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THE ECONOMIC IMPACT OF CENTRAL BANK TRANSPARENCY: A SURVEY

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The Economic Impact of Central Bank Transparency: A Survey*

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Abstract

We provide an up-to-date overview of the literature on the desirability of central bank transparency from an economic viewpoint. Since the move towards more transparency, a lot of research on its effects has been carried out. 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 summarize 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.

JEL codes: E31, E52, E58

Keywords: Central Bank Transparency, Monetary Policy, Survey

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1 Introduction

Central banks used to be very secretive, but the last two decades a lot of central banks changed their regimes into a more transparent one.¹ As central banks became independent, being transparent gained importance based on accountability arguments. An additional reason why transparency came into prominence, is its influence on the formation of expectations. With the increased importance of financial markets, managing inflation expectations has become key in monetary policymaking (e.g. Winkler, 2002). It is important because 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). Whether transparency is beneficial from an economic point of view, however, is a question with a less obvious answer. Therefore, a lot of research has been conducted to find out whether the trend towards more transparency is desirable from an economic perspective as well. These studies vary with respect to the analyzed aspect of transparency and their method of analysis, which makes it difficult to assess the overall pattern. In this paper we provide more insight into the transparency literature, refraining from accountability issues. By doing so, several interesting 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 paper is not the first overview of the literature on the economic effects of central bank transparency. These earlier surveys discuss the literature based on different categorizations of transparency (Geraats, 2002; Hahn, 2002; Carpenter, 2004) or views of transparency (Posen, 2003).² Since the construction of these overview papers, 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 summarized as well. To improve the insight into the desirability of more transparency from an economic viewpoint, an up-to-date overview is needed.

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

¹Goodfriend (1986) provides a nice summary and comments on the Fed's written defense for secrecy, which it made in 1975 when it was sued to make its policy directive and minutes public immediately after Federal Open Market Committee meetings.

²See Geraats (2006) for an overview of the practice of monetary policy transparency.

other strands of theoretical literature. First, we look at the research based on reserve targeting models which dates from the end of the eighties, beginning of the nineties, starting with the paper by Dotsey (1987). More recently several new strands of literature emerged as well. 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 strand of literature analyzes the effect of transparency within monetary policy committees (e.g. Sibert, 2003). The most recent 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. Under the assumption of learning, managing inflation expectations becomes more important. Figure 1 summarizes the evolution of the theoretical transparency literature.

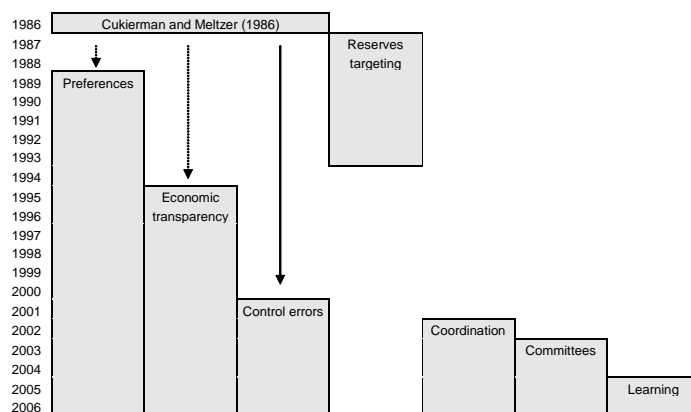


Figure 1: Overview of the theoretical transparency literature

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. 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 as well. In this paper 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.

The paper is organized as follows. Section 2 provides 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 reserve targeting models (2.2), the coordination literature (2.3), the committee models (2.4), and the learning literature (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 will discuss the findings, and provide some directions for further research within this field.

2 Theoretical Findings

Several arguments have been put forward both in favor of as well as against transparency. Theoretical work formalizes these arguments with the help of economic models. Appendix A provides an overview of the theoretical papers, starting in 1986 with the seminal work of Cukierman and Meltzer up to now. The papers are arranged in order of the year in which they were published, and they are alphabetized within a year. For each paper it is clarified which aspect of transparency is treated. Geraats (2002) made a useful classification of transparency into five different categories:

- 1) *Political transparency* includes information provision about the central bank's goals, how they are prioritized, and quantified. In addition, it concerns explicit institutional arrangements or the presence of a contract between the government and the central bank.
- 2) *Economic transparency* exists when the central bank shares its knowledge about the economy, for example by providing the economic data, and models it uses, and the forecasts that it makes.
- 3) *Procedural transparency* concerns openness about the procedures used to make monetary policy decisions (e.g. by being open about the strategy, and by publishing voting records, and minutes).
- 4) *Policy transparency* is present when there is no asymmetric information regarding the central bank's policy (decisions are clearly explained, changes are immediately announced, and future policy paths are indicated).
- 5) *Operational transparency* is higher when the central bank regularly assesses its performance, and when it is open about the macroeconomic disturbances that influence the transmission process.

Besides the aspect of transparency considered in the papers, we also briefly describe the model used in the papers reviewed (see the overview table in Appendix A). Because the model choice as well as the manner in which transparency is modeled are crucial for the outcome obtained. The importance 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.

Finally, the last column in the theoretical overview table in Appendix A contains a summary of the findings of each theoretical paper.

In the next sections we will discuss the various strands of literature in chronological order.

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.(1), period i 's actual money growth (m_i) is a function of the policymaker's planned money growth (m_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 .

$$m_i = m_i^p + \psi_i \tag{1}$$

The policymaker tries to solve a maximization problem. Eq.(2) is the central bank's multi-period, state dependent objective function. The central bank chooses the rate of money growth 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. Variations on this maximization problem are used in other theoretical transparency papers. In eq.(2) β is the central bank's discount factor, E_0 is the its expected value operator conditioned on the available information in period 0, including a direct observation of the central bank's period 0 weight attached to inflation surprises to stimulate output (x_0). The policymaker's choice

of the money growth rate depends on its weight attached to the benefits of surprise inflation (economic stimulation) and its costs (higher inflation).

$$\max_{\{m_i^p, i=0,1,\dots\}} E_0 \sum_{i=0}^{\infty} \beta^i \left(e_i x_i - \frac{(m_i^p)^2}{2} \right) \quad (2)$$

The central bank knows the manner in which the public forms its expectations about money growth and inflation, up to a random shock. Therefore the central bank knows the unanticipated rate of money growth (e_i) it creates by picking a particular money growth rate (as defined in Eq.(3)). $E[m_i | I_i]$ is the public's forecast of actual money growth, given the public's information set I_i . This information set includes the actual money growth up to and including the previous period.

$$e_i = m_i - E[m_i | I_i] \quad (3)$$

Eq.(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 .

$$x_i = A + p_i, \quad A > 0 \quad (4)$$

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):

$$p_i = \rho p_{i-1} + v_i, \quad 0 < \rho < 1, \quad v \sim N(0, \sigma_v^2) \quad (5)$$

The public cannot 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 details of the model 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 money growth is described by eq.(6).

$$m_i^p = \frac{1 - \beta\rho}{1 - \beta\lambda} A + \frac{1 - \beta\rho^2}{1 - \beta\rho\lambda} p_i \quad (6)$$

When eq.(6) is put into eq.(1) the actual money growth turns out to be:

$$m_i = \frac{1 - \beta\rho}{1 - \beta\lambda} A + \frac{1 - \beta\rho^2}{1 - \beta\rho\lambda} p_i + \psi_i \quad (7)$$

The actual money growth's unconditional mean is:

$$E(m_i) = \frac{1 - \beta\rho}{1 - \beta\lambda} A \quad (8)$$

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 monetary growth. When monetary growth control is less effective (a higher variance of the control errors: σ_ψ^2) the adjustment of expectations is slowed-down (λ , the memory of the public, is higher). 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 surprise inflation now at the cost of future inflation.

The variance of money growth is given by eq.(9)

$$V(m_i) = \left[\frac{1 - \beta\rho^2}{1 - \beta\rho\lambda} \right]^2 \frac{\sigma_v^2}{1 - \rho^2} + \sigma_\psi^2 \quad (9)$$

From eq.(9) it follows that, when there is some degree of time preference, the variance of the money growth, $V(m_i)$, is higher when monetary control is less effective (σ_ψ^2 higher). This impact is both direct (actual money growth is more variable for any planned money growth level) 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 monetary control error, the lower the discount factor β , the higher $V(m_i)$. 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 ($V(e)$), partly resulting in higher money growth variability.

When the central bank chooses the quality of monetary control the degree of transparency is set. More effective monetary control increases transparency, and makes it 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 are based on the model briefly presented in the above. In the subsequent Subsections, these branches will be discussed paying explicit attention to their link with the CM(1986) paper.

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 could make the public think that the central bank focusses on counteracting short-run output fluctuations. This makes the time-inconsistency problem worse because of higher inflation expectations and the resulting higher 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 preference transparency is transparency about the value of x_i . In addition, some papers look at transparency about the central bank's targets (in the CM-model: e_i or m_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).

Stein (1989) presents 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. Therefore, it is impossible for the central bank to be clear about its policy objectives precisely and credibly. The solution is to make imprecise statements, that is, to only announce a range within which the target lies. 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 other ways (greater monetary noise: ψ_i), which could lead to greater costs. Second, it might be beneficial when the social trade-offs between policy objectives change over time. That is, the central bank can use surprise inflation when society likes it the most. Another argument why secrecy might be desirable is, is that it could lead to wage moderation to limit real wage uncertainty, which lowers inflation and boosts output (Sørensen, 1991). 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, intransparency 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. As in Sørensen (1991), Grüner (2002) argues in favor of secrecy based on lower wages, and as a consequence average inflation and unemployment. Even when the only objective is to have low inflation uncertainty, transparency might not be desirable, because under bounded rationality it may lead to a higher variance of inflation. 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. These lower inflation expectations make the trade-off between inflation and output favorable, which makes it possible to respond stronger to shocks. One exception is the central banker that puts the most weight on output, because his type will be revealed in the most likely outcome and therefore inflation expectations cannot be improved.

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 flexibility, 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 is argued by Schaling and Nolan (1998). The benefit from more 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, to the public unknown, supply shocks). The 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, Hoeberichts and Schaling (2000), transparency lowers inflation as well, because wage setters perceive the central bank as more conservative, and less uncertainty reduces the volatility of inflation. However, it increases the volatility of output in response to supply shocks, which is harmful for society's welfare. When the flexibility problem is large in relation to the credibility problem, secrecy may be desirable. This trade-off is confirmed by Eijffinger and Hoeberichts (2002), who find improved independence associated with more transparency.

The effects on average monetary policy responses are exactly the opposite when Beetsma and Jensen (2003) model preference uncertainty in an analogous but slightly different fashion (isolating the effects of preference uncertainty on policy uncertainty). They show that in several cases preference uncertainty may not be beneficial, even when the flexibility problem is assumed to be relatively large. Other arrangements, e.g. an inflation contract, target or immediately choosing the optimal degree of conservatism are superior. Eijffinger et al. (2003) argue that the main result of their earlier paper still holds; when the beneficial effects on output variability outweigh the undesirable effects on inflation (both level and variability), it may be desirable to have uncertainty about the preferences of the central bank. According to Hughes Hallett and Viegli (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.

In summary, the theoretical research on the effects of preference transparency does not give a unanimous answer with regard to its desirability. It is found that the outcomes depend heavily on the model assumptions being used. An overview of these assumptions is presented in Appendix A. In most papers only unanticipated monetary policy has an effect on output. Additional assumptions, for example about the importance of reputation building, the manner in which wages are set, and the precise definition of transparency, do differ however, and are responsible for differences in outcomes.

2.1.2 Economic Transparency

The desirability of economic transparency is heavily debated as well. On the one hand, transparency about the economic model used may not be desirable because there is no consensus on the correct model of the economy (Cukierman, 2000). 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, 2000). Others 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 papers 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.

Noisy announcements (providing a range on its forecast of the money demand disturbance) may make the trade-off between flexibility and credibility 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 (2000) 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 loses 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 contrast 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 Hoerberichts, 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 its level of transparency itself, it will become more likely that even when the central bank is weak, reputational concern 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 (2006b) 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.

In short, in line with preference transparency, differences in model details explain differences in observed outcomes (see Appendix A). Furthermore, the views on

the desirability of economic transparency are mixed, even when papers based on the same type of model are compared. Despite the above, 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 is one aspect of operational transparency, as defined by Geraats (2002).

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 inflation, which makes deviations from the announced zero-inflation path more costly for the central bank. Therefore it is less likely to engage in inflation surprises, which leads to 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 ex post relatively heavily for inflation surprises by reducing future reputation. Therefore, lower transparency need not lead ex ante to a similar increase in the inflation bias. In addition, when the average employment target of the central bank is zero, then the inflation bias is zero independent of the degree of transparency. Then the costs of reducing transparency in terms of an increased inflation bias is not present. 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 flexibility. 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.

Sibert (2006) shows that in case 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.

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 and flexibility, as did CM(1986), whereas according to the most recent paper this trade-off is non-existing, and transparency is desirable.

2.2 Reserves Targeting

Another strand of literature analyzes the implications of policy transparency within reserve targeting models. Several economists point out that it might be desirable if central banks were to be transparent about their policy. It could reduce excessive speculation, and make financial markets more efficient, movements more predictable, and reduce volatility (as argued by e.g. Blinder 1998) Furthermore, the effectiveness of stabilization policy could improve when the financial markets know the underlying reasons for the central bank's current policy actions and its long-run policy intentions, because market reactions to policy will more likely reinforce these policy actions (e.g. Broaddus 2001).

The theoretical papers that focus on the effects of policy transparency date from the late 1980s and begin 1990s, and can be seen as a separate strand in the theoretical transparency literature. All these papers focus on (non-borrowed) reserves targeting models (which are outdated, because nowadays almost all central banks target inter-bank or repo-rates instead), in which the policy instrument is a target for the money supply. The inter-bank rate (e.g. the federal funds rate) adjusts to ensure equilibrium between supply and demand of total reserves in the market for bank reserves (borrowed and non-borrowed). The central bank's supply of non-borrowed reserves depends on its short-term money target and the inter-bank rate. The central bank's short-term money target is disclosed when there is policy transparency. Furthermore, it is assumed that the

central bank has private information about disturbances to the money market, which makes it impossible for the public to deduce the policy target from the inter-bank rate.

The first research in this strand of the literature is in favor of more secrecy. Dotsey (1987) argues that secrecy about the short-term monetary target has the desirable effect of reducing the variability of the federal funds rate, because it will respond less to unobserved monetary target disturbances. However, the variance of the private sector's forecast errors in forecasting the federal funds rate increases. In contrast to Dotsey (1987), Tabellini (1987) argues that secrecy about the short-term reserves rate could increase the volatility of the federal funds rate. The responses of the inter-bank rate to unobserved money market disturbances increases, because part of these disturbances is assigned to the unknown reserve target. The variability of the reserve aggregates may be increased by this additional volatility of the funds rate, which can even extend to interest rates of longer maturity and to other financial aggregates through a term structure relationship. Therefore, secrecy could make it more difficult for a central bank to achieve its monetary targets. Yet another paper argues instead in favor of secrecy (Rudin, 1988). When some private sector agents engage in "Fed watching", policy secrecy could increase the predictability of the federal funds rate. Because monitoring costs to infer the reserve target decrease in case of transparency, more people take a closer look at what the central bank does. As a result, future interest rates respond more strongly to the unforecastable elements in future disturbances. The agents that are newly induced to monitor the Fed may forecast better, but this may not hold for the forecasts of all other agents, whether they are Fed watchers or not. The increase in the amount of central bank watchers leads to a stronger response of the inter-bank rate to money market disturbances. Increased volatility makes forecasting the inter-bank rate more difficult for at least some, and perhaps all, of the private agents. Another motivation for secrecy about the current monetary aggregate objectives is provided by Cosimano and Van Huyck (1993). Secrecy forces commercial banks to solve a bivariate signal extraction problem in which the current federal funds rate and deposit rate are used to estimate both the current reserve target and the future reserve targets. Secrecy reduces the sensitivity of the interest rate to the current level of reserves and lowers the marginal interest rate cost of moving towards the central bank's reserve target and hence lowers the upward bias in total reserves. The central bank prefers secrecy as a consequence of this. For reasonable parameter values secrecy is beneficial for the commercial banks as well.

The reserves targeting strand in the transparency literature, does not reach a unanimous conclusion about the desirability of policy transparency. Papers that analyze this particular aspect of transparency within a more contemporary framework, in which the central bank targets the policy rate instead of (non-)borrowed reserves, would be a useful contribution to the transparency literature.

2.3 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 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. In addition, they second guess the actions of other agents. 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. Agents face a coordination motive as well as a wish to match the fundamentals. When public information is the only source of information, greater precision always leads to higher social welfare. Instead when some private information is available, greater precision of public information does not always lead to higher social welfare. When private information is very precise, more public information is likely to lower social welfare. In this case, the coordination motive causes agents to put more weight on the public signal than is justified by the level of its precision. Svensson (2006) shows that for empirically reasonable parameter values, the research performed by MS (2002) is in favor of more transparency. As a conservative benchmark, Svensson (2006) demonstrates that when the precision of public and private information is the same, social welfare increases with the provision of public information. Morris et al. (2006) indicate to agree with Svensson's comment and 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. 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 market and goods 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 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 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.

Several other papers argue in favor of transparency. The optimal degree of trans-

parency is positive under all circumstances in Cornand en Heineman (2004). It is usually preferable to be as precise as possible about the information provided. Sometimes, to prevent overreaction to public information, however, it is better to withhold this information from some agents. Pearlman (2005) too 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.

Demertzis and Hoerberichts (2005) show that, when introducing costs to information precision into the MS (2002) framework, for reasonable parameter values a trade-off between increasing the precision of public information and the accuracy of private information exists. Increasing the degree of transparency is not necessarily desirable in all circumstances. Demertzis and Viegi (2005) 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 at 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.

Although, at a first glance, it seemed that the work of MS (2002) argued against transparency, it turned out that for reasonable parameter values it actually favored transparency. Most of the research that has built upon this work is in favor of (at least some degree of) transparency.

2.4 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 (Buiters, 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, 2000). The publication of individual votes makes it possible to assess the competence of individual members (Buiters, 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, 2000). 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.

The arguments presented above were formalized a couple of years later, when theoretical research on procedural transparency started to develop. These theoretical papers model the effects of procedural transparency in 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 (under the precondition that the young policymakers sometimes vote for inflation). 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). In Gersbach and Hahn (2006a) procedural transparency makes it easier to reelect central bankers that are highly efficient (good in choosing the right interest rate), such that the competence level of the central bank governing council is increased. But central bankers that 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 one unanimous conclusion, and the way in which committees are modeled is pivotal.

2.5 Learning

In the 1970s the rational expectations hypothesis gained popularity. More recently, however, a lot of critique toward rational expectations has been formulated, because it is hard to believe that every economic agent behaves rationally and uses the same model of the economy. In reaction to this criticism, mod-

els that include learning agents were constructed. Agents are provided with learning algorithms which they update based on past data.³ 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, see e.g. Orphanides and Williams (2005a). Svensson (2003) put forward the idea that transparency may have a large impact on learning by the private sector to form the right expectations about the economy and inflation. Nevertheless, transparency was largely neglected in the learning literature for several years, until Svensson argued that welfare is likely to be higher under transparency because transparency about the state and functioning of the economy and the working of monetary policy is likely to improve the information available to the private sector, and through this, their decisions. After this insight, several papers sought to fill this gap in the learning literature.

According to this strand of literature, more transparency seems to be desirable. In Eusepi (2005), transparency about the policy rule can be helpful in reducing the uncertainty and stabilize 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 and therefore 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 publication of forecasts is desirable too. 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 to the equilibrium faster. Cone (2005) shows mixed results. Transparency turns out to be 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.

Overall, 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. But this strand of research is still in its infancy, so more research in this field is both necessary as well as expected.

³Evans and Honkapohja (2005).

3 Empirical Results

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 made at a given point in time, and do not provide data about changes in the degree of transparency. 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.

Appendix B summarizes the empirical literature on the economic effects of transparency. Papers are first sorted according to the year of publication, and then within a year they are listed in alphabetical order. For each paper, it is indicated what the research encloses: the analyzed aspect of transparency, the countries under scrutiny, the data period considered, the index used, and the obtained results. The next sections summarize the findings per topic.

3.1 Anticipation

One important finding of the empirical literature is the improved policy anticipation associated with transparency. This result is supported by the majority of papers who analyze transparency in relation to the ability to anticipate. This holds both for papers that look at transparency in general (Muller and Zelmer, 1999; Siklos, 2003; Coppel and Connolly, 2003; Swanson, 2004; 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 was found as a result of political transparency (Haldane and Read, 2000; Clare and Courtenay, 2001; Lildholdt and Wetherilt, 2004; Biefang-Frisancho Mariscal and Howells, 2006), 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 was 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 of the Fed that took place in 1994. Since then, interest rate decisions take place following a scheduled meeting of the FOMC, and are immediately disclosed by a press statement.

Not all papers find improved anticipation effects. Reeves and Sawicki (2005) 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 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. In addition, testimonies to parliamentary are especially backward-looking and do not contain much new information. Another finding is that, although transparency about different points of views about the economic outlook could improve anticipation of future monetary policy, this is not the case for transparency about committee members' disagreement about monetary policy (Ehrman and Fratzscher, 2005). Furthermore, the reaction of Canadian interest rates to Canadian macroeconomic news is, even after increased transparency, still low in contrast to the reaction to US news, which indicates that the understanding of which Canadian macroeconomic information is relevant for the Bank of Canada's reaction function is still not clear to the public (Gravelle and Moessner, 2001).

3.2 Synchronization

In addition to the effects on the anticipation of monetary policy, some papers look at the synchronization of forecasts. Biefang-Frisancho Mariscal and Howells (2006) show that transparency has improved consensus among forecasting agents (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 better macroeconomic outcomes (Cecchetti and Krause, 2002). Drawback of this paper is that transparency is measured in 1998, while the data period looked at is 1990-1997, therefore causality could run the other way. In this respect, the use of detailed time-series data on transparency could be helpful. Higher political transparency (about the target) has been beneficial for both the level of inflation (Kuttner and Posen, 1999; Fatás et al., 2006) 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). Output volatility does not appear to be significantly affected by this form of transparency (Fatás et al., 2006). Empirical research finds some costs from increasing procedural transparency: the quality of discussion and debate

could decrease (Meade and Stasavage, 2004). Chortareas, Stasavage and Sterne (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 come along 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 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 costs of disinflation in terms of lost output and employment. That both forms of transparency are related to lower sacrifice ratio's is confirmed by Chortareas et al. (2003), who estimate short-run Phillips curves to get country-specific sacrifice ratios. Publishing detailed forecast, including a discussion of the forecasts errors and risks, and minutes and voting records seems to help reducing the sacrifice ratio. 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 aspects of transparency (the economic, alternative economic, and operational index) are significantly correlated with lower inflation variability.

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 is supported by the country-specific and panel data regressions in van der Cruijssen and Demertzis (2007), who make use of detailed time-series and expectations derived from surveys. 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, but this is not the case in the UK after it became independent and in Sweden (inflation targeter). Improved anchoring of inflation expectations is an indication of improved credibility. Demiralp (2001) provides some indication of improved credibility as well.

Nominal interest rates are lower for countries with a clear inflation objective (Siklos, 2004). Geraats et al. (2006), use detailed time-series information to analyze the effect of various transparency changes on the levels of interest rates. Lower interest rates may be interpreted as improved reputation and flexibility of central banks. They find that many transparency increases have had a sig-

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

3.5 Cross-Country Comparison

Although the empirical papers cover a lot of central banks, some get more attention than others (e.g. the Federal Reserve Bank of the US). In most cases, it does not matter which country is looked at, 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, some perform case studies of a couple of countries. Some of the latter papers find beneficial effects for all countries looked at (e.g. Haldane and Read, 2000), but not all of them. Transparency about different point of views about the economy improved anticipation of monetary policy in the US, but no significant effect could be found for the Bank of England and the ECB (Ehrman and Fratzscher, 2005). Reasons given are the differences in objectives across these central banks and the finding of Romer and Romer (2000) that the Fed has better knowledge and information about the economy than the markets have. Other examples of diverse findings are van der Crujzen and Demertzis (2007), who find improved anchoring after several transparency increases in some countries of their sample. In addition, Geraats et al. (2006) find lower interest rates in a lot of cases, but not after all cases of increased transparency. One reason could be that the type of transparency change matters, but also the particular central bank that is looked at could be crucial. For example, the central bank's initial level of transparency and credibility could play an important role. More research is needed to analyze whether this is indeed the case.

4 Discussion and Conclusions

The debate on the desirability of transparency is still going on. As we show in this paper, the way in which transparency was analyzed theoretically has changed a lot during the last two decades. The research was initiated by Cukierman and Meltzer (1986), who display that transparency reduces inflation at the cost of the central bank's flexibility, a trade-off that could make transparency undesirable. Several branches of literature have been inspired by this research. One of these branches looks into the effects of preference transparency. Several papers argue that preference transparency would lead to higher inflation, whereas other researchers find, similar to CM (1986), that it would lower inflation instead. However, even those researchers demonstrate that the accompanied flexibility loss could still make this form of transparency unfavorable. Although there are also papers that do not find hampered stabilization policy, which illustrates that up till now no agreement on preference transparency has been achieved. For another branch of literature that is partly inspired by

CM (1986) as well, but analyzes economic transparency instead, we find that although earlier papers argue against more transparency, more recent work favors it. A similar trend is present in the branch of literature on control errors. Differences in outcomes result from diverging model assumptions, which are summarized in the theoretical overview table (Appendix A).

Shortly after CM (1986), another strand of literature emerged. This strand was based on reserve targeting models, and ended in 1993, but did not reach a unanimous conclusion on the desirability of policy transparency. However, this literature is of little relevance for contemporary policymakers, since targeting the policy rate instead of reserves is the current practice of almost all central banks.

As we have presented in this survey, at the beginning of this century, three completely new strands of literature emerged. This new theoretical work focuses on the way in which individuals take actions. One strand analyzes the effect of public information within coordination games. It assumes that agents have both public and private information and face a coordination motive in addition to a desire to match the fundamentals of the economy. Most of the work in this area is in favor of more public information, although some papers show circumstances in which this might not be the case.

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 as well. The manner in which committee members are modelled is decisive.

The most recent strand in which the effects of central bank transparency are analyzed, is the learning literature. The majority of the work in this field supports more transparency because it improves learning. However, one has to be aware of the fact that this strand of literature is still in its infancy, so more work in this field is both needed, and expected to be carried out.

On the whole, we observe a tendency that more recent work is in favor of transparency, with the exception of the strands that analyze procedural and preference transparency for which results remain mixed. Nevertheless, the ultimate answer to whether transparency is desirable or not, is provided by the empirical literature.

Empirical research on the economic effects of more transparency is of a more recent origin than the theoretical work. It started in 1999 when some data with regard to transparency changes had become available. Some years later, it received an extra impulse when several measures of transparency were constructed to facilitate more research in this area. The empirical results are largely in favor of more transparency. It is found that transparency has the potential to improve the anticipation of future monetary policy, which makes the conduct of monetary policy more efficient. This holds for transparency in general but for all aspects individually as well. In addition, more transparency could reduce interest rate volatility and make forecasts more synchronized. Better macroeconomic outcomes and improved credibility are found for all aspects of transparency. 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 clearly point in favor of more political transparency. This is not the case for procedural transparency, which could have some detrimental side-effects, namely a lower quality of discussion and debate. For all other aspects of transparency more transparency turned out to have desirable effects, which is in line with more recent theoretical research.

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 looked at yet. In addition, the evidence on flexibility and reputation does not unanimously point into one direction. Furthermore, several 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 and more research will focus on central bank communication.

Furthermore, future empirical literature should look into the robustness of the results. It is difficult to measure transparency and there are some specific drawbacks from the use of indices. For example, which components should be included and with which weight? Future research could try to find out which aspects matter the 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: the good economic performance or the transparency increase? 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). Although central banks have increased their level of transparency, there is still some room left for further improvements. 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 (on average a score of 2.6), but there is still some room for improvements for three central banks. Economic transparency ranks second (on average a 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. About procedural transparency the literature has not been 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 lit-

erature is not decisively in favor of more operational transparency. In addition, although the empirical literature is in favor of it, relatively little empirical research focussed on this aspect of transparency and it originates only from 2003 onwards.

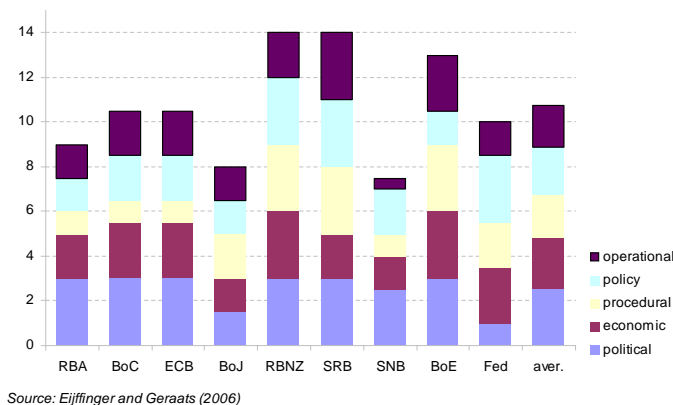


Figure 2: Actual degree of transparency (measured in 2002)

Coming back to the questions that we raised in the introduction of this survey and thereby 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. There is a tendency of more recent, micro-directed research 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. But now that most central banks have already become more transparent, it is likely that the research will shift more towards communication, a trend that is already observable. As Winkler (2002) pointed out, the release 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.

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A Theoretical Summary Table

Author(s)	Aspect(s)	Used model	Brief description	Outcome
Cukierman and Meltzer (1986)	operational	ML	Infinite horizon. Based on optimal policy models of KP (1977) and BG (1983b). Multiperiod state dependent objective function (weights shifts 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	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 cannot precommit. Time-inconsistent policy higher utility. Different types of cb-ers with different preferences.	desirable, but statements should be imprecise: providing a range within which the targets lies (market reactions more swiftly)
Lewis (1991)	political	ML	Infinite horizon. Based on CM (1986). Cb is intransparent about the weight attached to the objectives.	might be desirable (prevents other more costly forms of secrecy, and enables the use expansionary policy when it is the most desired.)
Sørensen (1991)	political	ML. Simple model with a strong labour union.	Labor union sets the nominal wage rate before the policy maker 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 in the objective function, the union does not.	might be undesirable (lower variance of inflation and output, but higher inflation and lower output)
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 natural output. Cb has private forecasts about the money demand disturbance before wages are set. Public cannot distinguish between the forecast and its forecast error.	desirable, but should be noisy: giving a range on the cb's forecast of the money demand disturbance (improved predictability of monetary policy 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(s)	Aspect(s)	Used model	Brief 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. Low target would be desirable for creating surprise inflation but not for evaluation. Cbt: info about shocks provided before inflation expectations are formed.	might be beneficial (lower inflation bias without distorting stabilization policy)
Cukierman (2000)	economic	1) ML, and 2) Neoknesian	Mp-game with uncertainty about the relative weights in the objective function. Nominal wage contract 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 realize (also unknown when signing contracts). Cb sets monetary policy, output is determined. Cb loss function is quadratic in output.	might be undesirable
Eijffinger et al. (2000)	political	ML	Mp-game with uncertainty about the relative weights in the objective function. Nominal wage contract 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 realize (also unknown when signing contracts). Cb sets monetary policy, 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 cb-ers. 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 (better outcomes through more concern about reputation) -political transparency is not (worse outcomes because actions do not affect its reputation), although it could be in a richer model
Cukierman (2002)	political	NK	The cb is a flexible inflation targeter, and intransparent about its loss-function and the weight attached to output gap stabilization.	undesirable (detrimental for credibility)
Grüner (2002)	political	2-stage game with interaction between the cb and a monopoly union	Union sets nominal wage before cb sets inflation. Crucial distinction between uncertainty about the objectives (influenced by disclosure of information) and uncertainty about inflation (affected by cb's objectives, and actions of all players).	might be undesirable (higher wages, average inflation and unemployment, possibly higher variance of inflation)
Eijffinger and Hoebenichts (2002)	political	ML	Based on Lohmann (1992), Schaling and Nolan (1998), Eijffinger et al. (2000). Conservative cb-er, weight for output stabilization 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 Svensson (2002)	operational	ML	Infinite horizon model. Based on CM(1986).Cbt: the degree to which cb preferences (serially correlated) can be inferred by the public. Control: extent to which outcomes match intentions. Standard cb loss function. More cbt then inflation expectations more sensitive to policy actions, current policy decisions influence future inflation expectations. No implication for current aggregates (not forward looking). Cbt introduces a constant marginal cost of loose monetary policy, 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)

Author(s)	Aspect(s)	Used model	Brief 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 policy maker types (weights in objective function differs) which is unknown. Public forms expectations, then stochastic shocks are realized, then monetary policy 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)
Eijffinger et al. (2003)	political	ML	See Eijffinger et al. (2000).	might be undesirable (when less flexibility > decrease in level and variability of inflation)
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 gets the economic information (economic judgement, forecasts, models) before forming expectations.	undesirable (eliminates the possibility to stabilize employment)
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 to 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)

Author(s)	Aspect(s)	Used model	Brief description	Outcome
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 en Heineman (2004)	total	Coordination	MS(2002) with the possibility of intermediate degrees of cbt.	desirable (but sometimes to only part of the ps)
Gersbach and Hahn (2004)	procedural	Committee	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)
Hoerberichts et al. (2004)	economic	NK	Cb is sufficiently conservative. Cbt: about cb's assessment of the expectations of the ps.	desirable (increase in output stabilization > the decrease in inflation stabilization)
Gersbach and Hahn (2005)	procedural	Committee	2-period. Monetary union, members appointed by national governments.	may be undesirable
Cone (2005)	economic	Learning	Canonical time-inconsistency mp-model.	depends on circumstances
Demertzis and Hoeberichts (2005)	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 privat information)
Demertzis and Viegi (2005)	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
Eusepi (2005)	political	Learning.	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	Micro-fund general equilibrium model with nominal rigidities. Real interest rate transmission mechanism 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)
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, 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

Author(s)	Aspect(s)	Used model	Brief description	Outcome
Gersbach and Hahn (2006a)	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
Gersbach and Hahn (2006b)	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 targetted and realized inflation)
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, and authorities dislike accountability punishments, control over monetary policy 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 strenght. Period 1: traders decide whether to attack the currency. Success depends on economic strenght 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 (2006)	operational	Expectations augmented Phillips curve	2-periods. Either nom. 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)
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)

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). 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, mp=private sector, mp=monetary policy, BG=Barro and Gordon, KP=Kydland and Prescott.

B Empirical Summary Table

Author(s)	Aspect(s)	Country(ies)	Period(s)	Index	Conclusion(s)
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)
Siklos (1999)	political	7 IT: AU, CA, FI, NZ, ES, SE, UK, 3 non-IT: US, DE, CH	1958-97	-	desirable (inflation persistence sign. lower after the adoption of inflation targets for a majority of IT countries, no evidence for better inflation performance/sign. influencing 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)
Clare and Courtenay (2001)	political	UK	1994-99	-	desirable (increased speed of reaction to interest rate announcements, but the size of the reaction remained the same or decreased, indicating the news content of macroeconomic announcements may have fallen)
Demiralp (2001)	policy	US	1994?	-	desirable (improved market anticipation and credibility)
Gravelle and Moessler (2001)	total	CA	1995-2000	-	no effect (interest rate reaction to Canadian macroeconomic news is still low)
Chadha and Nolan (2001)	total	UK	1987-99	-	no effect (increased financial market volatility cannot be attributed to more cbt since May 1997)
Cechetti and Krause (2002)	total	22	1995-99, 1990-97, 1990-97	F	desirable (lower average inflation (sign.), better macroeconomic performance (not sign.), less policy inefficiency (not. sign.))
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 inflation or 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)
Poole et al. (2002)	policy	US	1987-2001	-	desirable (improved anticipation after 1994)
Rafferty and Tomljanovich (2002)	policy	US	1983-98	-	desirable (improved predictability, 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)

Author(s)	Aspect(s)	Country(ies)	Period(s)	Index	Conclusion(s)
Fracasso et al. (2003)	economic/operational	20	2000-02	own measure	desirable (improved predictability of mp through higher quality inflation reports)
Lange et al. (2003)	political and policy	US	1983-2000	-	desirable (improved predictability of monetary policy)
Poole and Rasche (2003)	policy	US	1988-2002	-	desirable (lower market surprises)
Kohn and Sack (2003)	policy	US	1989-93	-	desirable (improved anticipation of future policy and economy, which improves policy effectiveness)
Gerlach-Kristen (2004)	procedural	UK	1997-2003	-	desirable (improved prediction of monetary policy)
Levin et al. (2004)	political	5 IT (AU, CA, NZ, SE, UK), 7 non-IT (US, JP, DK, FR, DE, IT, NL)	1994-2003	-	desirable (lower inflation persistence, better anchored inflation expectations, especially for the longer term horizons)
Lildholdt and Wetherilt (2004)	all	UK	1975-2003	-	desirable (improved predictability of monetary policy, especially after the introduction of inflation targeting)
Siklos (2003)	political, economic / operational total	5 non IT (US, DE, CH, NL, AT), 6 IT (AU, CA, SE, NZ, ES, UK)	1988-99	-	desirable (lower inflation expectations, improved predictability of inflation)
Meade and Stasavage (2004)	procedural	US	1994-2001, 1997-2001	-	desirable (decreased market volatility and uncertainty)
Siklos (2004)	political	20 OECD countries	1967-99	-	undesirable (decreased quality of the FOMC's discussion and debate)
Tomljanovich (2004)	total	AU, CA, DE, JP, NZ, UK, US	1990-2003	-	desirable (sign. lower nominal interest rates)
Swanson (2004)	total	US	1985-2003	-	desirable (slightly larger reductions in volatility and increased efficiency of financial markets)
Demertzis and Hughes Hallett (2005)	all aspects	AU, CA, EU, JP, NZ, SE, CH, UK, US	early 90s-end2001	EG	desirable (improved predictability of monetary policy)
Ehrman and Fratzscher (2005)	procedural	UK, US, EU	1999-2004	-	desirable (not significantly correlated with average levels of inflation and output, and variability of output, but total, economic, and operational transparency are significantly correlated with lower inflation variability, 95% confidence level)
					desirable (transparency about different points of views about the economic outlook improves anticipation of monetary policy, only for the US) and undesirable (transparency about disagreement about monetary policy could worsen it)

Author(s)	Aspect(s)	Country(ies)	Period(s)	Index	Conclusion(s)
Fujiwara (2005)	economic	JP (41 forecasting institutions)	1998-2003	-	desirable (less uncertainty, improved understanding of future monetary policy)
Reeves and Sawicki (2005)	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 are being 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, its effect is more subtle and more difficult to pick up.)
Bauer et al. (2006)	policy	US	1986-2004	-	desirable (more synchronized private sector forecasts about the economy and policy decisions, but common forecast error unchanged)
Biefang-Frisancho Mariscal and Howells (2006)	political, procedural	UK	1984-2003	-	desirable (improved policy anticipation after 1992 (inflation targeting), and more consensus among forecasters after 1997 (independence + procedural transparency), although this is more likely caused by a fall in the dispersion of inflation rate forecasts)
van der Crujjsen and Demertzis (2007)	all	AU, CA, EU, JP, NZ, SE, CH, UK, US	1989-2004	EG, BSG, S, and D	desirable (better anchored inflation expectations and less inflation persistence)
Fatás, Mihov and Rose (2006)	political	42	1960-2000	-	desirable (lower inflation rates, output volatility not significantly affected)
Geraats, Eijffinger, and van der Crujjsen (2006)	all	AU, EU, JP, NZ, SE, CH, UK, US	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
Gürkaynak (2006)	political	US, UK, SE	1994-2005, 1993-2005, 1996-2005	-	desirable (better anchored inflation expectations)
Swank et al. (2006)	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 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). 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 5: EG=Eijffinger and Geraats (2006), BSG=Bini-Smaghi and Gros (2001), S=Siklos (2002) and D=De Haan et al. (2004), F=Fry et al.(2000). IT=inflation targeting, cbt=central bank transparency.