Central Bank Transparency*

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March 2002

Abstract

Central bank transparency has become one of the key features of monetary policy recently. This survey article provides a structured review of the theoretical literature on the consequences of transparency of monetary policy, proposing a distinction between uncertainty and incentive effects of transparency. The theoretical insights are compared to the various ways in which central banks have become transparent in practice. In addition, there is an assessment of the empirical evidence concerning the transparency of monetary policy.

*The comments of the anonymous referee are gratefully acknowledged. I also would like to thank the many colleagues and central bankers with whom I have had the opportunity to discuss this topic because they collectively greatly contributed to the shape of this survey.

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1 Introduction

Central banking has undergone a remarkable change during the last decade. The new paradigm in monetary policy appears to be central bank independence and transparency. Although the importance of central bank independence has long been recognized in the academic literature, research in favor of transparency of monetary policy is relatively new and largely seems a response to the new best practice in central banking. This survey article provides an overview of the burgeoning literature on transparency of monetary policy and relates it to the ways in which central banks have adopted greater openness.

The trend towards greater central bank transparency is evident from casual observation. Notable examples are the central banks of New Zealand, Canada, the United Kingdom and Sweden that adopted a framework of 'inflation targeting' in the early 1990s, which is characterized by an explicit inflation target and the publication of inflation forecasts.[1] Many others have adopted greater openness as well, although not always in the form of inflation targeting or to the same extent. This includes central banks in emerging markets like Brazil, the recently founded European Central Bank (ECB), and even well-established central banks like those of the United States, Japan and Switzerland.

Further evidence that central bank transparency has become one of the key features of monetary policy is documented in the 1998 survey of 94 central banks by Fry, Julius, Mahadeva, Roger and Sterne (2000), which is the most comprehensive survey on the conduct of monetary policy to date. It reveals that 74% of central banks consider transparency a vital or very important component of their monetary policy framework, only surpassed by central bank independence and the maintenance of low inflation expectations (with 83% and 82%, respectively; Fry et al. (2000, p. 135)). Subsequent changes adopted by central banks suggest that the relevance of transparency has only increased.

One explanation for transparency of monetary policy could be that it is a necessary complement of central bank independence; some degree of openness is required to enable accountability and safeguard the democratic legitimacy of independent central banks. This public policy argument undoubtedly is an important reason for greater openness in central banking, but it does not address the economic desirability of transparency. Building on some influential early contributions,[2] this issue has attracted attention and the economic literature on central bank transparency has recently started to take off.

Central bank transparency could be defined as the absence of asymmetric information between monetary policymakers and other economic agents. This means that it reduces uncertainty and this is often believed to be beneficial (although it need not be). Furthermore, transparency may affect the incentives that policymakers face to manipulate private sector beliefs through signaling and reputation building. Section 2 provides a general discussion of these uncertainty and incentive effects, which are used throughout this survey to obtain a better understanding of the theory and practice of central bank transparency.

The presence of two, possibly opposing effects explains why the findings of the transparency literature are not unequivocal. In addition, there appears to be a discrepancy between the effects emphasized in the theoretical literature and the motives for central bank transparency in practice. Theoretical con-

[1] See Leiderman and Svensson (1995), Bernanke, Laubach, Mishkin and Posen (1999) and Mishkin and Schmidt-Hebbel (2001) for an excellent account of the experience of inflation targeting countries.

[2] See the seminal paper by Cukierman and Meltzer (1986) and the more informal account by Goodfriend (1986).

siderations against transparency often rely on uncertainty effects, whereas policymakers tend to regard the reduction of uncertainty as one of the prime benefits of transparency. Also, many central banks have embraced transparency to take advantage of incentive effects that enhance their reputation and generate greater flexibility; instead, incentive effects in theoretical arguments often rely on the presence of a time-inconsistency problem that central bankers tend to dismiss.

Another reason for the great variety of findings on transparency is that the effect of asymmetric information is likely to depend on the specific context. Following Geraats (2000), this paper distinguishes five aspects of transparency that correspond to different stages in the policymaking process: political, economic, procedural, policy and operational transparency. This conceptual framework is presented in section 3 and it is subsequently used to discuss the theoretical literature on transparency of monetary policy. The theoretical results are interpreted in terms of uncertainty and incentive effects and compared to central bank transparency in practice.

Empirical evidence on the economic consequences of transparency is discussed in section 4; the (limited) findings so far suggest that transparency is beneficial. Section 5 reviews the literature on central bank accountability, and addresses the relationship between central bank independence and transparency. The conclusion of this survey, in section 6, is that the greater openness adopted by central banks has gone beyond the requirements for accountability, although independence may have enhanced the economic benefits of transparency. As a result, one can genuinely speak of a new paradigm of central bank independence and transparency.

2 Transparency: Uncertainty and Incentive Effects

Transparency refers to the physical property of an object to transmit light, which means one can see through it. When applied to concepts, transparent means clear; so colloquially, it conveys a positive attribute. In an economic context, a useful definition of transparency is the presence of symmetric information; lack of transparency, or opacity, then refers to asymmetric information. This means that opacity generates uncertainty. However, transparency is not equivalent to complete certainty or perfect information. For instance, in the case of monetary policy, the central bank and private sector could both face uncertainty about the structure of the economy; but, as long as both have the same information and are aware of it, transparency prevails.[3]

This definition of transparency focuses on information that agents actually have, not on the act of disclosing information. The reason is that public availability of data need not suffice to achieve transparency. If manipulation of data is required to extract useful information and agents are constrained by limited resources, then asymmetric information could persist. In addition, there may be sociolinguistic reasons that complicate effective communication of relevant information. This is further discussed in the context of monetary policy by Winkler (2000), who proposes to view transparency in terms of openness, clarity, honesty and common understanding.

The definition that transparency corresponds to symmetric information is implicitly used in most of the literature. Since transparency amounts to the removal of information asymmetries, one may be tempted to invoke the first fundamental welfare theorem and argue that it is generally beneficial. In

[3]Failure of common knowledge about the information symmetry is another instance of lack of transparency.

practice, however, lack of transparency is unlikely to be the only market failure, so the theory of the second best implies that greater transparency need not be welfare improving.

To understand the economic consequences of transparency it is helpful to distinguish two effects. First, asymmetric information generates uncertainty for the agents that experience the information disadvantage, and provides the opportunity for others to directly exploit the presence of private information; this could be labeled the 'uncertainty effect'. Second, those with access to private information may try to manipulate the beliefs of others through signaling; the response to the signal could influence the sender's incentives, and thereby indirectly alter economic behavior; this could be called the 'incentive effect' of asymmetric information. Both effects are analyzed more closely in the remainder of this section.

2.1 Uncertainty Effects

One might expect that the decline in uncertainty due to transparency would generally be welfare enhancing, because it reduces forecast errors and the expected variability of the variable(s) subject to uncertainty. However, some simple illustrative examples show that this is incorrect.

Suppose one is interested in the variables x and z which satisfy

$$\begin{aligned} x &= \bar{x} + \varepsilon \\ z &= \mathrm{E}_P[x] \end{aligned}$$

where $\bar{x}$ is deterministic, ε is white noise with $\mathrm{E}[\varepsilon] = 0$ and $\mathrm{Var}[\varepsilon] = \sigma_\varepsilon^2 > 0$, and $\mathrm{E}_P[.]$ is conditional on the information set of the private sector, which is assumed to have rational expectations. When there is transparency (denoted by superscript T), both the policymaker and the public know ε, but under opacity (denoted by superscript O) ε is not observed by the public.[4] Consider the effect of transparency about ε on the variance of private sector forecast errors of x, $L_x = \mathrm{E}\left[(x - \mathrm{E}_P[x])^2\right]$, and the variance of z, $V_z = \mathrm{E}\left[(z - \mathrm{E}[z])^2\right]$. Clearly, transparency reduces forecasts errors of x, but it increases the variability of z since private sector expectations of x are more volatile.[5] This is a special case of a famous result by LeRoy and Porter (1981). So, transparency could be harmful if social losses are increasing in V_z, for instance when variability of z is intrinsically undesirable or negatively affects forecasting by a third party that does not observe ε.

Since many transparency models assume the presence of a publicly available stochastic signal, it is instructive to consider a simple example of this case as well. Suppose now that[6]

$$\begin{aligned} x &= \bar{x} + \varepsilon \\ s &= x + \upsilon \\ z &= \mathrm{E}_P[x|s] \end{aligned}$$

where s is a public signal of x, and υ is white noise with $\mathrm{E}[\upsilon] = 0$ and $\mathrm{Var}[\upsilon] = \sigma_\upsilon^2 > 0$. For analytical convenience, assume that ε and υ are independent and normally distributed. So, x and s have

[4] It is implicitly assumed that the public is aware of the information asymmetry. Otherwise, opacity amounts to asymmetric and incorrect information.

[5] More precisely, $0 = L_x^T < L_x^O = \sigma_\varepsilon^2$ and $\sigma_\varepsilon^2 = V_z^T > V_z^O = 0$.

[6] For concreteness, think of x as the policymakers's goal, s a policy instrument and z an economic outcome. However, there are many other economic interpretations.

a jointly normal distribution. To analyze the subtle but important difference between transparency about ε and υ it is helpful to start with the benchmark case in which the private sector does not observe ε and υ. Although x is unknown to the private sector, the signal s can be used to obtain a better forecast: $\mathrm{E}_P^O[x|s]$. Signal extraction yields[7]

$$\mathrm{E}_P^O[x|s] = \bar{x} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + \sigma_\upsilon^2}(s - \bar{x})$$

Intuitively, this shows how private sector expectations about x are updated from the prior $\bar{x}$ using the public signal s. If the signal is higher than anticipated ($s > \bar{x}$), the forecast is raised. The sensitivity of the forecast of x to the signal s is increasing in the signal-to-noise ratio $\sigma_\varepsilon^2/\sigma_\upsilon^2$. For a small σ_υ^2, the signal is accurate and expectations are responsive; but when σ_ε^2 is small, there is not much uncertainty about x and therefore not much need to update expectations using s. The responsiveness of private sector expectations to public signals appears to be a crucial ingredient of incentive effects of transparency.

First, consider transparency about ε. This implies that $\mathrm{E}_P^T[x] = x$, so the (noisy) signal s is redundant. The effect of transparency about ε is similar to the case without the signal; it has the advantage that it reduces private sector forecast errors of x due to less uncertainty, but it has the disadvantage that it increases variability of z because private sector expectations of x are more volatile.[8]

Now, consider transparency about υ. This means that the public can perfectly infer x from s: $\mathrm{E}_P^T[x|s] = x$. As a result, the uncertainty effects are the same, whether transparency pertains to ε or υ.

However, there is a critical difference between the two cases. The sensitivity of private sector expectations to the public signal s is zero when there is transparency about ε since the signal is redundant, but it is maximum (equal to one) when there is transparency about υ because the signal is perfect. As a result, the incentive effects of transparency about ε and υ are different.

Morris and Shin (2000) consider uncertainty effects in a richer setting. They analyze a model in which a principal, who only controls the noisiness of a public signal of the state of the economy, would like to coordinate the average action of heterogenous agents with respect to that state. Each agent also has access to a private signal of the state, and aims to take an action that is appropriate for the state of the economy and attune its action to those of other agents. Morris and Shin (2000) show that better public information is not advantageous if the public signal is sufficiently noisy compared to private signals. Intuitively, in an attempt to coordinate their actions, agents pay less attention to the private signal and overreact to the public signal. So, when the public signal is relatively noisy this exacerbates the volatility of the average action, which harms the principal.

This is an intriguing example of an uncertainty effect that is induced by strategic interaction between private sector agents. One could argue that its implications for central bank transparency are that the release of unreliable or vague information by the central bank could be welfare reducing, but that greater transparency generally seems desirable since public information is potentially of superior quality in monetary policy.

[7] Use the fact that when x and s are bivariate normal, $\mathrm{E}[x|s] = \mathrm{E}[x] + \frac{\mathrm{Cov}\{x,s\}}{\mathrm{Var}[s]}(s - \mathrm{E}[s])$. Without the normality assumption, the right-hand side provides the best linear unbiased estimator of $\mathrm{E}[x|s]$.

[8] To be precise, $0 = L_x^T < L_x^O = \sigma_\upsilon^2\sigma_\varepsilon^2/\left(\sigma_\varepsilon^2 + \sigma_\upsilon^2\right)$ and $\sigma_\varepsilon^2 = V_z^T > V_z^O = \sigma_\varepsilon^4/\left(\sigma_\varepsilon^2 + \sigma_\upsilon^2\right)$.

2.2 Incentive Effects

The examples of the uncertainty effect above illustrate that the desirability of transparency depends crucially on the specific context. The same applies to incentive effects. The source of the incentive effect is the desire of an agent with private information (let's say a central bank) to influence the beliefs of others (say, private sector inflation expectations) through signaling (for instance, in the form of a policy action or outcome). The response by the receiver of the signal (the private sector) could in turn shape the sender's incentives (for example, when it affects the inflation-output trade-off faced by the central bank) and thereby affect the sender's behavior (perhaps, give a lower inflation bias). The latter is the incentive effect of the information asymmetry. Since a large fraction of the literature on central bank transparency employs strategic monetary policy games, it is useful to analyze such an incentive effect for a stylized model in the spirit of the seminal paper by Kydland and Prescott (1977).

Suppose that the economy is described by the aggregate supply function

$$y_t = \bar{y} + \theta \left(\pi_t - \pi_t^e \right) + \varepsilon_t \tag{1}$$

where y_t is real aggregate output, $\bar{y}$ the natural rate of output, π_t the level of inflation, π_t^e the level of private sector inflation expectations, ε_t an aggregate supply shock with $\mathrm{E}\left[\varepsilon\right] = 0$, $\mathrm{Var}\left[\varepsilon\right] = \sigma_\varepsilon^2 > 0$, $\theta > 0$ and subscript t indicates the time period. The monetary policymaker maximizes the objective function

$$W_t = -\frac{1}{2} \left(\pi_t - \tau \right)^2 + \beta \left(y_t - \bar{y} \right) \tag{2}$$

where τ is the policymaker's inflation target and β is the policymaker's preference for output stimulation versus inflation stabilization ($\beta > 0$). Assume (until further notice) that the inflation target τ equals the socially optimal rate $\bar{\tau}$. The objective function could be increasing in output because it enhances chances of reelection for incumbent politicians.[9]

For simplicity, assume that the central bank directly controls the rate of inflation π_t and takes the level of private sector inflation expectations π_t^e as given. A motivation for the latter is that the private sector sets nominal wage contracts prior to the policy decision and locks in its inflation expectations for a horizon that encompasses the entire policy decision and transmission process. In addition, it is assumed that the public has rational expectations and forms its expectations for period t at the end of period $t-1$, so $\pi_t^e = \mathrm{E}_{t-1}\left[\pi_t\right]$. This implies the commonly adopted information asymmetry that the private sector does not observe the supply shock ε_t when it sets its expectations π_t^e.[10]

Then, maximizing (2) with respect to π_t subject to (1) and given π_t^e, and subsequently using rational expectations yields

$$\pi_t = \tau + \beta\theta \tag{3}$$

$$y_t = \bar{y} + \varepsilon_t \tag{4}$$

The supply shock ε_t has no effect on inflation, because the policymaker cares about stabilization of inflation but not output. Although the policymaker attempts to stimulate output beyond the natural rate

[9] This objective function would not be appropriate for independent central banks. However, this specification is useful as it helps to understand the sizeable literature on central bank transparency that assumes that policymakers have a motive to stimulate output beyond the natural rate.

[10] This information asymmetry is immaterial in the present context, but section 3.2 shows it could have a significant effect.

through surprise inflation, it does not succeed ($\mathrm{E}[y_t] = \bar{y}$); the public simply anticipates its behavior and increases its inflation expectations accordingly. But the high level of inflation expectations forces the policymaker to raise inflation to prevent a drop in output. Hence, inflation π_t is above the socially optimal level τ. This is the celebrated inflationary bias of discretionary monetary policy.

The literature has proposed five solutions to this inflation bias.[11] First, the central bank could abandon discretion and commit to a policy rule.[12] Second, the public could appoint 'conservative' central bankers. Third, the central bank could be bound by incentive contracts. Fourth, a longer term of office for monetary policymakers could improve the outcome due to reputation considerations. This is discussed below as a simple illustration of an incentive effect. Fifth and more recently, central bank transparency could bring relief. This is elaborately reviewed in section 3, which also touches on the second and third solutions.

To understand how incentive effects work, consider the commonly assumed information asymmetry that the private sector is uncertain about the central bank's preferences. This could be caused by a principal-agent problem or imperfect screening of central bankers due to the unobservability of preferences. For simplicity, assume that the central bank's inflation target τ is stochastic with $\mathrm{E}[\tau] = \bar{\tau}$ and $\mathrm{Var}[\tau] = \sigma_\tau^2 > 0$, and that τ is only observed by the central bank but not the public. In the static model above this gives rise to an uncertainty effect. When the inflation target is higher than expected ($\tau > \bar{\tau}$), inflation expectations are relatively low, which boosts output. Although asymmetric information about the inflation target τ does not affect the average level of inflation and output, it increases private sector forecast errors for both variables.[13]

In a dynamic context preference uncertainty also generates an incentive effect. Since the private sector rationally uses past policy outcomes to update its beliefs of the policymaker's preferences, the policymaker could use inflation as a signal. It could attempt to build reputation as a policymaker with a low inflation target τ by decreasing current inflation to reduce future inflation expectations and obtain a more beneficial inflation-output trade-off (1). The effect of such signaling/reputation is a reduction of the inflation bias and an improvement of the policymaker's expected payoff.

More formally, consider the two-period model in which the monetary policymaker maximizes the dynamic objective function

$$U = W_1 + \delta W_2 \tag{5}$$

where δ is the intertemporal discount factor ($0 < \delta < 1$) and W_t is given by (2). Assume that each period, the monetary policy game is the one described above with asymmetric information about τ (and ε_t). Then, the public uses π_1 to infer τ and form π_2^e. Thus, it sets its expectations according to the updating equation

$$\pi_2^e = u_0 + u_1 \pi_1 \tag{6}$$

The policymaker maximizes (5) with respect to π_1 and π_2 using (2), (1) and (6), and taking π_1^e as given.

[11] See Walsh (1998, chapter 8) for an elaborate overview of the first four solutions.

[12] There exists a vast literature on monetary policy rules, which has evolved from a search for optimal rules under commitment to the identification of useful monetary policy reaction functions. See Taylor (1999) for a compilation of recent contributions.

[13] Inflation is given by (3) in both cases; output equals (4) under transparency and $y_t^O = \bar{y} + \theta(\tau - \bar{\tau}) + \varepsilon_t$ under opacity about τ. However, the expected payoff for the policymaker is not affected: $\mathrm{E}\left[W_t^O\right] = \mathrm{E}\left[W_t^T\right] = -\frac{1}{2}\beta^2\theta^2$.

Then, the first order conditions, rational expectations and (6) imply $u_1 = 1$ and[14]

$$\pi_1 = \tau + (1-\delta)\beta\theta \quad (7)$$

$$\pi_2 = \tau + \beta\theta \quad (8)$$

The level of inflation in the second period is the same as in the static model. But in the first period, the inflation bias is smaller because the policymaker realizes that private sector inflation expectations π_2^e are sensitive to inflation ($u_1 > 0$) so there is an incentive to invest in reputation by reducing inflation in the first period.[15] The public is able to infer the inflation target τ from π_1, so there is no longer uncertainty in period two and output y_2 is given by (4). Expected output in the first period also equals the natural rate $\bar{y}$, although its variance is higher because of uncertainty about τ.

In contrast, when there is perfect transparency about the policymaker's inflation target τ, inflation and output are given by (3) and (4) in both periods. The reason is that the public already knows the inflation target τ, so it no longer uses π_1 to infer τ and $u_1 = 0$. As a result, the outcome is the same as in the static model.

It follows that transparency about the inflation target τ has two effects. It has a beneficial uncertainty effect because it eliminates public uncertainty about inflation and output. In addition, it has a detrimental incentive effect because it removes the reputation considerations that reduce the inflation bias in the first period. The latter effect dominates so that opacity about preferences appears advantageous for the policymaker.[16] The result that preference transparency leads to higher inflation tends to be a property of models that feature an inflation bias due to a time-inconsistency problem. However, incentive effects are often beneficial for other aspects of transparency, but these effects always rely on the presence of some additional information asymmetry, typically preference uncertainty. So, the fact that preference transparency could be detrimental applies more generally.

There are many papers in which reputation reduces the inflation bias in a dynamic setting due to the incentives generated by asymmetric information about the central bank's preferences. Notable examples include Backus and Driffill (1985) and Barro (1986), who analyze reputation/signaling with two central bank types, and Cukierman and Meltzer (1986), who consider a continuum of central bank types in the presence of an additional information asymmetry about monetary control errors.[17] One could argue that this reputation literature gives rise to two policy implications. First, it is desirable to have monetary policymakers with a long horizon so that the possibility of losing reputation exerts a disciplinary effect. This could be established by setting long terms of office for central bankers. Second, some uncertainty about policymakers' preferences appears healthy as it induces a beneficial incentive effect. This suggests that it may be helpful to have regular turnover of policymakers, for instance by having partially overlapping tenures or rotating shifts for central bankers.

[14] To see this, the first order conditions yield $\pi_1 = \tau + \beta\theta(1 - \delta u_1)$ and $\pi_2 = \tau + \beta\theta$. Solve π_1 for τ and substitute into π_2. Then rational expectations imply $\pi_2^e = \pi_1 + \delta\beta\theta u_1$, so matching coefficients with (6) yields $u_1 = 1$.

[15] In the terminology of the signaling literature, the policymaker tries to mimic the behavior of a type with a lower inflation target τ. Since every type does so and the public anticipates this, there is a separating equilibrium in which each type is revealed.

[16] In particular, $\mathrm{E}\left[U^O\right] = -\frac{1}{2}\left[(1-\delta)^2 + \delta\right]\beta^2\theta^2 > -\frac{1}{2}(1+\delta)\beta^2\theta^2 = \mathrm{E}\left[U^T\right]$.

[17] Some reputation papers (e.g. Barro and Gordon 1983) do not rely on information asymmetries and rational updating of private sector beliefs, but instead postulate incentive effects in the form of (arbitrary) trigger strategies in which inflation expectations depend on past policy outcomes.

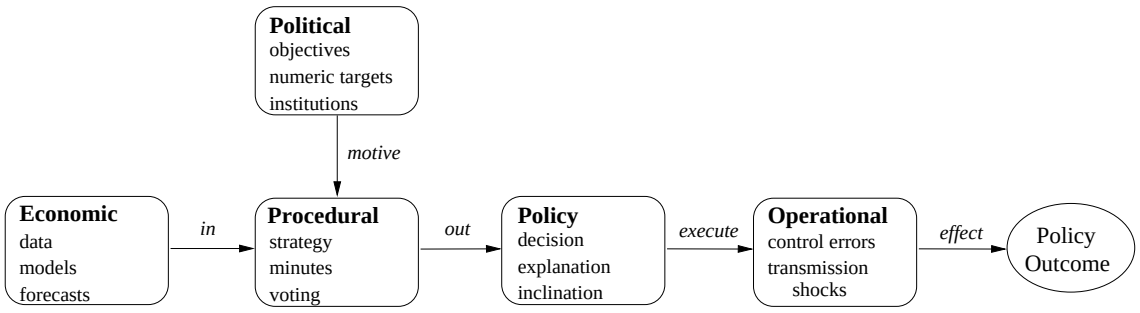

Figure 1: A conceptual framework for transparency.

Of course, one could consider many variations on this stylized monetary policy game that incorporate other information asymmetries.[18]

3 Central Bank Transparency: Theory and Practice

The examples discussed in the previous section show that the effect of transparency may be sensitive to the specific context. Since transparency could pertain to any aspect of monetary policymaking, it is helpful to use a conceptual framework that reflects the different stages of the policymaking process. Following Geraats (2000), one can distinguish five aspects of transparency: political, economic, procedural, policy and operational transparency. Each of these aspects could give rise to different motives for transparency. Their relationship to the policy process is illustrated in figure 1.[19]

1. *Political transparency* refers to openness about policy objectives and institutional arrangements that clarify the motives of monetary policymakers. This could include explicit inflation targets, central bank independence and contracts.

2. *Economic transparency* focuses on the economic information that is used for monetary policy, including economic data, policy models and central bank forecasts.

3. *Procedural transparency* describes the way monetary policy decisions are taken. This includes the monetary policy strategy and an account of policy deliberations, typically through minutes and voting records.

4. *Policy transparency* means a prompt announcement and explanation of policy decisions, and an indication of likely future policy actions in the form of a policy inclination.

5. *Operational transparency* concerns the implementation of monetary policy actions, including a discussion of control errors for the operating instrument and macroeconomic transmission disturbances.[20]

[18] See Cukierman (1992) for a thorough treatment of some interesting cases.

[19] This conceptual framework for transparency could also be applied to other forms of economic policymaking, or decision-making more generally.

[20] Note that there is a significant difference between economic and operational transparency. The former includes anticipated

The main merit of this framework is that it focuses on the content and context of information disclosure, which makes it a convenient structure to review the theory and practice of central bank transparency.[21]

3.1 Political Transparency

Theoretical contributions on political transparency shed light on the effect of asymmetric information about the policymaker's preferences, the consequences of explicit inflation targets and institutional arrangements like central bank independence, contracts and override mechanisms.

The consequences of a simple form of preference uncertainty have already been analyzed in section 2.2. In the static model with asymmetric information about the policymaker's inflation target τ, there is no effect on the average level of inflation and output, but merely an increase in private sector uncertainty about these variables. However, several papers find that asymmetric information about other preference parameters could have different effects.

To understand why the effect of asymmetric information about the central bank's preferences appears sensitive to the source of uncertainty, consider the static monetary policy game in section 2.2 but instead of (2), assume a commonly used objective function that is quadratic in output:

$$W_t = -\frac{1}{2}\alpha\left(\pi_t - \tau\right)^2 - \frac{1}{2}\beta\left(y_t - \kappa\bar{y}\right)^2 \tag{9}$$

where τ is the central bank's inflation target which is assumed to equal the socially optimal rate $\bar{\tau}$, $\kappa\bar{y}$ is the socially optimal output target ($\kappa > 1$), and α and β are the preference parameters for inflation and output stabilization, respectively ($\alpha, \beta > 0$).[22] The central bank aims to stabilize output above its natural rate $\bar{y}$ because of the presence of imperfect competition or other market distortions that depress the natural rate of output below the socially optimal level $\kappa\bar{y}$. Regardless of the source of private sector uncertainty, maximizing (9) with respect to π_t subject to (1) and given π_t^e yields

$$\pi_t = \frac{\theta^2}{\alpha/\beta + \theta^2}\pi_t^e + \frac{\alpha/\beta}{\alpha/\beta + \theta^2}\tau + \frac{\theta}{\alpha/\beta + \theta^2}\left(\kappa - 1\right)\bar{y} - \frac{\theta}{\alpha/\beta + \theta^2}\varepsilon_t \tag{10}$$

In the absence of preference uncertainty, using rational expectations $\pi_t^e = \mathrm{E}_{t-1}\left[\pi_t\right]$ and (10) gives

$$\pi_t = \tau + \frac{\beta\theta}{\alpha}\left(\kappa - 1\right)\bar{y} - \frac{\theta}{\alpha/\beta + \theta^2}\varepsilon_t \tag{11}$$

Again, there is an inflation bias as average inflation is above the socially optimal level τ. In addition, the supply shock ε_t has a negative effect on inflation, because the policymaker partly stabilizes its effect on output.

When there is private sector uncertainty about the inflation target τ, this has no effect on average inflation because (10) shows that inflation is linear in τ. The same holds for uncertainty about the

disturbances that are reflected in the policy instrument, whereas the latter pertains to shocks that were unanticipated by the policymaker.

[21] The information on the practice of central bank transparency in the remainder of this section can be found in the references described in section 4.1, but it can also be gleaned from central banks' web sites.

[22] Researchers often set α or β equal to one; however, it appears that such a normalization is not innocuous in the presence of uncertainty about these preference parameters.

output gap $(\kappa - 1)\,\bar{y}$. However, α and β have a nonlinear effect on inflation, so uncertainty matters for the average level. In particular, suppose that the private sector does not observe the preference parameter for inflation stabilization α, which is the case analyzed by Schaling and Nolan (1998). For simplicity, assume that $\tau = 0$ and that ε_t is independent of α. Since (10) shows that inflation is convex in α, expected inflation is higher with uncertainty about α due to Jensen's inequality.[23]

As is clear from (10), uncertainty about α not only affects the average inflation bias but also the stabilization of supply shocks ε_t. This is addressed by Eijffinger, Hoeberichts and Schaling (2000*a*) who basically use the same model as Schaling and Nolan (1998). Since uncertainty about α increases the expected response of inflation to supply shocks, it amplifies the variability of inflation but limits the volatility of output. The latter could be so strong that preference uncertainty reduces the variance of output. Eijffinger et al. (2000*a*) find that uncertainty about the inflation stabilization parameter α may even improve social welfare for this reason.[24]

But now suppose there is uncertainty about the output stabilization parameter β, which has a concave effect on inflation. Then similarly, the expected level and stabilization of inflation decrease, reversing the previous results. This is surprising; (11) shows that only the relative preference parameter α/β matters for inflation in the absence of uncertainty, but expected inflation and stabilization appear sensitive to the arbitrary specification of uncertainty about α or β. This can be avoided by normalizing $\theta = 1$ and treating α and β as preference weights that satisfy $\alpha + \beta = 1$ so that $\alpha = \bar{\alpha} + \xi$ and $\beta = \bar{\beta} - \xi$, where ξ is white noise.[25] With this consistent specification of uncertainty about the preference weights α and β there is no change in the average level or stabilization of inflation due to the uncertainty effect.[26] Hence, as is pointed out by Beetsma and Jensen (2001), preference uncertainty is not desirable because it merely increases the variance of inflation and output.

However, there are circumstances in which uncertainty effects could influence average inflation and make secrecy desirable. Cukierman (2001*b*) argues that central banks have a motive to be opaque about their preferences if they have an asymmetric concern about output. In particular, a central bank that only cares about output stabilization if output falls short of the natural rate, generates an inflation bias when it faces uncertainty about supply shocks. So, to prevent an increase in inflation expectations it is better to keep the preference asymmetry confidential.[27]

Furthermore, political uncertainty could be desirable when the private sector acts strategically instead of passively forming rational expectations. Sørensen (1991) assumes that the union that represents the private sector minimizes $\mathrm{E}\left[(\pi - \pi^e)^2\right]$ with respect to π^e subject to (10), using the consistent speci-

[23] To be precise, $\pi_t^e = \mathrm{E}\left[\frac{\theta}{\alpha/\beta+\theta^2}\right](\kappa-1)\,\bar{y}/\left(1-\mathrm{E}\left[\frac{\theta^2}{\alpha/\beta+\theta^2}\right]\right) > \beta\theta\,(\kappa-1)\,\bar{y}/\,\mathrm{E}\,[\alpha]$.

[24] This finding is robust to the more accurate approximations reported in the comment by Beetsma and Jensen (2001).

[25] Unfortunately, the justification for such a specification has not been clearly spelled out in the literature. Ultimately, what matters is uncertainty about the marginal rate of substitution. This specification ensures that uncertainty about $-\frac{d\pi}{dy} = \frac{1-\bar{\alpha}-\xi}{\bar{\alpha}+\xi}\frac{y}{\pi}$ is isomorphic to uncertainty about $-\frac{dy}{d\pi} = \frac{1-\bar{\beta}+\xi}{\bar{\beta}-\xi}\frac{\pi}{y}$. In contrast, the effects of the other parameterizations of relative preference uncertainty are sensitive to the definition of the marginal rate of substitution and lead to spurious results.

[26] In particular, (10) reduces to $\pi_t = \left(\bar{\beta}-\xi\right)\pi_t^e + (\bar{\alpha}+\xi)\,\tau + \left(\bar{\beta}-\xi\right)(\kappa-1)\,\bar{y} - \left(\bar{\beta}-\xi\right)\varepsilon_t$ so that inflation is linear in ξ.

[27] Similar in spirit, Geraats (1999) shows that greater concern about decreases in output generally yields a convex response of inflation to supply shocks and therefore an average inflation bias. In addition, perfect information about supply shocks exacerbates this convexity due to the responsiveness of inflation expectations. So, with asymmetric preferences, secrecy about supply shocks may also be beneficial because it reduces the inflation bias.

fication of uncertainty about the preference weights α and β. Although preference uncertainty increases the variance of inflation and output, it could be beneficial as it reduces average inflation and increases average output. Intuitively, the union not only cares about unbiasedness of π^e but also exhibits risk aversion. Since π^e has an uncertain effect on π, the union decides to underestimate inflation to limit volatility, and its lower inflation expectations decrease inflation and boost output.[28]

Similarly, Grüner (2002) finds that uncertainty about the central bank's relative preferences has a beneficial effect on the average level of inflation and output when the central bank's objective is (9) with $\kappa = 1$ and the union essentially minimizes $\mathrm{E}\left[(\pi - \pi^e)^2 - (\pi^e - \pi)\right]$, where the second term represents the real wage and induces an inflation bias.[29] In addition, greater preference uncertainty could actually reduce the variance of inflation if preference uncertainty is sufficiently high.[30] Intuitively, greater preference uncertainty could make the union so cautious that the reduction in π^e dominates the direct effect of preference uncertainty on inflation uncertainty.

Another interesting issue is strategic interaction between monetary and fiscal policy, which is considered by Hughes Hallett and Viegi (2001). They analyze a static monetary-*cum*-fiscal policy game in which the central bank and the government decide simultaneously about inflation and the budget deficit, respectively, and the private sector has rational expectations. It is assumed that the fiscal deficit f has a positive effect on output, so (1) becomes $y = \bar{y} + \theta(\pi - \pi^e) + f + \varepsilon$. Budget imbalances are considered undesirable and the objective functions for fiscal and monetary policy have the form $W^f = W - \frac{1}{2}f^2$ where W is given by (9).

Hughes Hallett and Viegi (2001) consider the case in which the government and private sector both face asymmetric information about central bank preferences β or κ. They find that uncertainty about the 'political' preference parameter β reduces average inflation, whereas uncertainty about the 'economic' preference parameter κ has no effect on average. But the discussion above suggests this is due to their parameterization of political preference uncertainty. Indeed, redoing their analysis, it appears that a consistent specification of uncertainty about the preference weights α and β has no effect on average inflation or the budget deficit.[31] But interestingly, there is a change in the response of monetary and fiscal policy to supply shocks ε. The reason is that the fiscal authorities base their response to supply shocks on the expected reaction of monetary policy, which in turn incorporates fiscal policy. As a result, the interaction between fiscal and monetary policy gives rise to an uncertainty effect on the stabilization of supply shocks ε when there is asymmetric information about the relative preference weight α/β.

When fiscal policy is endogenous and the government's political preference parameter β is determined by democratic elections, Hughes Hallett and Viegi (2001) find that lack of transparency about the central bank's political preferences β is likely to lead to a more left-wing government that cares less about inflation stabilization. (This also holds for the consistent specification of preference weight uncertainty.) The interaction between monetary and fiscal policy with electoral feedback seems a fascinating

[28] Typically, minimizing $\mathrm{E}\left[(\pi - \pi^e)^2\right]$ amounts to rational expectations ($\pi^e = \mathrm{E}[\pi]$), but this does not hold when $\partial\pi/\partial\pi^e$ is stochastic.

[29] Although uncertainty about the preference weights is not modeled consistently, the conclusions appear robust.

[30] However, one can show (an appendix is available on request) that preference uncertainty needs to be so large that there exists no symmetric distribution over the preference weights α and β such that this condition holds. So, this result mostly seems a theoretical curiosity.

[31] An appendix is available from the author on request.

area for further transparency research.

The literature on preference transparency often presumes it is possible for monetary policymakers to effectively communicate their preferences. However, removing asymmetric information about preferences may not be trivial. For instance, central banks with objective functions (2) or (9) have an incentive to misrepresent their preferences to reap the benefits of lower private sector inflation expectations. Furthermore, the publication of central bank preferences could be considered costless announcements or 'cheap talk'. Stein (1989) argues that this makes it impossible for a central bank to communicate its private information precisely and credibly, although it is feasible to credibly make imprecise announcements in the form of ranges. However, when signals are costly, it may be possible to precisely communicate private information despite the incentive to manipulate expectations, as is shown by the two-period monetary policy game in section 2.2.

Another possible way to reduce preference uncertainty is the publication of an explicit inflation target. This has a beneficial uncertainty effect, but it could also improve the central bank's incentives to meet the target. Walsh (1999) analyzes the consequences of inflation targeting in a variation on the static monetary policy game in section 2.2. He assumes that an explicit target is not cheap; the central bank is penalized for deviations from the announced inflation target $\hat{\tau}$ so that its objective function is $\hat{W} = W - \frac{1}{2}\gamma\left(\pi - \hat{\tau}\right)^2$, where W is given by (2). In this way, inflation targeting reduces the average inflation bias when the announced target equals the socially optimal rate ($\hat{\tau} = \tau = \bar{\tau}$).

Furthermore, Walsh (1999) presumes that the socially optimal rate of inflation $\bar{\tau}$ depends on the supply shock ε, which is not known to the private sector.[32] Then, a non-contingent explicit inflation target $\hat{\tau}$ equal to the expected socially optimal rate would distort the central bank's response to supply shocks. Instead, the central bank could construct an inflation target based on unverifiable internal forecasts of supply shocks and announce it before the private sector forms its inflation expectations. Although the central bank has an incentive to misrepresent this signal to manipulate private sector expectations, its announcement reveals private information about supply shocks.[33] It appears that the imperfectly credible inflation targets announced by the central bank reduce the inflation bias without distorting stabilization policy and are therefore more beneficial than a constant, external target equal to expected socially optimal inflation.

Political transparency could also be enhanced by institutional arrangements that clarify the motives and incentives of monetary policymakers. The large literature on the optimal institutional design of monetary policy has generated some insights that touch on transparency, so these are briefly discussed here. A prominent example is central bank independence, which formally isolates monetary policy from political pressures and thereby provides greater clarity about the objectives pursued by monetary policymakers. The influential work by Rogoff (1985) shows that the appointment of 'conservative' central bankers that put greater weight on inflation stabilization α reduces the inflation bias. However, the increase in credibility of low-inflation policy comes at the cost of less flexibility in the central bank's

[32] He argues it may not be desirable to completely offset the effect of supply shocks on inflation because of the consequences for output. However, this suggests that the social objective function (2) should incorporate the benefits of output stabilization, as in (9).

[33] In Walsh (1999), signal extraction is complicated by asymmetric information about the central bank's preference for output stimulation β. Note that uncertainty about β does not directly affect inflation when the objective function is (2) or $\hat{W}$.

response to supply shocks ε, as can be seen from (11). This could be overcome by the appointment of central bankers with a conservative inflation target τ, which is advocated by Svensson (1997). It follows from (11) that for $\tau = \bar{\tau} - \frac{\beta\theta}{\alpha}(\kappa - 1)\bar{y}$, the inflation bias vanishes without harming stabilization policy. Another option, which is favored by Blinder (1997), is to choose 'responsible' central bankers that pursue an output target equal to the natural rate $\bar{y}$ so that $\kappa = 1$.

Instead of selecting central bankers with desirable preferences, the incentives of central bankers could be directly affected through contracts. Walsh (1995) shows that the optimal contract is such that the central banker's payoff equals $W^c = W + c_0 - \beta\theta(\kappa - 1)\bar{y}(\pi - \bar{\tau})$, where W is given by (9) and c_0 is sufficiently high to induce the central banker to enter into the contract. It is straightforward to check that such a contract that penalizes the central banker for high inflation completely eliminates the inflation bias without distorting stabilization of supply shocks, so that $\pi_t = \bar{\tau} - \frac{\theta}{\alpha/\beta+\theta^2}\varepsilon_t$.

However, when there is uncertainty about the central bank's relative preferences, the trade-off between credibility and flexibility reemerges for optimal inflation contracts and targets, as is shown by Muscatelli (1998) for uncertainty about α and by Beetsma and Jensen (1998) for the consistent specification of uncertainty about the preference weights.

Political transparency could also benefit from explicit override mechanisms that specify formal procedures for government interference in monetary policy. Lohmann (1992) analyzes the effect of override mechanisms when social welfare W is given by (9), monetary policy is delegated to a conservative central banker, but the government has the option to override the central bank at a cost and maximizes $W^o = W - d_o c$ where d_o is an indicator variable for government interference and $c > 0$ is the cost of overriding. She finds that the possibility of government interference enhances the flexibility of monetary policy but at the cost of higher inflation.

There are many other papers that consider political transparency but mainly focus on another information asymmetry, so these are discussed in the sections below.

In practice, many central banks have taken active steps to clarify their objectives. The adoption of explicit targets, especially inflation targets, is increasingly common, with the United States and Japan as notable exceptions. Such targets take the form of a point or a range of typically two percentage points, and they often specify long term objectives. However, during periods of disinflation, inflation targets typically indicate medium term goals that are adjusted depending on inflation outcomes.[34] Although central banks tend to put a lot of emphasis on the inflation target, other aspects of the central bank's preferences, like the relative preference weight or the shape of the output objective, are hardly ever mentioned.

Political transparency has also benefitted from the advance of formal institutional arrangements. The delegation of the conduct of monetary policy to a central bank that enjoys operational independence has become very popular. Nowadays, this is considered part and parcel of best practice in monetary policy. On the other hand, the use of explicit inflation contracts between the central bank and the government is relatively rare. The best example is probably New Zealand, where the central bank governor could be fired if the inflation target is not met. Finally, the existence of an explicit override procedure is more frequent, though not very common.

[34] Mahadeva and Sterne (2001) present a simple model of endogenous inflation targets and provide empirical support that target deviations have an asymmetric effect on inflation target revisions.

All in all, political transparency of monetary policy has significantly improved over the last decade. Nevertheless, opaqueness remains in important respects, and in a few cases (in particular, secrecy about asymmetric objectives, or ambiguity about relative preferences with centralized union bargaining) there is some theoretical support for this.

3.2 Economic Transparency

The theoretical literature on economic transparency mostly considers the consequences of asymmetric information about economic data and/or forecasts. Tarkka and Mayes (1999) introduce mutual uncertainty about expectations in the monetary policy game in section 2.2 with $\beta = 0$. In particular, both the central bank's inflation target and the public's inflation expectations are private information. Tarkka and Mayes (1999) analyze the effect of asymmetric information about the central bank's estimate of the public's inflation expectations. They find that the publication of unconditional central bank forecasts for inflation and output could communicate both the central bank's inflation target and its assessment of private sector expectations, and lead to greater predictability of monetary policy and less variability of output.

However, a reduction of economic uncertainty may be detrimental as is shown by Gersbach (1998) and Cukierman (2001*a*). Both consider the monetary policy game with objective function (9) and $\kappa = 1$, so there is no inflation bias. They assume perfect information about the central bank's preferences and analyze the effect of asymmetric information about the supply shock ε. Crucially, in the case of transparency, information about supply shocks is known to the private sector before it sets inflation expectations. Since the private sector incorporates the supply shock into its inflation expectations, it follows that $\pi^e = \pi$. This means that stabilization of output y in the face of supply shocks is no longer possible due to the Lucas surprise transmission mechanism (1). In addition, inflation becomes more variable because of the volatility of private sector inflation expectations. The higher variance of both output and inflation means that transparency about ε reduces social welfare.[35] When the private sector observes the central bank's forecast instead of the actual supply shock before it forms its inflation expectations, the central bank is not able to stabilize the forecasted supply shocks and the publication of forecasts is harmful.[36]

On the other hand, for a neo-Keynesian real interest rate transmission mechanism in which the central bank sets the nominal interest rate, which affects output and indirectly inflation, Cukierman (2001*a*) finds that the publication of central bank forecasts has no effect on the variability of output and inflation, although it increases the volatility of interest rates. This illustrates that the desirability of transparency could depend on the monetary transmission mechanism and the specification of the social welfare function.

To understand how economic transparency gives rise to incentive effects, consider a variation on the two-period model in section 2.2 with uncertainty about the central bank's inflation target τ. The central

[35] To be precise, taking $\kappa = \beta = 1$, $\pi^T = (\pi^e)^T = \tau - \frac{\theta}{\alpha}\varepsilon$, $y^T = \bar{y} + \varepsilon$ and $\mathrm{E}\left[W^T\right] = -\frac{1}{2}\frac{\alpha+\theta^2}{\alpha}\sigma_\varepsilon^2$. Under opacity, inflation equals (3), $y^O = \bar{y} + \frac{\alpha}{\alpha+\theta^2}\varepsilon$ and $\mathrm{E}\left[W^O\right] = -\frac{1}{2}\frac{\alpha}{\alpha+\theta^2}\sigma_\varepsilon^2$. Hence, $\mathrm{E}\left[W^T\right] < \mathrm{E}\left[W^O\right]$.

[36] A similar detrimental uncertainty effect is present in a note by Jensen (2000), who adopts a New-Keynesian Phillips curve and considers transparency about supply shocks before (forward-looking) inflation expectations are set (see also section 3.5).

bank no longer directly controls inflation π but a policy instrument m that satisfies

$$\pi_t = m_t + v_t \tag{12}$$

where m_t could be interpreted as money supply growth and v_t as a velocity shock that is independent of ε and τ, and satisfies $\mathrm{E}[v_t] = 0$ and $\mathrm{Var}[v_t] = \sigma_v^2$. The public observes the policy instrument m_1 and uses it to form its inflation expectations π_2^e. Assume that the level of inflation π_1 is not yet known due to lags in the transmission of monetary policy.

In the presence of economic transparency, the private sector knows the velocity disturbance v_1 and is able to infer the inflation target τ from m_1, similar to section 2.2. But under opacity, the private sector does not observe the economic shock v_1 to which the central bank responds, which leads to a signal extraction problem as in section 2.1. This reduces the responsiveness of private sector expectations π_2^e to the policy instrument m_1 and thereby diminishes the central bank's incentive to invest in reputation. As a result, economic opacity gives rise to a larger inflation bias in the first period.[37] This incentive effect hinges on the presence of preference uncertainty. Although economic transparency is beneficial, preference transparency leads to the worst case of a full inflation bias.

It seems that disclosure of the velocity shock v_1 suffices while the supply shock ε_1 is immaterial for transparency, but this is specific to the monetary policy instrument. Geraats (2000), who first analyzed a similar model, posits an aggregate demand relation instead of (12), and assumes that the central bank controls the nominal interest rate. Since the interest rate responds to aggregate demand and supply shocks, both need to be disclosed to obtain transparency. This could be achieved through the publication of central bank forecasts for both output and inflation.

Most transparency models assume that the transparency regime is exogenous, but Geraats (2000) argues that the choice of regime may provide a signal of the central bank's type. Since weak central banks with inflationary preferences are more reluctant to embrace transparency as it reveals their intentions, the market rationally penalizes opaque central bank through higher inflation expectations. This feedback could provide such a strong incentive that every central bank opts for transparency.

The beneficial incentive effects of economic transparency are not restricted to the presence of a time-inconsistency problem or inflation bias. Geraats (2000) assumes the objective function (9) with $\kappa = 1$, and finds that transparency improves social welfare because it gives the central bank greater flexibility to adjust interest rates in response to economic disturbances. Intuitively, the monetary policy instrument is both the tool for stabilization policy and a guide for private sector expectations. Under opacity, changes in the interest rate to stabilize the economy lead to undesirable shifts in inflation expectations, so that the central bank optimally engages in interest rate smoothing and no longer fully offsets anticipated demand shocks.

The desirability of economic transparency may not only be sensitive to the economic structure, but also to the institutional setting. The models by Geraats (2000) suggest that transparency is beneficial both when monetary policy is conducted by the government with a politically motivated objective function (2), and when it is delegated to an independent, responsible central bank with (9) and $\kappa = 1$.

[37] More precisely, under transparency, π_1 is given by (7); under opacity, $\left(\frac{\partial \pi_2^e}{\partial m_1}\right)^O = \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_v^2} \equiv \lambda$ and $\pi_1^O = \tau + (1 - \lambda\delta)\beta b$. Further, π_2 is (8) in both cases. Asymmetric information about the structure of the economy could give rise to a similar effect.

However, Geraats (2001*b*) shows that economic transparency is undesirable when monetary policy is conducted by a conservative central bank that is subject to political interference, using a similar model as above but with a Lohmann (1992) overriding mechanism. The government with objective (2) uses the money supply as a signal of the central bank's intentions and would like to interfere when the conservative central bank is too contractionary. Since overriding is costly, the government exhibits risk averse behavior when the signal is noisy due to economic opacity, so it interferes less. This uncertainty effect of economic secrecy reduces the inflation bias induced by political interference and it protects the central bank from the government, thereby generating greater effective independence.

The incentive effect of economic transparency that reduces the inflation bias is also present when the adjustment of inflation expectations is part of the monetary transmission process, as is shown by Geraats (2001*a*). Furthermore, she proves that commitment is not sufficient to eliminate the inflationary bias of discretionary monetary policy; economic transparency is needed as well. Intuitively, when the central bank commits to a policy action in the presence of economic opacity, there is still scope for inflation surprises, which produces an inflation bias.

Somewhat related, there are several papers that analyze monetary policy rules when there is asymmetric information about the economy. Canzoneri (1985) assumes that the central bank has unverifiable private information on money market disturbances and proposes flexible targeting rules for the money supply (see also Garfinkel and Oh 1993). Using a similar model, Garfinkel and Oh (1995) find that noisy announcements of money forecasts could influence inflation expectations and provide greater flexibility than merely a fixed money rule. Finally, Athey, Atkeson and Kehoe (2001) present a model in which the optimal monetary policy rule does not incorporate the central bank's private information, but the private information in their model pertains to the socially optimal rate of inflation which is assumed to be stochastic.

In practice, the degree of economic transparency varies a lot. Most economic data relevant for monetary policy is publicly available, although there are some exceptions like confidential bank supervision data. However, few central banks reveal their knowledge about the structure of the economy by publishing models used for policy analysis. Those that do so typically present one structural macroeconomic model, which may not capture the breadth of their analysis. On the other hand, the publication of forward-looking analysis is prevalent. All major central banks nowadays disclose central bank forecasts for inflation, output and often other variables as well. The Bank of England stands out with colorful fan charts for inflation and output forecasts that also indicate the risks to forecasts, and it seems to have inspired several other countries, including Sweden and Brazil.

Although there are several theoretical arguments that suggest that economic transparency could have harmful uncertainty effects (in particular, for a Lucas type or New Keynesian transmission mechanism, and in the absence of central bank independence), in practice the beneficial incentive effects (in the form of a lower inflation bias or greater flexibility of stabilization policy) appear to dominate. The only exception is openness about economic models, which remains surprisingly rare.[38]

[38] Cukierman (2001*b*) argues this could be due to the lack of professional consensus about the correct economic model.

3.3 Procedural Transparency

Uncertainty and incentive effects also play a role in procedural transparency, which is analyzed by Gersbach and Hahn (2001*a*) and Gersbach and Hahn (2001*b*) who both focus on the publication of individual voting records and incorporate accountability through reelection.

Gersbach and Hahn (2001*a*) consider a two-period monetary policy game in which the government elects central bankers for one period at a time. Central bankers derive positive benefits from being elected, their preferences are known and described by (9) with $\kappa = 1$, but their knowledge of the economy, or their competency, is private information. Secrecy about individual voting records inhibits the evaluation of a central banker's skills before reelection, which generates a detrimental uncertainty effect in the second period. On the other hand, transparency creates a strategic incentive effect in the first period as incompetent central bankers refuse to abstain from voting as it would reveal their ineptitude; instead, they perturb the decision by random votes to maximize their chances of reelection. Gersbach and Hahn (2001*a*) find that the latter effect dominates, so the publication of individual voting records is socially harmful in their model.

Using a similar model but with slightly different assumptions, Gersbach and Hahn (2001*b*) conclude that voting transparency is beneficial. Here it is assumed that there is unobservable heterogeneity in central bankers' preferences and that the private benefits from reelection are sufficiently small. It appears that central bankers with idiosyncratic preferences have no incentive to exhibit socially desirable behavior to try to get reelected. Intuitively, strategic voting involves sacrificing one vote in period one to (possibly) get a vote in period two (in case of reelection under voting secrecy); this is dominated by securing one vote in period one (while possibly getting a vote in period two) under truthful voting. So, there is no incentive effect of voting transparency.[39] The disclosure of voting records just produces a positive uncertainty effect as it allows the government to reelect only those with socially desirable preferences.

These two models illustrate that a small alteration in assumptions could easily reverse the conclusion. In practice, asymmetric information about the characteristics of central bankers is likely to pertain to both their competencies and preferences. But the negative effect of transparency in the first model depends crucially on the possibility of abstention. It is debatable whether this is a reasonable assumption for voting by central bankers.[40] A tentative conclusion would be that the disclosure of individual voting records is desirable when there is accountability through reelections. However, there may be other considerations besides accountability. For instance, publishing voting records (or minutes) could induce greater effort; in addition, it may facilitate but could also expose undesirable political pressures.[41]

Other aspects of procedural transparency, like the monetary policy strategy or proceedings of policy meetings, have also received scant attention in the theoretical literature. The release of an account of policy proceedings, typically in the form of minutes, provides information about the nature of arguments

[39] This remains true when the private benefits derived from reelection are large, because central bankers always vote strategically in period one so that the outcomes under voting transparency and secrecy are identical.

[40] Abstention seems more plausible when decisions are made 'by consensus', which suggests that consensus decision-making may be preferable to explicit voting without publication of records.

[41] See Buiter (1999) for a sophisticated argument. He also provides informal arguments in favor of the publication of (unattributed, non-verbatim) minutes.

and strategic considerations used by policymakers.[42] For instance, it could reveal to what extent central banks engage in international policy coordination or take into account strategic interactions with unions and fiscal policy. The effect of uncertainty about these issues would be an interesting new direction for formal research.

Regarding the publication of a monetary policy rule or strategy, there is a large literature on the evaluation of monetary policy rules (Taylor 1999), but it typically implicitly assumes that the rule is common knowledge so it bypasses transparency issues.[43] Furthermore, despite their popularity in the academic literature, central banks have been extremely reluctant to adopt rules that specify the settings of policy instruments, with the only exception of exchange rate pegs.[44] Instead, they typically conduct monetary policy in a discretionary fashion while adhering to a self-made framework. Increasingly, central banks are explicit about this framework and publish a monetary policy strategy. This can vary from a textbook inflation targeting approach, to the tailored frameworks of the European Central Bank and the Swiss National Bank.

In practice, few central banks release minutes or voting records, and even countries with an inflation targeting framework are often not transparent in this respect. When minutes are published, they tend to be non-verbatim and non-attributed but very informative about the arguments advanced during the policy deliberations. For instance, the minutes of the Bank of Japan reveal the comments made by the government representative that attends the meetings. The few central banks that release voting records typically disclose individual votes and include them with the minutes.

All in all, both in theory and in practice, procedural transparency is still quite underdeveloped but gradually evolving.

3.4 Policy Transparency

There are several models that analyze the consequences of transparency about policy decisions, and they all focus on (non-)borrowed reserves targeting where the policy instrument is a target for the money supply. In the market for bank reserves, the interbank rate (e.g. the federal funds rate) adjusts to ensure equilibrium between the demand and supply of total reserves, which consist of borrowed and non-borrowed reserves. Non-borrowed reserve targeting is modeled as a simple reaction function for the supply of non-borrowed reserves by the central bank that depends on the interbank rate and the central bank's short term money target. In the case of policy transparency, this money target is disclosed. The models differ in their information structure under policy opacity, but they have in common that there are money market disturbances that are private information to the central bank so that the policy target cannot be deduced from the interbank rate.

Dotsey (1987) assumes that the central bank has a stochastic short term money target. The average target is known to the private sector, but there is asymmetric information about a white noise target

[42] In practice, minutes are not only informative about the way monetary policy deliberations are conducted, but also about other aspects of transparency. This exemplifies the advantage of the conceptual framework used in this paper, which focuses on the content and not the form of information disclosure.

[43] One could argue that a policy rule is more transparent than discretion, in the sense that it is easier to understand. But the definition adopted in this survey allows both procedures to be transparent (i.e. based on symmetric information).

[44] For a critique of instrument rules, see Svensson (2001) who promotes a targeting framework.

disturbance. Of course, this gives rise to an uncertainty effect. Dotsey (1987) finds that secrecy about the short-term money target increases the variance of private sector forecast errors of the interbank rate. However, he argues that secrecy reduces the variance of the interbank rate because it responds less to the unobserved money target disturbance.[45] Presuming that central banks care about the variability of the interbank rate, this suggests that policy secrecy is desirable.

Rudin (1988) extends this model and shows that less secrecy about the non-borrowed reserves target could actually reduce the accuracy of interbank rate forecasts when there are central bank watchers. The reason is that a reduction in secrecy makes it less costly to monitor the activities of the central bank to infer the reserves target, so it increases the proportion of central bank watchers. This in turn results in a stronger response of the interbank rate to money market disturbances and thereby increases its volatility, which makes it harder to forecast the interbank rate.

In another variation on the model by Dotsey (1987), Tabellini (1987) reaches yet a different conclusion. He assumes that the central bank has a constant non-borrowed reserves target. In the case of policy opacity, financial markets do not observe the policy target, but use the interbank rate to update their prior. Again, secrecy increases the variance of private sector forecast errors of the interbank rate. However, it also increases the response of the interbank rate to unobserved money market disturbances, because they are partly attributed to the unknown reserve target.[46] As a result, policy opacity increases the variance of the interbank rate, which is considered harmful.

Cosimano and Van Huyck (1993) consider asymmetric information about current policy directives for reserve targets when the central bank's trading desk aims to meet the reserve target while keeping the interbank rate low. Commercial banks use the interbank rate and the deposit rate to infer the reserve target. This gives rise to a strategic incentive effect for the central bank's trading desk to manipulate current reserves. In this way, it manages to obtain a more favorable trade-off between reaching the reserve target and keeping the federal funds rate low so that policy secrecy is preferred.[47]

These models all assume (non-)borrowed reserves targeting and do not apply to the many central banks that use the interbank or repo rate as the policy instrument.[48] In addition, the models focus on the market for bank reserves and ignore the repercussions of policy transparency on financial markets more generally. The latter seems a promising area for future research, also for an investigation of the role of policy explanations and inclinations.

In practice, most central banks promptly announce decisions about the settings of their operational instrument or target. But this has not always been the case; for instance, the Federal Reserve used to keep decisions on the federal funds target secret until the next policy meeting and has only made same-

[45] This is similar to the example in section 2.1 with $z^O = \mathrm{E}_P^O[x|s] = \bar{x} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2+\sigma_\upsilon^2}(\varepsilon+\upsilon)$ and $z^T = \bar{x} + \varepsilon$, where x could be interpreted as the money target and z as the interbank rate.

[46] In terms of the signaling example in section 2.1, take $x = \bar{x}$ and interpret σ_ε^2 as the prior variance. Then $z^O = \mathrm{E}_P^O[x|s] = \bar{x} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2+\sigma_\upsilon^2}\upsilon$, whereas $z^T = \bar{x}$.

[47] The model predicts the existence of a positive bias in monetary aggregates. The paper finds empirical support for this bias using US data from 1978 to 1985, but it does not analyze the empirical effects of policy transparency.

[48] Regarding the choice of policy instrument, Herrendorf (1999) and Atkeson and Kehoe (2001) assume that the nominal exchange rate implies policy transparency whereas money supply growth gives rise to policy opacity, and conclude that the former tends to be preferable because it reduces the incentive for surprise inflation. Although this suggests that transparency is beneficial, the effect of policy transparency can only be evaluated for a given policy instrument.

day announcements since 1994. Policy decisions are usually accompanied by a brief explanation when they involve adjustments of the policy instrument, but this is less common when policy settings are kept unchanged. Finally, there are very few central banks that provide a policy inclination. The Federal Reserve includes a fixed phrase in its policy statements that indicates the policy bias; the Reserve Bank of New Zealand takes the unusual approach to provide a medium term projection for short term interest rates in its quarterly monetary policy report. These issues still await formal theoretical analysis.

3.5 Operational Transparency

An important precursor on operational transparency is the seminal paper by Cukierman and Meltzer (1986). They provide a motivation for operational ambiguity using an infinite horizon version of the monetary policy game in section 2.2. There is asymmetric information about the policymaker's preference parameter for output stimulation β_t, which is stochastic and exhibits positive autocorrelation. The policymaker does not reveal the planned settings of the policy instrument m_t and has imperfect control over inflation π_t because of unanticipated control errors v_t (see (12)). The public only observes past inflation outcomes (π_t, π_{t-1}, ...) and uses these to forecast the policymaker's future preferences (β_{t+1}).

Greater monetary control makes inflation a more reliable signal of the policymaker's objectives, so that private sector inflation expectations π^e_{t+1} are more sensitive to past policy outcomes π_t. This beneficial incentive effect associated with less operational ambiguity reduces the inflation bias. On the other hand, loose monetary control gives rise to an advantageous uncertainty effect as it allows the government to create surprise inflation when it is most desirable (i.e. when β_t is high). The uncertainty effect could outweigh the incentive effect so that imperfect monetary control may be optimal for the policymaker.[49]

Faust and Svensson (2001) extend the model of Cukierman and Meltzer (1986) in two important ways. First, they introduce a distinction between imperfect monetary control and (operational) transparency, where the latter is defined as the extent to which the monetary control errors v_t are disclosed to the private sector. Second, the central bank's objective function is (9) instead of (2), so that the central bank cares about output stabilization and inflation responds to private sector inflation expectations as in (10). The output target $\kappa_t \bar{y}$ is private information to the central bank and follows a persistent stochastic process around the socially optimal target $\kappa \bar{y}$, so the public tries to infer the central bank's goal $\kappa_{t+1} \bar{y}$ from inflation π_t.

For a given level of monetary control, greater operational transparency makes the public's inflation expectations more responsive to inflation, which provides an incentive to reduce the inflation bias. It also reduces the central bank's 'activism' in the sense that intended policy m_t responds less to the idiosyncratic output target $\kappa_t \bar{y}$ and reputation π^e_t. Although this tends to reduce the variability of inflation, inflation expectations become more variable as they track the central bank's objectives more closely, so that the effect on the variance of inflation is ambiguous. In addition, there is less scope for surprise

[49] In a similar model, Lewis (1991) considers the optimal degree of persistence in β_t and finds that incomplete persistence is beneficial because it generates greater preference uncertainty which enhances the beneficial incentive effect and induces the central bank to improve monetary control. Balke and Haslag (1992) introduce costly information acquisition about the central bank's preferences and find that it causes the central bank to improve monetary control since this limits the loss of incentive effects due to greater preference transparency.

inflation, which constitutes a disadvantageous uncertainty effect for the central bank, but is socially beneficial as it reduces the variance of output.

Using numerical analysis, Faust and Svensson (2001) find that greater operational transparency is likely to improve social welfare, but may not be preferred by the central bank. In fact, for a very patient central bank ($\delta \approx 1$) with an output target equal to the natural rate ($\kappa_t = 1$), perfect operational transparency is socially optimal whereas minimum transparency would be chosen by the central bank. The reason is that the inflation bias is absent so that there is no beneficial incentive effect but merely a detrimental uncertainty effect for the central bank.[50]

Jensen (2001) considers a two-period model that is similar except that it features a New-Keynesian Phillips curve (e.g. Clarida, Galí and Gertler 1999):

$$\pi_t = \mathrm{E}_t\left[\pi_{t+1}\right] + \frac{1}{\theta}\left(y_t - \bar{y}\right) - \frac{1}{\theta}\varepsilon_t \tag{13}$$

This relation distinguishes itself from the traditional Phillips curve (1) because of forward-looking inflation expectations $\mathrm{E}_t\left[\pi_{t+1}\right]$ instead of $\mathrm{E}_{t-1}\left[\pi_t\right]$. The central bank has imperfect control over the output gap $y_t - \bar{y}$ through an unobservable policy instrument. The private sector uses the output gap as a signal to form its expectations for next-period inflation. Again, greater operational transparency makes the signal more accurate and gives rise to a beneficial incentive effect that reduces the inflation bias. However, there is also a detrimental uncertainty effect because openness about control errors worsens the current inflation-output trade-off. Intuitively, when the (persistent) output goal is high, the central bank attempts to create surprise inflation, but greater operational transparency reduces the scope for this because of the increase in forward-looking inflation expectations in (13).[51] As a result, Jensen (2001) concludes that operational transparency may be undesirable for central banks that enjoy high credibility since it reduces their flexibility.

These models on operational transparency suggest that central banks face a disadvantageous uncertainty effect (in case of a Lucas-type or New-Keynesian transmission) but a positive incentive effect (in case of an inflationary bias). In practice, transparency about control errors related to the operating instrument appears immaterial as most central banks have (nearly) perfect control over their policy instrument. However, they all face significant unanticipated disturbances that affect the transmission from policy actions to outcomes. Many central banks regularly publish macroeconomic analysis which implicitly provides some information on these transmission disturbances, but very few, such as the United Kingdom and Sweden, actually provide an account of past forecast errors.

It is useful to compare these findings on operational transparency to economic transparency.[52] Although similar theoretical effects are present, in practice there appears to be relatively little operational

[50] When both the degree of transparency and monetary control are endogenous, Faust and Svensson (2000) argue that minimum transparency with maximum control is the likely outcome in practice.

[51] Similar to the uncertainty effect of economic transparency about supply shocks ε_t in section 3.2, this hinges on the assumption that information about these control errors or shocks is disclosed *before* current inflation expectations are set, so that it affects the *current* inflation-output trade-off.

[52] There is a clear analogy between the effects of economic and operational transparency; both increase the accuracy of a signal of central bank intentions, namely policy actions (m_t) for the former and policy outcomes (π_t or y_t) for the latter. But these signals are affected by different kinds of shocks (anticipated versus unanticipated), so the effects of both types of transparency are generally not the same.

transparency but much greater economic transparency. There could be several reasons for this. For instance, central banks may find it embarrassing to acknowledge that there have been significant shocks that they did not anticipate. Or it could be due to the different nature of the shocks disclosed, or the fact that the public is likely to pay less attention to policy outcomes because policy actions provide a more timely signal of the central bank's intentions. These issues remain an interesting topic for further research.

4 Empirical Evidence

Since central bank transparency has gained such prominence it is useful to see empirical evidence of its significance. There are several approaches that shed light on this: measuring transparency by identifying to what extent information relevant for monetary policy is publicly available; detecting the effect of confidential information on monetary policy; analyzing market reactions to information disclosures; and investigating the macroeconomic consequences of central bank transparency by exploiting cross-section and/or time-series variation. Empirical evidence from each of these approaches is now discussed.

4.1 Transparency Measures

Transparency of monetary policy is a dynamic and sometimes subtle process. Fortunately, there are some excellent descriptions of central bank transparency for several countries. Leiderman and Svensson (1995) give a nice overview of the initial experience with explicit inflation targets. Bernanke et al. (1999) also focus on inflation targeting and provide a systematic description of the monetary policy frameworks of nine countries. More specifically devoted to transparency, Blinder, Goodhart, Hildebrand, Lipton and Wyplosz (2001) conduct an elaborate review of the communication strategy and practice of the Federal Reserve, the European Central Bank, the Bank of Japan, the Bank of England and the Reserve Bank of New Zealand.

In addition to qualitative descriptions it is useful to have quantitative measures of central bank transparency for formal econometric analysis. Fry et al. (2000) provide a particularly rich source of data on monetary policy frameworks: a comprehensive survey of 94 central banks that covers a wide variety of aspects ranging from institutional characteristics to policy focus and monetary analysis. They construct several indices, including a measure of 'policy explanations' based on (a) the explanation of policy decisions, (b) the publication of forward-looking analysis, and (c) the explanation of assessment and analysis.[53]

Another central bank transparency index is presented by Eijffinger and Geraats (2002). This index covers the five aspects of transparency distinguished in section 3, (i) political, (ii) economic, (iii) procedural, (iv) policy, and (v) operational transparency, and is calculated for nine central banks.[54]

[53] More precisely, the Fry et al. (2000) index for central bank transparency attaches equal weight to: (a) prompt explanations of policy decisions, discussions in central bank bulletins, minutes and voting records; (b) the frequency and form of forward-looking analysis, risks to forecasts and forecast errors; and (c) the frequency of bulletins, speeches and research papers.

[54] To be precise, the Eijffinger and Geraats (2002) central bank transparency index captures the public availability of the following components with equal weight: (i) formal objectives, quantitative targets, and institutional arrangements; (ii) economic data, policy models, and central bank forecasts; (iii) monetary policy strategy, minutes, and voting records; (iv) prompt an-

Both studies suggest that New Zealand, Sweden and the United Kingdom are among the countries with the most transparent central banks. Indices for central bank transparency have the advantage that they provide a simple, quantitative summary of this multifaceted concept, although they inevitably reflect subjective choices and omissions.

4.2 Confidential Information

After mapping the disclosure practices of central banks it is useful to know whether information that is withheld is actually relevant for monetary policy. There are two interesting studies that investigate this issue. Peek, Rosengren and Tootell (1999) show that macroeconomic forecasts in the United States could be improved by using confidential data on bank supervision. Furthermore, they find that confidential bank supervision data affect monetary policy actions.

Romer and Romer (2000) establish that Federal Reserve staff forecasts of inflation and output, which are disclosed with a five-year lag, outperform commercial forecasts. They argue that this information asymmetry is due to the vast resources devoted to forecasting at the Federal Reserve. In addition, Romer and Romer (2000) find that monetary policy actions contain information about the confidential forecasts.

Both studies provide firm evidence of private information about macroeconomic variables that is relevant for monetary policy.

4.3 Market Reactions

Another approach is to analyze market reactions to information disclosures. There is a sizeable empirical literature on the response of financial markets to macroeconomic announcements. It could be informative on transparency of monetary policy in several ways.

When announcements pertaining to monetary policy lead to reactions in (efficient) financial markets, this suggests they convey news and contribute to transparency. For instance, an event study analysis by Muller and Zelmer (1999) suggests that the release of Monetary Policy Reports in Canada gives an exchange rate response. Using a panel of inflation targeting countries, Siklos (2000) finds that private sector inflation forecasts from survey data decrease in the months inflation reports are published. In addition, Clare and Courtenay (2001) analyze the effect of the release of macroeconomic data and monetary policy decisions by comparing the behavior of UK financial markets on announcement and non-announcement days. They find that the effects on exchange rates and equity and interest futures have changed since independence of the Bank of England. There appears to be a significantly smaller lasting effect of macroeconomic announcements on bond and equity futures, which may reflect greater confidence in monetary stabilization. In addition, interest rate futures seem to respond less to monetary policy actions. This suggests greater predictability of monetary policy and could be interpreted as an indication of transparency.

Several other studies find that the adoption of greater information disclosure in monetary policy is associated with a decline in the response of market interest rates to changes in the official interest rate.[55]

nouncement and explanation of policy decisions, and policy inclination; (v) control errors, transmission shocks, and monetary policy evaluation.

[55]This could be explained using the signaling example in section 2.1. Let z be the market interest rate and s the official

Muller and Zelmer (1999) find evidence for Canada, Haldane and Read (2000) for the United Kingdom and the United States. The latter propose to decompose the effect of official interest rate changes on the yield curve into macroeconomic news (affecting the short end) and information about monetary policy preferences (visible on the long end). They find a significant decrease in the effect of monetary policy actions on the short end of the yield curve, which suggests that transparency has reduced information asymmetries about the economy.

An open empirical issue is whether central bank transparency increases volatility in financial markets. Chadha and Nolan (2001) find that independence of the Bank of England has lead to an increase in daily volatility of short term interest rates, but this does not seem to be due to monetary policy announcements.

4.4 Macroeconomic Effects

The analysis of the macroeconomic effects of transparency of monetary policy has been complicated by the fact that it is a relatively recent phenomenon for which few quantitative measures exist.

Bernanke et al. (1999) bypass these limitations and adopt a case study approach to investigate the consequences of inflation targeting, covering Germany, Switzerland, New Zealand, Canada, the United Kingdom, Sweden, Israel, Australia and Spain. They conclude that inflation targeting seems to be beneficial.

The experience with ten years of inflation targeting now also allows econometric studies. For instance, Corbo, Landerretche and Schmidt-Hebbel (2001) perform an extensive empirical analysis and find that the adoption of inflation targeting reduces inflation forecast errors, inflation persistence, the sacrifice ratio and the volatility of output, and increases output persistence.

Kuttner and Posen (2000) investigate whether changes in exchange rate volatility in the United States, Germany and Japan could be due to variations in monetary transparency. They argue that greater transparency of the US Federal Reserve has contributed to a more stable exchange rate between the deutsche mark and the dollar, whereas the increase in volatility between the deutsche mark and the yen is consistent with more conservative monetary policy by the Bank of Japan.

In addition, the recent availability of quantitative measures of transparency is likely to spark a thriving empirical literature. It already got a promising start. Chortareas, Stasavage and Sterne (2001) use an alteration of the Fry et al. (2000) (sub)index of the publication of forward-looking analysis for 87 countries and show that greater transparency reduces average inflation. The result is robust to the inclusion of macroeconomic features (like openness and per capita output) and institutional characteristics (like political instability and central bank independence), but it does not hold for countries with an exchange rate peg (which is not surprising since those essentially import average inflation from abroad).

Cecchetti and Krause (2001) focus on a macroeconomic performance measure based on the variability of inflation and output, and analyze the effect of monetary framework characteristics, including central bank independence, accountability and transparency (using indices from Fry et al. 2000), and credibility (measured as low past inflation outcomes). They find that credibility and to a lesser extent

interest rate, and assume that $x = \bar{x}$ and greater information disclosure reduces the prior variance σ_ε^2. Then $z^O = \mathrm{E}_P^O[x|s] = \frac{\sigma_v^2}{\sigma_\varepsilon^2+\sigma_v^2}\bar{x} + \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2+\sigma_v^2}s$ and $z^T = \bar{x}$.

transparency appear to improve macroeconomic performance.

Clearly, there is much scope and need for further empirical research to establish the consequences of central bank transparency and identify which aspects of transparency matter most.

5 Central Bank Accountability

It is often stated that there are two different rationales for central bank transparency: economic benefits and democratic accountability (e.g. Blinder et al. 2001). Accountability has become increasingly important as more and more countries delegate the conduct of monetary policy to independent central banks. Clearly, some degree of transparency is a necessary condition for accountability, but it does not suffice. Transparency refers to mere information disclosure, but accountability also involves bearing responsibility for monetary policy actions and possibly facing repercussions when policy appears deficient. So, accountability directly affects the central bank's incentives, whereas incentive effects of transparency only operate indirectly through private sector expectations.

Transparency could facilitate accountability of monetary policy in several ways. Political transparency in the form of formal objectives, quantitative targets and clarity about the institutional structure is probably the most important as it provides a criterion for evaluation and identifies who is responsible. Economic, procedural and policy transparency enable scrutiny of the motivation for policy actions and thereby ex ante accountability of policy. Operational transparency about transmission disturbances contributes to ex post accountability based on policy outcomes.

Central bankers could be held responsible in several ways. They could be subject to central bank contracts (Walsh 1995, Persson and Tabellini 1993) that specify penalties or allow dismissal of the central bank governor when policy targets are not reached. In practice, only New Zealand has an explicit contract between the government and the central bank. Alternatively, there could be less drastic sanctions, like an open explanatory letter to the government when target deviations are large, which is the case for the Bank of England. However, formal procedures when targets are missed are not very widespread. Instead, the most common form of central bank accountability appears to be monitoring by the legislature.[56] A recent phenomenon that also contributes to accountability is a public evaluation of the monetary policy framework by external experts, which has been conducted for New Zealand and the United Kingdom.

Another way of ensuring accountability of monetary policy is to shift the final responsibility to government through an override mechanism. Although political interference clearly compromises central bank independence, it could be beneficial (Lohmann 1992) and harmful effects could be limited by an explicit override procedure based on checks and balances.

Eijffinger, Hoeberichts and Schaling (2000*b*) consider accountability through transparency and incorporate uncertainty about the central bank's preference parameter for inflation stabilization α into the Lohmann (1992) model with an overriding mechanism. They find that greater preference transparency makes the central bank on average more conservative as it reduces average inflation and the inflation response to supply shocks, but this in turn increases government interference to enhance flexibility. These

[56] Fry et al. (2000, Table 4.5) report that 88% of countries have an explicit target, 74% engage in regular central bank monitoring by the legislature, but only 18% have formal procedures when targets are missed.

results are consistent with the intuition in section 3.1, but also subject to the same caveat; the effects vanish when a consistent specification of uncertainty about the preference weights is used. Using the same model, Eijffinger and Hoeberichts (2000) compare two ways of improving accountability, increasing transparency in the form of less preference uncertainty, and boosting government responsibility by lowering the cost of overriding the central bank. They argue that the former increases credibility at the cost of flexibility, whereas the latter improves flexibility but hurts credibility. However, it should be noted that this relies on an inconsistent specification of preference uncertainty.

There are a few measures of accountability of monetary policy. Briault, Haldane and King (1997) construct a central bank accountability index for fourteen industrialized countries based on parliamentary monitoring, the release of minutes, the publication of a monetary policy report, and the existence of an (explicit or implicit) override mechanism. de Haan, Amtenbrink and Eijffinger (1999) present an indicator for central bank accountability for sixteen industrialized countries that captures (a) an explicit definition and ranking of monetary policy objectives; (b) transparency through monetary policy reports, minutes and a public evaluation of policy; and (c) the final responsibility for monetary policy reflected by parliamentary monitoring, override mechanisms and dismissal procedures. The central bank accountability index reported by Fry et al. (2000) focuses on (i) accountability with respect to a specific target, and (ii) public accountability.[57] These accountability measures all have in common that they combine aspects of both transparency and responsibility.

Accountability may explain why transparency is a relatively recent phenomenon that only emerged after central bank independence took hold. Thus, it is not surprising that there appears to be a strong, positive relation between central bank independence and transparency across countries.[58] However, there is less empirical support for the conjecture that this is due to accountability. Quite to the contrary, there is no cross-country relationship between central bank independence and accountability, and there is only a small positive association between accountability and other aspects of transparency.[59]

Instead, there may be economic reasons behind the systematic relation between central bank independence and transparency. Geraats (2001*b*) argues that the desirability of economic transparency depends on the institutional framework. There are beneficial incentive effects when monetary policy is conducted by the government or by an independent (conservative or responsible) central bank, whereas a harmful uncertainty effect prevails when a conservative central bank is subject to political interference. This suggests that central bank transparency is not just an externality of accountability required of independent central banks, but that it has taken hold independently because of its perceived economic benefits.

[57] In particular, the Fry et al. (2000) index of central bank accountability gives equal weight to (i) the extent to which there is an explicit target, set by the government, with formal procedures for target deviations, and (ii) regular central bank monitoring by the legislature.

[58] Using data on 93 countries, Fry et al. (2000, Table 5.1) find a highly significant correlation of 0.42 between their index of policy explanations and their indicator of central bank independence, which reflects statutory objectives of price stability, goal and instrument independence, limits on monetary financing of budget deficits, and length of terms of office.

[59] Fry et al. (2000, Table 5.1) report statistically insignificant correlations of 0.06 and 0.14, respectively.

6 Concluding Remarks

The recent practice in central banking motivates a closer look at the theory of transparency of monetary policy. It is generally possible to distinguish between uncertainty and incentive effects of transparency, but their consequences depend crucially on the precise circumstances. So, not surprisingly, central bank transparency is still the subject of heated debates, as can be witnessed by the exchange between Buiter (1999) and Issing (1999).

Although the theoretical literature has made a lot of progress recently, there is as yet no academic consensus on the economic desirability of transparency of monetary policy. Furthermore, there appears to be a striking discrepancy between the arguments advanced by the profession and those favored by policymakers. Theoretical arguments often emphasize harmful uncertainty effects and positive incentive effects based on time-inconsistency problems, whereas central bankers tend to cherish beneficial uncertainty effects of transparency and downplay considerations that presume an inflation bias. Nevertheless, the academic literature has also advanced some arguments why transparency could be desirable when central banks are independent and inflation bias problems absent. In particular, greater central bank transparency could reduce private sector uncertainty, it could give the central bank greater flexibility to stabilize economic disturbances and reduce the volatility of output, and it could align central bankers' actions more closely to socially optimal behavior.

The empirical work that is available suggests that transparency tends to be beneficial. Based on this, one could reach the tentative conclusion that the economic benefits of central bank transparency are likely to dominate. Thus, it provides support for policy recommendations like the "Code of Good Practice" from the International Monetary Fund (1999).

This survey indicates many directions for future research, some of which have been completely unexplored.

First, there is ample scope for further theoretical work on central bank transparency to check the robustness of results and broach new areas. Promising extensions would incorporate term structure responses, open economy effects, financial market repercussions, and strategic interaction between central banks, unions and fiscal policy, and analyze the consequences of greater central bank transparency when common knowledge fails.

Second, given the mixed theoretical findings on central bank transparency, a careful consideration of assumptions is warranted. For instance, one should exert caution with harmful uncertainty effects that rely on the presence of transmission mechanisms for which empirical support is controversial. Besides the monetary transmission mechanism, critical assumptions include the information structure and the social welfare function. Although informational assumptions are likely to remain more art than science, it would be desirable to be more rigorous about the social welfare function. So, another fruitful extension of the transparency literature would be to employ models with microfoundations because they provide a theoretically consistent welfare criterion.

Third, more empirical work is needed, not only to assess the realism of assumptions, but also to pursue testable implications of transparency models and to estimate the quantitative effects of greater transparency. Fortunately, this has become much easier with the greater availability of data.

This survey also clarifies the reasons behind the recent emergence of transparency in monetary

policy. It is often argued that the movement towards central bank independence has caused concerns about democratic legitimacy, which give rise to accountability requirements that necessarily involve greater transparency. However, the conjecture that transparency simply stems from accountability of independent central banks is not supported by the facts. Instead, this survey supports the argument that central bank transparency has been adopted for economic reasons. As a result, the prevailing paradigm in monetary policy is best characterized as central bank independence and transparency.

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