank (ECB) gebrekkig is. Dit geldt ook voor respondenten met een economische baan en goede economische kennis. Met haar communicatiebeleid kan een centrale bank deze transparantiekennis beïnvloeden. Nederlandse huishoudens weten beter wat de belangrijkste doelstelling van de ECB is en of zij economische informatie prijsgeeft (aspecten waarover de ECB relatief transparant is) dan of notulen van vergaderingen openbaar worden gemaakt en voorspelfouten worden gecommuniceerd (transparantievormen die de ECB niet toepast). Daarnaast hangen transparantiepercepties niet alleen af van de transparantiekennis maar spelen andere, psychologische factoren een rol. Zo zijn optimistische mensen eerder geneigd de ECB als transparant te ervaren. Deze niet-kennisgerelateerde factoren bemoeilijken het voor centrale banken om transparantiepercepties te veranderen.

Centrale banken zijn geïnteresseerd in het opbouwen en behouden van het vertrouwen, omdat dit hun beleid vereenvoudigt. Uit mijn enquête blijkt dat hoe hoger de gepercipieerde mate van transparantie is, des te meer vertrouwen men heeft in de ECB. Centrale bank transparantie helpt via dit vertrouwenseffect om inflatiepercepties in lijn te brengen met de werkelijke inflatie en om inflatieverwachtingen te verankeren rondom de doelstelling van de centrale bank. Dit kanaal is echter afwezig voor een groot deel van de respondenten, omdat zij geen percepties over de transparantie van de ECB hebben gevormd. Er is voldoende ruimte om deze percepties te creëren. Om van hogere transparantiepercepties te kunnen profiteren, kunnen centrale banken er voor kiezen om vooral de nadruk te leggen op de manieren waarop zij wel transparant zijn. Een andere optie is de werkelijke hoeveelheid publieke informatie te verhogen

en dit goed te communiceren zodat de gepercipieerde transparantie ook toeneemt. De keuze tussen deze twee mogelijkheden hangt af van hoe eenvoudig percepties te beïnvloeden zijn en de kosten van de implementatie van additionele transparantie.

Het zal niet gemakkelijk zijn om een effectieve communicatiestrategie te ontwikkelen. De manier waarop transparantiepercepties worden gevormd verschilt per persoon, omdat percepties niet alleen afhangen van kennis maar ook van psychologische factoren. Voor centrale banken is het belangrijk om hiervan bewust te zijn.

Aangezien veel centrale banken al vele malen transparanter zijn geworden, rijst de vraag of het wenselijk is om verdere stappen naar maximale transparantie te zetten. In *hoofdstuk 6* laat ik zien dat dit niet raadzaam is. Centrale banken doen er goed aan te streven naar een intermediair niveau van transparantie. Hoewel een bepaalde mate van informatievoorziening door de centrale bank gepaard kan gaan met verbeterde inflatievoorspellingen van de private sector, verslechtert een grote stroom aan informatie mogelijk de kwaliteit van deze voorspellingen, of hun gepercipieerde kwaliteit. Men kan door de bomen het bos niet meer zien (*verwarringsargument*) of gaat te veel gewicht hangen aan de onzekerheid waarmee voorspellingen zijn omgeven (*onzekerheidsargument*). In beide gevallen worden prijzen in belangrijkere mate bepaald aan de hand van prijsstijgingen in het verleden dan op basis van inflatievoorspellingen. Dit resulteert in persistentere inflatie wat het voor de centrale bank lastiger maakt om haar inflatiedoel te behalen.

De aanwezigheid van een optimaal intermediair niveau van transparantie wordt bevestigd door de data. Ik gebruik een omvangrijke paneldataset, waarbij ik zowel de landeninformatie als de tijdinformatie benut. Hoewel de aanwezigheid van een intermediair optimaal niveau van transparantie de robuustheidtesten doorstaat, is het van belang op te merken dat het exacte optimale niveau moeilijk vast te stellen is. Zo is het optimale niveau in meer ontwikkelde landen hoger, wat niet verrassend is aangezien de inwoners hiervan beter getraind zijn in het verwerken van informatie (meer scholing). Het punt waarop zij last krijgen van verwarring ligt relatief hoog. Daarnaast worden zeer hoge transparantieniveaus minder frequent of helemaal niet waargenomen; oftewel het rechteruiteinde van de U-curve die tussen transparantie en inflatiepersistentie wordt gevonden, is relatief onzeker.

Wat betekenen deze uitkomsten voor het beleid van centrale banken? Ofschoon veel centrale banken gebaat zouden zijn bij meer transparantie is het niet verstandig om te streven naar maximale transparantie; het gaat om de *kwaliteit* van publieke informatie en niet om de kwantiteit.

Laat me nu op basis van mijn onderzoeksresultaten terugkomen op mijn onderzoeksvraag. Transparantie is vanuit economisch oogpunt een goede zaak. Het heeft geresulteerd in beter verankerde inflatieverwachtingen, lagere inflatiepersistentie en meer flexibiliteit. Het is van belang dat transparantietoenamen ook resulteren in een stijging van de gepercipieerde transparantie. Dit leidt namelijk tot meer vertrouwen in de centrale bank, realistischere inflatiepercepties en inflatieverwachtingen die dichter bij de doelstelling van de centrale bank liggen. Centrale banken doen er goed aan niet te streven naar volledige transparantie. Hoewel veel centrale banken, vooral in minder ontwikkelde economieën, gebaat zouden zijn bij meer transparantie, is dit

veel minder waarschijnlijk voor centrale banken die al een hoog transparantieniveau hebben (waaronder de ECB en de US Federal Reserve Bank).

Hoewel de transparantieliteratuur al goed ontwikkeld is, met veel theoretisch en recentelijk ook empirisch onderzoek, raakt een onderzoeker nooit "uitgezocht"; een poging om een bepaalde onderzoeksvraag te beantwoorden, roept vaak weer nieuwe vragen op. Toekomstig onderzoek kan verschillende wegen inslaan.

Het transparantieonderzoek kan verder worden *verfijnd*. Niet alle combinaties van transparantievormen en mogelijke economische effecten zijn geanalyseerd. Ook is het onderzoek niet evenwichtig verspreid over de verschillende transparantievormen. De omvangrijke dataset van Dincer en Eichengreen (2007) kan verder worden benut. Daarnaast is het zinvol meer aandacht te besteden aan de robuustheid van de bevindingen. Dit is vooral belangrijk omdat het moeilijk is transparantie te meten. Zo is het bij het bepalen van het transparantieniveau subjectief welke transparantievormen mee te tellen en met welk gewicht. Toekomstig onderzoek zou kunnen uitvinden welke transparantievormen er het meeste toe doen en daarom een zwaarder gewicht zouden moeten krijgen. Daarnaast is de wijze waarop monetair beleid transparant wordt gemaakt nog volop in ontwikkeling, met als gevolg dat nieuwe transparantievormen niet door de huidige transparantiemaatstaven worden meegeteld. Een ander probleem is omgekeerde causaliteit, de vraag wat er eerst was: de goede economische prestaties of transparantie? Onderzoek naar de determinanten van transparantie is daarom ook zinvol.

Aangezien de meeste centrale banken al transparanter zijn geworden, verschuift onderzoek naar het vinden van het *optimale transparantieniveau*. Ik denk dat er meer (empirisch) onderzoek zal volgen. Transparantie kan de economie via meerdere kanalen beïnvloeden dan enkel via de kwaliteit van voorspellingen wat van belang is voor het bepalen van het optimale transparantieniveau. Daarnaast is meer inzicht in centrale bank specifieke determinanten van het optimale transparantieniveau gewenst.

Omdat veel centrale banken al stappen naar meer transparantie hebben gezet, neemt de rol van *communicatie* bij het managen van inflatieverwachtingen toe. Er vindt daarom een verschuiving van het onderzoek plaats van de analyse van de effecten van langdurige transparantieveranderingen naar onderzoek naar de effecten van dagelijkse communicatie. Het zou zinvol zijn als de helderheid van de informatie kan worden gemeten. De optimale communicatiestrategie hangt af van wie de ontvanger is (een leek of een econoom), vanwege uiteenlopende kennis en percepties. Het doel is niet om zoveel mogelijk te communiceren, maar om de boodschap duidelijk over te laten komen. Dit vereist een focus op de kwaliteit van de informatie in plaats van de kwantiteit.

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