INSTITUT UNIVERSITAIRE DE HAUTES ETUDES INTERNATIONALES
THE GRADUATE INSTITUTE OF INTERNATIONAL STUDIES, GENEVA

HEI Working Paper No: 04/2002

A Model of Central Bank's Accountability

FRANCESCA CASTELLANI
Graduate Institute of International Studies

Abstract

This paper describes a mechanism by which the government manages to hold the appointed monetary authorities accountable for their policies. Asymmetric information about central bank's preferences proxies the "democratic deficit", evoked to justify the call for accountability. Three main results emerge from the model.
First, a clear distinction is drawn between accountability and transparency. Accountability is modelled as an ex-post political intervention, relating to the scrutiny of monetary policy decisions by the government, and transparency is described as an ex-ante decision of the CB about its own communication strategy.
Second, accountability requirements imposed by the government help mitigate the shortcomings of asymmetric information (uncertain CB's preferences), thereby moderating the "democratic deficit". Third, the "optimal" stringency of the accountability requirements is investigated.

A Model of Central Bank's Accountability

FRANCESCA CASTELLANI [#] [•]

May 2002

This paper describes a mechanism by which the government manages to hold the appointed monetary authorities accountable for their policies. Asymmetric information about central bank's preferences proxies the "democratic deficit", evoked to justify the call for accountability. Three main results emerge from the model.
First, a clear distinction is drawn between accountability and transparency. Accountability is modelled as an ex-post political intervention, relating to the scrutiny of monetary policy decisions by the government, and transparency is described as an ex-ante decision of the CB about its own communication strategy.
Second, accountability requirements imposed by the government help mitigate the shortcomings of asymmetric information (uncertain CB's preferences), thereby moderating the "democratic deficit". Third, the "optimal" stringency of the accountability requirements is investigated.

[#] Graduate Institute of International Studies (E-mail: fcastellani@hotmail.com).
[•] I am grateful to Xavier Debrun and Charles Wyplosz for very helpful comments and discussions.

1. Introduction

The literature on credibility has emphasized the advantages of delegating monetary policy to an independent central bank as a solution to the inflation bias characterizing discretionary policies. Recent developments in the literature on the design of monetary institutions have underscored the social costs of delegation. While the benefits of central bank independence have been recognized as leading to better policy outcomes, concern has been expressed as to the "democratic deficit"[1] entailed by the choice of an institution, which is not the by-product of social preferences and, as such, likely to depart from socially optimal policies in pursuit of a private agenda. Increased attention to these shortcomings has stimulated the debate on the need for an unelected institution to be responsible for her deeds, i.e. to be accountable for its decisions to democratically elected representatives.

The literature on accountability has focused on ways and means to make the central banker liable for her policy choices. In previous work (Castellani, 2001), we proposed a taxonomy of the existing literature. There, we argued that what is widely acknowledged as an accountability problem stems from the individual and social costs associated with the delegation of a policy instrument to an unelected institution, whose preferences over macroeconomic objectives do not reflect[2] society's (fiscal authorities, wage setters, private sectors, etc.) ones[3]. The perception of these costs (e.g. the suboptimal stabilization policy of conservative central bankers in the sense of Rogoff (1985)) by society and individuals motivates the request for formal accountability mechanisms.

Most authors perceive accountability as a desirable feature of monetary institutions and focus their reflection on the means to achieve it. Generally, the principal (government)-agent (central bank) relationship is assumed to be impaired by the imperfect knowledge by the former of the latter's preferences and/or state of the economy. In this context, the call for accountability materializes in a call for transparency (e.g. publication of forecasts, minutes) so that the agent's ex-post conformity to her mandate can be more easily monitored.

---

[1] Briault and al. (1996, pag.12) "*delegation of power to an unelected authority might be interpreted as a dilution of democracy: an empowered, but unaccountable, central bank gives rise to a democratic deficit*".

[2] This can be related both to preference divergence between principal and agent with complete information, or to unknown agent's preferences.

[3] This is independent from the supporting mechanism (inflation targeting, Walsh contracts, etc.).

In spite of the fact that transparency seems a recognized pre-requisite for accountability, consensus still lacks as to the effect of increased transparency. In general, while more precise information about the central bank's preferences[4] facilitates the expectation-formation process, thereby increasing the credibility of the monetary policy, it is more problematic to clearly conclude on its capacity to move society towards a first-best world. The results on the desirability of greater transparency[5] are not robust to model specification and depend crucially on the credibility-flexibility trade-off. While several authors (Faust and Svensson (1998), Schaling and Nolan (1998), Castren (1999), Geraats (2001)) invoke increased transparency as an incentive for the central banker to behave closer to the social optimum, others (Jensen (2000), Eijffinger et al. (2000), Cukierman (2000)), underscore the risk that it might interfere with the ability of the central bank to perform efficient stabilization by means of policy surprises and end in lower social welfare.

While it is evident that transparency has a role to play in accountability problems, we find the traditional "accountability through transparency" approach to some extent incomplete. Contributions, focusing on transparency as a precondition for holding the monetary authority responsible for its policy-making, abstract from a formal conceptualization of accountability. In fact, they fail to clearly discriminate between accountability and transparency.

In this paper, we shed some light on the distinction between accountability, responsibility for policy-making (deeds), and transparency, the communication strategy adopted by the central bank, (words)[6]. We attempt to formally characterize the former.

Our viewpoint is that the need for accountability arises because of the potential divergence between what is expected from the Central Bank (deliver the socially optimal policy) and what the central bank actually delivers. This discrepancy might be due to several factors, among which the uncertainty about the central bank objectives and / or preference as investigated by the accountability / transparency literature.

---

[4] See Blinder et al (2001) on central banks' communication strategy.

[5] The nature of transparency varies across contributions: e.g. Faust and Svensson (1998) relate it to the size of the unobservable noise of the control error in monetary policy; Schaling and Nolan (1998) to the variability of CB's preference shocks.

[6] Issing (1999), elaborating on Briault, Haldane and King (1996), indicates that accountability has to deal with the "deeds" of the central bank, while transparency with the "words" used in her communication strategy.

Our model insists on the ex-post character of accountability[7]. As the evaluation of the central bank's performance is carried out by representative governments or more generally by economic agents, after monetary policy decisions have been made, monetary authorities are held accountable ex-post. For instance, in the EMU, while monetary decisions are taken every fortnight, their evaluation by the European Parliament occurs every quarter. Such a time lapse cannot but entail a difference in the accuracy of the information available to decision-makers and policy-reviewers, and it is very difficult to imagine any political evaluation abstracting from it.

Hence, policy appraisal, or, as we call it, the central bank evaluation test, "CBET", by the government and policy-making by the central bank are not concurrent. As a consequence, they might be carried out on the basis of different information sets. This might involve a misjudgement: a policy perceived now as a mistake was perhaps the best possible one given the information (i.e. projections) available to the policy-maker when it was opted for[8]. In reviewing monetary policy, the government is likely to avail itself of all existing information, comprising the pieces become accessible in the meantime, in order to establish the benchmark to scrutinize the CB.

In our attempt to independently characterize accountability and transparency, we use the most common theoretical benchmark, a one-period credibility model, where the fact that both government and economic agents ignore the preferences of the monetary authority proxies the above-mentioned "democratic deficit". We assume that the evaluation of monetary policies, intervening at a later stage of the game, is based on different information sets. The fact that information sets differ is tantamount to assume that the central bank is doubtful about the way the government will appraise its policy or that the model of the economy used by the government in its scrutiny of monetary decisions may differ from the one employed by the CB in its policy-making. At the time of decision-making, the CB ignores the information that will become available and be used for the assessment by the political authority. The question is then to study policy-making by an independent CB, once it takes into account the fact that its decisions are going to be scrutinized.

[7] Padoa-Schioppa (2001) also underlines the "ex-post" nature of accountability.
[8] This point, though in a different context, is also put forward by Orphanides (2001).

The original contribution of this paper to the accountability literature lies in both the description of a formal mechanism used by the government to hold monetary authorities accountable and the distinction drawn between accountability and transparency. Accountability is depicted as an ex-post exercise that can hardly be disentangled from political pressure, while transparency refers to an ex-ante decision by the CB about its communication strategy.

Four main results emerge. First, the formal mechanism put in place by the government to ensure accountability helps mitigate the shortcomings of asymmetric information (uncertain CB's preferences), thereby moderating the "democratic deficit". With no democratic deficit (zero preference uncertainty), the delegation mechanism[9] simultaneously succeeds in granting the central banker independence *and* holding her accountable to deliver the socially optimal policy. In this case, delegation turns out to be costless and an explicit institutionalized treatment of accountability scheme is superfluous[10]. Second, uncertainty perceived by the CB about the evaluation mechanism put in place by the government might induce monetary authorities to be unduly cautious in the making of monetary policy. Third, in the analysis of the "optimal" stringency of the accountability mechanism, we find that governments characterized by different degrees of inflation-aversion will have different needs in terms of accountability. Fourth, to illustrate the distinction between accountability and transparency, we propose a regime of "weak" transparency (i.e. truthful revelation of preference shocks) that might need to be paired by a formal accountability mechanism, in alternative to a regime of "strong" transparency (i.e. reduction in preference variability) where the central bank is by itself accountable (i.e. it delivers the socially optimal policy). This calls for future research on the linkages between transparency and accountability.

In the remainder of the paper, we proceed as follows. Section 2 describes the basic model. The third section illustrates the formal procedure put in place by the government to evaluate monetary policies. In section 4, we present monetary policy-making by an accountable central banker. Section 5 characterises the "optimal" stringency of the accountability requirements. Section 6 sheds some light on the distinction between accountability and transparency. Section 7 concludes.

[9] A explicit institutional treatment of accountability is superfluous in the case of costless delegation. The same is true in the case of costless delegation in Persson and Tabellini (1994) and Walsh (1995).
[10] See Persson and Tabellini (1994) and Walsh (1995).

2. The model

We elaborate on the standard one–period Barro-Gordon (1983) credibility model and assume that the government and economic agents in general ignore the true preferences of the authority to which monetary policy is delegated. The resort to the Barro-Gordon framework is dictated by the simplicity to endogenously derive the need for central bank independence and to relate to mainstream literature on central bank's independence. This makes the benchmark case for our analysis (centralized policy making by the government) easy to derive and justifies, in a flexible and explicit way, the appointment of an independent monetary authority.

The representative government's loss function features costs to deviation of inflation from a socially optimal rate, $\tilde{p}$, and output from some output target, $\bar{y}$:

$$L^G = \frac{1}{2}\left[(y-\bar{y})^2 + f(p-\tilde{p})^2\right], \quad \tilde{p}, \bar{y} \quad 0 \qquad (1)$$

where f represents the marginal cost of inflation deviations from target. Output follows the familiar "Lucas-type" specification

$$y = p - p^e + e \qquad (2)$$

Output is a function of the surprise inflation engineered by the policy-maker and the supply shock, normally distributed with mean zero and variance, s_e^2. Equation (2) implies that the "natural" level of output is normalized to zero (in log). The government's desire to stabilize output around $\bar{y}$ leads to the well-known time inconsistency problem that motivates central bank independence (Rogoff, 1985).

As usual, we assume that wage-setters form their expectations before supply shocks are realized, while monetary policy-making takes place once they become known.

With centralized decision-making and in the absence of pre-commitment technology, the government, minimizing (1) subject to (2) delivers the discretionary monetary policy (GD stands for government discretion):

$$p^{GD} = \tilde{p} + \frac{\bar{y}}{f} - \frac{e}{1+f} \qquad (3)$$

$$y^{GD} = \frac{f}{1+f}e \qquad (4)$$

Equation (3) underscores the usual inflationary bias and characterizes the stabilization policy.

To evaluate the expected loss function incurred by the government with centralized policy-making, we substitute (3) and (4) in the loss function (1) and take expectations obtaining

$$E(L^{GD}) = \frac{1}{2}\left[\left(\frac{1+f}{f}\right)\bar{y}^2 + s_e^2\left(\frac{f}{1+f}\right)\right] \qquad (5)$$

2.1. Delegation of monetary policy to an independent central bank under uncertainty

To overcome the inability of the government to credibly precommit to the optimal monetary policy (first best), the government delegates monetary policy to an independent central banker, whose preferences for output and inflation are private information of the appointed officials and, therefore, unknown to the government and the public. To simplify the algebra, to no harm to results, we suppose that the monetary authority and the government share the same output target $\bar{y}$ but have different inflation objectives:

$$L^{CB} = \frac{1}{2}\left[(1-z)(y-\bar{y})^2 + (f+z)(p-p^*)^2\right], \;\; p^*, \bar{y} \quad 0 \qquad (6)$$

Preferences are subject to a shock (z) by which they deviate from those of the government 's (median voter). The specification of uncertain CB preferences in (6), drawn on Muscatelli (1998), allows to easily characterize the expectation-formation process[11]. Then, we assume that the shock, z, bounded between –1 and 1, has zero mean and variance, s_z^2, and it is independently distributed from all other shocks.

Minimizing (6) subject to (2), the independent central bank delivers

[11] See Nolan & Scaling (1998) for alternative specifications of uncertain CB preferences.

$$p^{CB} = p^{*} + \frac{(1-z)}{f}\bar{y} - \frac{(1-z)}{1+f}e \qquad (7)$$

$$y^{CB} = -\frac{z}{f}\bar{y} + \frac{(f+z)}{1+f}e \qquad (8)$$

Comparing (3) and (7) it is clear that, were the government and the central bank to share the same inflation target, delegation would reproduce on average the same results as centralized policy-making. This implies that, for delegation to achieve on average lower inflation, the central bank's inflation target should be inferior to the government's. The presence of uncertainty gives rise to a stochastic bias, which is deflationary (inflationary) in the case of a positive (negative) shock.

To determine the inflation target (D stands for delegation), we substitute (7) and (8) into (1) to find the value of p^{*} minimizing $E(L^{G})$:

$$\arg\min_{p^{*}} E(L^{G}) = p^{*D} = \tilde{p} - \frac{\bar{y}}{f} \qquad (9)$$

Equation (9) shows that the inability of political authorities to observe central bank's preferences precludes optimal delegation, as it fails to eliminate the stochastic bias. The same result is in Muscatelli (1998) and Beetsma and Jensen (1998). Substituting (9) in (7), we obtain

$$p^{CB} = \tilde{p} - \frac{z}{f}\bar{y} - \frac{(1-z)}{1+f}e \qquad (7a)$$

Stabilization of supply shocks will also be conditional on the preference shock.

We now analyze the incentive of the government to delegate monetary policy, comparing its expected loss under its own discretionary regime (5) and the one in the case of delegation. To keep the algebra manageable, we assume throughout the paper that the random variables, as well as their squared values, are independent.

The government's expected loss with delegated monetary policy is calculated substituting (7a) and (8) into (1)

$$E(L^{G,CB}) = \frac{1}{2}\left[\left(1 + \frac{s_z^{2}(1+f)}{f^{2}}\right)\bar{y}^{2} + s_e^{2}\left(\frac{f+s_z^{2}}{1+f}\right)\right] \qquad (10)$$

Comparing (5) and (10), we find that delegation is preferable if and only if

$$\sigma_z^2 \leq \frac{\phi(1+\phi)\bar{y}^2}{(1+\phi)^2\bar{y}^2 + \phi^2\sigma_e^2} \qquad (11)$$

While delegation benefits society in terms of credibility as the central bank delivers, on average, a lower inflation than the government, its costs are positively associated with the uncertainty about the monetary authority's preferences. It can be noticed that higher preference uncertainty reduces the benefits of delegating monetary policy ($\partial E(L^{G,CB})/\partial \sigma_z^2 > 0$). The higher is the output target, the larger are the gains in terms of credibility for the government, given its stronger incentive to create surprise inflation. A large inflation bias under discretion allows for a greater level of preference shock variability[12], σ_z^2, for delegation to be preferred to centralization, as the analysis of the right hand side (RHS) of (11) reveals ($\partial RHS/\partial \bar{y} > 0$). It is interesting to note that the higher the degree of conservatism of the government, the smaller is the effect of preference variability on its loss function ($\partial^2 E(L^{G,CB})/\partial \sigma_z^2 \partial \phi < 0$), implying that political authorities devoting increasing attention to inflation variability (ϕ) regard less preference shocks.

3. The political evaluation procedure of the central bank's performance

As we underscore above, the "democratic deficit", brought about by unknown central bank's preferences, prevents delegation from holding the central bank accountable to deliver the socially optimal policy. This calls for a formal mechanism to ensure the accountability of monetary authorities.

In the remainder of this section, we describe the procedure employed by the government to assess monetary policy decisions ("deeds"). We shall call it "CB evaluation test", CBET. Being evaluation, by definition, an ex-post exercise, the lack of simultaneity between policy-making and policy appraisal might give rise to distortions. The information set used in decision-making and reviewing need not be identical[13] or the evaluation procedure might not be entirely transparent for the CB (i.e. the model of

[12] Here, the mainstream literature would interpret lower preference shock variability as a higher degree of transparency.

[13] Orphanides (2001) pinpoints the importance of these informational problems in policy reviewing or in appraising CB's behaviours through estimates of "Taylor rules".

the economy used by the government in its appraisal might be different from the one employed by the CB in its policy-making).

This echoes reality. While the ECB fixes its interest rate policy every fortnight, the evaluation carried out by the European Parliament is a quarterly exercise. It is then difficult to abstract from the fact that information, become available in the intervening time, does not have any bearing on the political judgment. Informational asymmetries might play a crucial role in the resulting judgment. Briefly, they might distort the government's scrutiny of central bank's behaviour.

To perform the "test", political authorities refer to a "fictitious" benchmark against which they evaluate monetary policy. In our case, this benchmark is *"ex-post"* centralized policy-making: the monetary policy the government would have chosen given the information available *at the time of evaluation*.

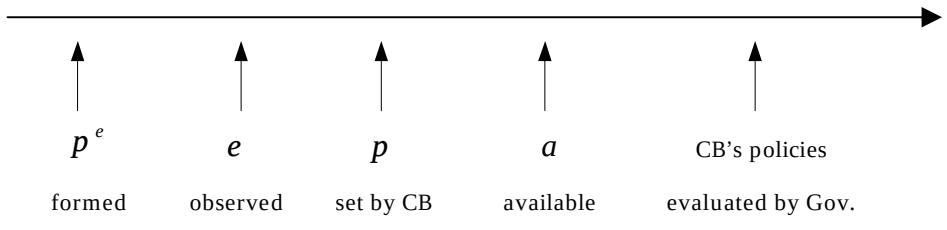
We assume that the additional information become available to the government consists of a discrepancy a, implying better knowledge by the government of the effect of monetary policy on the economy:

$$y^{G,a} = (1+a)(p - p^{e}) + e \qquad (12)$$

where a has zero mean and variance, s_a^2, and is independently distributed from all the other shocks. Superscript (G, a) identifies the government's "ex-post" information set or its model of the economy. Both the central bank and economic agents ignore the value of a.

Our multiplicative specification of uncertainty bears interesting elements in the discussion[14] as, contrary to additive uncertainty, it alters the short-term Philips curve trade-off, affecting CB's policy-making through s_a^2.

Events occur as follows



[14] In the literature on central banking, multiplicative uncertainty is usually introduced to identify uncertainty about the monetary policy transmission mechanism or monetary instruments. See Brainard's seminal work (1967), and Schellekens (2002), among others, for a recent analysis.

We find the government's "benchmark" minimizing (1) subject to (12):

$$p^{G,a} = \tilde{p} + \frac{\bar{y}}{f}\left[\frac{(1+a)(1+a+f)}{(1+a)^2+f}\right] - \frac{(1+a)e}{(1+a)^2+f} \qquad (13)$$

$$y^{G,a} = \frac{a}{(1+a)^2+f}\bar{y} + \frac{a(1+a)+f}{(1+a)^2+f}e \qquad (14)$$

The assumption underlining equations (13) and (14) is that inflation expectations are formed as in the regime of government discretion (GD). This reflects both the fact that a is private knowledge of the government, and that the CBET takes place ex post, while monetary policy, and *a fortiori* the expectation-formation process, are chosen before the realization of a. At the time of the evaluation, the government considers the monetary policy it would have put in place, given expectations materialized in nominal contracts and the model of the economy portrayed in (12).

Given the above, the CBET performed by political authorities captures in the simplest possible way the degree of ex-post satisfaction of the government. It is the difference between the "benchmark" loss function and the loss of the government with delegated monetary policy. Unsurprisingly, the latter is evaluated using the government's model of the economy, hence the subscript "a" in the second term of the right end side:

$$CBET = L^{G,a} - L_a^{G,CB} \qquad (15)$$

We now turn to investigate monetary policies when the central bank takes the CBET into account in its decision-making process.

4. Monetary policy-making by an accountable central bank

In this section, we investigate monetary policy when the central bank internalizes the evaluation by the government. In a nutshell, we analyze monetary policy by a central bank, which is "legally" or "formally" [15] held accountable.

[15] To differentiate it from the "spontaneous" accountability brought about by the optimal delegation mechanism.

4.1 Delegation of monetary policy to an accountable central bank

The central bank is aware that its policies are going to be scrutinized and it will take this *into account* in its policy-making. So, the loss function of an *accountable* central bank is

$$V^{CB} = L^{CB} - dE\left\{ CBET \mid I_{CB} \right\} \quad d \quad 0 \qquad (16)$$

Equation (16) indicates that the central bank will add to its initial loss another term consisting of its own expectation of the CBET that is of the evaluation by political authorities. I_{CB} is the information set available at the time the CB chooses its monetary policy. As monetary authorities ignore a, s_a^2 identifies their uncertainty about the evaluation that will be performed by political bodies. d is the subjective impact of the legal accountability procedure on the central bank's preferences. Among other things, d depends upon the degree of "stringency" of the accountability requirements. In section 6, we also interpret δ as the intensity of formal accountability requirements imposed by the government on the central bank to dampen the democratic deficit. Accountability is then equivalent to ex-post political interfering with independent policy-making.

Solving (16) and taking expectations conditional on e leads to the monetary policy stance in the presence of accountability (superscript: CB,A)

$$p^{CB,A} = \tilde{p} + \bar{y}\left[\underbrace{\frac{d}{(1+d)f}}_{A} - \underbrace{\frac{z(d+(1+f)(1+d))}{(1+d)f\left((1+f)+d\left(1+f+s_a^2\right)\right)}}_{B}\right] - \underbrace{\frac{(1-z+d)}{\left((1+f)+d\left(1+f+s_a^2\right)\right)}}_{C} e \quad (17)$$

$$y^{CB,A} = \bar{y}\left[\frac{z(d+(1+f)(1+d))}{f(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}\right] + \frac{(f+z)+d\left(f+s_a^2\right)}{\left((1+f)+d\left(1+f+s_a^2\right)\right)} e \qquad (17A)$$

Comparing equations (17) and (7a), policy-making respectively by an accountable and a non-accountable CB, we notice that the CBET leads the central bank to internalize the government's incentives to inflate, i.e. the CB anticipates that the government will blame it for not fully exploiting the short term Phillips curve[16]. A deterministic inflation

[16] Equations (17) and (7a) are equivalent when δ=0.

bias emerges, leading on average to higher inflation. At the same time, the consequences of unknown central bank's preferences are mitigated leading to a reduction in the size of the stochastic bias. Hence, accountability, as captured by CBET, limits the impact of preference uncertainty on the government's loss function. In particular, a conservative (liberal) shock to the central banker's preferences, z>0 (z<0), will lead to a lower deflationary (inflationary) effect in the presence of accountability than without it.

More stringent requirements in terms of accountability, a larger d, will have two opposite effects: increasing the size of the deterministic bias ($\partial A/\partial d > 0$) and decrease the stochastic one ($\partial B/\partial d < 0$). The overall effect of more stringent requirements (larger d) on inflation will depend on the size of the preference shock (see Appendix 1A). The above discussion pinpoints that while accountable monetary authorities will limit the impact of their specific preferences on inflation, they will also deliver on average higher inflation due to the fact that they partly internalize the political motives to inflate that will re-emerge at the time of the evaluation.

As to the stabilization of supply shocks, a larger d will induce the accountable central bank to stabilize more (less) when the conservative shock is large $z \quad z^* = \frac{s_a^2}{1+f+s_a^2}$ (small, $z < z^*$) enough. A larger s_a^2 will also contribute to reduce the size of the stochastic bias and of the stabilization policy as the central bank, more uncertain about the evaluation procedure, will become more cautious about its actions[17]. This is a new source of endogenous caution in monetary policy-making[18], one that is specifically attributable to the accountability requirements.

The expected loss of the government under monetary policy by an accountable central bank is obtained substituting (17) and (17A) into (1).

[17] In the presence of an additive shock (a), monetary policy would not be affected by the uncertainty about the evaluation mechanism, as CB would understand that its policy-making would not help alleviate its impact (i.e. bad luck) on the economy. In this case, s_a^2 would disappear from equations (17) and (17A).

[18] Brainard (1967) shows how uncertainty about the transmission mechanism of monetary policy leads to more cautious policy-making.

$$E\left(L^{G,CB,A}\right)=\frac{1}{2}\left\{\begin{array}{l}\left[\underbrace{\left(\frac{\left(d+(1+f)(1+d)\right)}{(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}\right)^2\frac{s_z^2}{f^2}\bar{y}^2}_{\text{A}}+\underbrace{\left(\frac{\left(f(1+d)+ds_a^2\right)^2+s_z^2}{\left((1+f)+d\left(1+f+s_a^2\right)\right)^2}\right)s_e^2}_{\text{B}}+\bar{y}^2\right]+\\ +f\left[\underbrace{\frac{d^2}{(1+d)^2f^2}\bar{y}^2}_{\text{C}}+\underbrace{\left(\frac{\left(d+(1+f)(1+d)\right)}{(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}\right)^2\frac{s_z^2}{f^2}\bar{y}^2}_{\text{D}}+\underbrace{\left(\frac{(1+d)^2+s_z^2}{\left((1+f)+d\left(1+f+s_a^2\right)\right)^2}\right)s_e^2}_{\text{E}}\right]\end{array}\right\} \quad (18)$$

Theorem 1

$\exists d^* > 0$ s.t. $E\left(L^{G,CB,A}\right)$ is minimized.

Proof: See Appendix 1A.

It is straightforward to check that (18) is identical to (10) when δ=0. As indicated above a higher δ reduces the negative impact of preference variability on the government's utility ($\partial x/\partial d < 0$ *where* $x = A, B, D, E$). This comes at the cost of a deterministic inflation bias ($\partial C/\partial d > 0$) reflecting the attempt of the CB to prevent too harsh criticism at the time its performance will be assessed by political authorities. As to the impact of s_a^2, its increase moderates both output volatility and inflation variability, leading to a reduction in the social loss. As indicated above, growing uncertainty perceived by the bank about the evaluation mechanism pushes it to be more cautious.

In Appendix 1C, we calculate $E\left(L^{GD}-L^{G,CB,A}\right)$ and find that delegation of monetary policy to an accountable central bank is preferable if and only if

$$\bar{y}^2 \quad s_e^2\left[\frac{\left(s_z^2(1+f)^2+d^2s_a^{2^2}\right)f^2(1+d)^2}{(1+f)\left[f(1+2d)\left(1+f+d\left(1+f+s_a^2\right)\right)^2-s_z^2\left(d+(1+d)(1+f)\right)^2\right]}\right] \quad (19)$$

Equation (19) implies that, to make delegation profitable, the government's credibility problem must be serious enough (large $\bar{y}$) and/or that preference shock variability must not be too high (s_z^2 small enough).

To summarize, accountability helps reduce the losses due to the stochastic preferences of the monetary authorities. It induces monetary authorities to be more cautious in their policy-making and downsize the impact of their private preference shifts. As such, it can be an instrument in the hands of the government to overcome the shortcomings of unknown preferences, containing the "democratic deficit" brought about by an appointed central banker.

This result makes an interesting contribution to the on-going debate on accountability. While the accountability/transparency literature usually highlights preference transparency as a means to an accountable central bank, we here show that accountability is a means to mitigate preference uncertainty, assuming that we have no practical means to root out such uncertainty.

In the next section, we try to characterize the optimal intensity/stringency of the formal accountability requirements.

5. Optimal stringency of the accountability requirements

To evaluate the interest of political authorities in holding the appointed central bank accountable for its policy making, we study the expected loss function of the government with an independent and accountable central banker (18), and analyze the "socially optimal" weight, δ*, attributed by the CB to the accountability mechanism. Here, we presume that the value of δ* is related to the stringency of the accountability requirements imposed by the government to minimize its loss function:

$$d^* \text{ s.t. } \min E\left\{L^{G,CB,A}\right\} \qquad (20)$$

We simulate equation (18) for different values of the structural parameters to find δ*. The analysis of the simulations[19] unveils six properties of δ* that bear interesting policy implications.

[19] As expected we find that when ä=0, that is no accountability requirement is imposed on the central bank, equations (10) and (18) are equivalent.

Property 1

When the variability of the preference shock is zero, no formal accountability requirements should be imposed on the CB (d=0).*

It is evident that in our model the absence of preference uncertainty implies no democratic deficit to contain, so that optimal delegation mechanism also makes the central bank spontaneously accountable to achieve the optimal social policy. Imposing formal accountability requirements would produce no benefits, whereas a deterministic inflation bias would remain as a result of the ex-post political intervention.

Simulations confirm that, when preference shock volatility is zero, δ*=0. So, in this case, society is better off if no institutionalized accountability mechanism is implemented. Were the government to ignore this and impose accountability, the social loss would turn out to be larger than in the absence of accountability. See Figure 1 and Table 1 in Appendix 2.

Property 2

A higher variability of the CB's preference shock entails more stringent accountability requirements.

As the preference shock volatility grows (s_z^2 increases), we find that optimally a larger ä is required to contain its impact on the loss function of the government. This implies that accountability requirements should match preference variability. See Figure 2 and Table 2 in Appendix 2.

Property 2A

For given level of preference variability, $\exists d > 0$ s.t. $E\left(L^{G,CB,A} \mid d > d\right) > E\left(L^{G,CB}\right)$

Monetary policy by an accountable central bank leads to a lower loss for the government if preference variability is high enough. Imposing accountability requirements inconsistent with the magnitude of preference volatility (too demanding) may turn out to be harmful for the government. This means that, for a given level of preference variability, while optimal requirements, ä*, still exist; there is also an upper bound beyond which formal accountability becomes detrimental. Imposing too large a ä might turn out to have a negative impact, as its beneficial effect of mitigating the impact of preference shocks (reduction in the variability of inflation and output) would be

insufficient to cancel out the rise in the inflation bias, ending in an increase in the social loss function. This involves the ability of political authorities to "dose up" accountability. See Figure 2A and Table 2A in Appendix 2.

Property 3

Higher uncertainty about the way the government puts in place the evaluation of the CB's (higher s_a^2) calls for weaker accountability requirements.

Simulations also indicate that the higher the uncertainty about the evaluation mechanism put in place by the government (large s_a^2), the less severe are the optimal requirements to be imposed on the monetary authority, for the same level of preference variability. The reason is that ambiguity perceived about the appraisal procedure employed by political officials induces the CB to be *unduly*[20] cautious in its policy-making. See Table 3 in Appendix 2.

Property 4

For a given degree of inflation-aversion, a higher propensity to inflate by the government (higher output target, more severe structural problems) calls for less demanding requirements.

The larger is the output target, the more effective is accountability. With a more inflation-prone government, delegation offers a beneficial opportunity in terms of credibility gain. So, ceteris paribus, political authorities will value this gain and be less demanding in terms of accountability as higher inflation brought about by it reduces the potential credibility gain to be enjoyed. See Table 4 in Appendix 2.

Property 5

For a given degree of inflation-aversion, a higher volatility of supply shocks involves more severe requirements.

A larger volatility of the supply shock also induces a higher optimal value of ä. A large s_e^2 implies stronger needs to stabilize supply shocks. As a result, it magnifies the negative consequences of preference variability, which result in suboptimal stabilization,

[20] Caution is suboptimal as it results from the ex-post political intervention, not from uncertainty about the transmission mechanism of monetary policy.

on the loss of the government so that more binding requirements in terms of accountability must be imposed. See Table 5 in Appendix 2.

Property 6

Everything else being equal, governments characterized by different degrees of inflation-aversion will have different needs in terms of accountability.

Property 6 has interesting implications for the on-going debate on the need to impose accountability requirements on the European Central Bank and on the nature of these requirements. Our model suggests that political preferences and the structure of the economy play a role in the choice of the accountability requirements to impose on the monetary authority. In particular, Appendix 1B and Table 6 in Appendix 2 suggest that a more inflation-averse government might ask for less binding accountability requirements whenever stabilization needs do not prevail over credibility gains.

This finding might be compatible with the different emphasis given to accountability by the Bank of England and the Bundesbank schools[21]. The former, contrary to the latter, admits the possibility for the government to take over monetary policy under certain circumstances and underscores the importance of transparency as a means to achieve accountability. The Bundesbank has never been held "formally" accountable, as it is the case for the Bank of England. As hinted by our model, an explanation for this might be found in the importance placed on price stability by the two governments.

In the next section, we try to formally distinguish transparency and accountability, analyzing the monetary policies carried out under both regimes and the incentive of the central bank to be "spontaneously" transparent.

6. Transparency and accountability

In the presence of unknown central bank's preferences, we have shown that the government imposes a formal mechanism of accountability to dampen the negative effects of asymmetric information ("overcome the democratic deficit"). We have also discussed the case where, in the absence of preference variability, no formal

[21] For further discussion see Cukierman (2000).

accountability scheme has to be devised, as the central bank is independent and accountable.

For the purpose of illustration, in this paragraph, we investigate further the distinction between accountability and transparency.

In the introduction, we argue that the two concepts are different. As Issing indicates the former has to do with the policies (deeds) carried out by the central bank, the latter with its communication strategy (words). Pushing reflection further, we study the case where, after the appointment but before policy-making, the monetary authority has the choice to be transparent. In the traditional contributions to the literature[22], transparency is defined in the *strong* sense of a reduction in preference variability. In fact, $s_z^2 = 0$ would reproduce the above-mentioned situation where accountability is no longer an issue once strong transparency is opted for. Implicitly thus, the literature presumes that only an opaque central banker would be characterized by changing preferences. Here, transparency is separated from the issue of preference variability, which may simply reflect the state of the policy debate inside the institution. We thus allow for a *weak* definition of transparency where the central banker can change her judgement on the inflation-output trade-off (as a result of learning for instance) but is perfectly transparent in the sense that she truthfully reveals the preference shock, z, to the public. This additional information can therefore be used in the expectation-formation process and prevent the CB from fooling wage-setters. However, as revelation occurs after appointment, the mandate assigned to her, which is contingent on her initial preferences, remains suboptimal.

Under our regime of "weak transparency" (TR), the CB minimizes (6) subject to (2) and the fact that preferences are revealed and therefore used in the expectation-formation process, delivering

$$p^{CB,TR} = \tilde{p} - \frac{z}{f}\left(\frac{1+f}{f+z}\right)\bar{y} - \frac{(1-z)}{1+f}e \qquad (21)$$

$$y^{CB,TR} = \frac{(f+z)}{1+f}e \qquad (21A)$$

[22] See Nolan and Schaling (1998), Castren (1999), Eijffinger at al. (2000).

Full preference transparency, in the presence of a suboptimal mandate to the CB, might not remove the need for a formal accountability mechanism. This highlights the fact that while accountability and strong transparency ($s_z^2 = 0$) are substitutes in the sense that a strongly transparent central bank is by itself accountable (it delivers the socially optimal policy), a regime of weak transparency might need to be paired with a formal mechanism to hold monetary authorities accountable. This paves the way for future research on the joint design of the accountability mechanism and the transparency requirements as two separate chapters in the optimal CB charter.

7.Conclusion

By using a standard model, we describe the mechanism by which the government holds the appointed monetary authorities accountable for their policies. Introducing asymmetric information about central bank's preferences, we are able to formally characterize the "democratic deficit", evoked to justify the call for accountability. An appealing feature of the model lies in its capacity to portray reality and interpret the evaluations of monetary policy decisions as ex-post political interventions.

The main contribution of the paper to the literature is threefold.

First, accountability is formally modelled and a clear distinction drawn between accountability and transparency. Accountability is formalized as an ex-post exercise, relating to the scrutiny of monetary policy decisions, and transparency is described as an ex-ante decision of the CB about its own communication strategy.

Second, we find that, while imposing accountability helps mitigate the shortcomings of asymmetric information (uncertain CB's preferences), thereby moderating the "democratic deficit", too binding requirements might turn out to be harmful.

Third, we investigate the "optimal" stringency of the accountability requirements on the basis of the underlying characteristics of the economy and the political preferences of the government.

APPENDIX 1

A. Impact of the accountability requirements (d) on social loss function in the presence of an accountable CB

We present the results relating to the impact of the accountability requirements on equations (17) and (18). To simplify calculations, all derivatives are calculated for the case of $s_a^2 = 0$.

Impact of d on the inflation rate (17) delivered by an accountable CB:

$$\frac{\partial p}{\partial d} \begin{matrix} > \\ < \end{matrix} 0 \text{ if } z \begin{matrix} > \\ < \end{matrix} -\frac{(1+d)(1+f)\bar{y}}{[2d+f(1+d)]\bar{y}-e(1+d)f} \quad \text{(i)}$$

Impact of d on the expected loss function of the government in the case of monetary policy-making by an accountable CB (18):

$$\frac{\partial E\left(L^{G,CB,A}\right)}{\partial d} \begin{matrix} > \\ < \end{matrix} 0 \text{ if } s_z^2 \begin{matrix} < \\ > \end{matrix} \frac{(1+d)^2(1+f)d\bar{y}^2}{[2d+f(1+d)][d+(1+d)(1+f)]\bar{y}^2+s_e^2(1+d)^2f^2} \quad \text{(ii)}$$

Proof of Theorem 1

From (ii), we can show

$$\frac{\partial E\left(L^{G,B,A}\right)}{\partial d} \Big|_{d=0} < 0$$

implying that there exist positive values of d^* which minimize $E\left(L^{G,CB,A}\right)$.

B. Impact of the government's preferences on the inflation-output variability trade-off (f) on social loss function in the presence of an accountable CB

We investigate the effect of the government's preferences on the inflation-output variability trade-off (ϕ) on equation (18).

$$E\left(L^{G,CB,A}\right)=\frac{1}{2}\left\{\begin{array}{l}\left[\underbrace{\left(\frac{\left(d+(1+f)(1+d)\right)}{(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}\right)^2\frac{s_z^2}{f^2}\bar{y}^2}_{\text{A}}+\underbrace{\left(\frac{\left(f(1+d)+ds_a^2\right)^2+s_z^2}{\left((1+f)+d\left(1+f+s_a^2\right)\right)^2}\right)s_e^2+\bar{y}^2}_{\text{B}}\right]+\\ f\left[\underbrace{\frac{d^2}{(1+d)^2f^2}\bar{y}^2}_{\text{C}}+\underbrace{\left(\frac{\left(d+(1+f)(1+d)\right)}{(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}\right)^2\frac{s_z^2}{f^2}\bar{y}^2}_{\text{D}}+\underbrace{\left(\frac{(1+d)^2+s_z^2}{\left((1+f)+d\left(1+f+s_a^2\right)\right)^2}\right)s_e^2}_{\text{E}}\right]\end{array}\right\} \quad (18)$$

While a larger ϕ reduces both inflation bias, ($\partial C/\partial f<0$), and the consequences of preference variability ($\partial x/\partial f<0 \quad x=A,D$), its impact on the part of output and inflation variability linked to supply shock volatility is as follows

$$\frac{\partial A}{\partial f}\begin{array}{l}>\\<\end{array}0 \quad \text{if} \; s_z^2\begin{array}{l}<\\>\end{array}(1+d)^2f$$

$$\frac{\partial E}{\partial f}\begin{array}{l}>\\<\end{array}0 \quad \text{if} \; f\begin{array}{l}<\\>\end{array}1$$

The overall impact of political preferences on equation (18) will also be contingent on the size of preference and supply shock variability

$$\frac{\partial E\left(L^{G,CB,A}\right)}{\partial f}\begin{array}{l}>\\<\end{array}0 \quad \text{if} \; s_z^2\begin{array}{l}<\\>\end{array}\frac{s_e^2f^3(1+d)^4-d^2(1+d)^2(1+f)^2\bar{y}^2}{\left[d(2+3f)+(1+d)(2+f)(1+d)\right]\left[d+(1+d)(1+f)\right]\bar{y}^2+s_e^2(1+d)^2f^3} \quad \text{(iii)}$$

The latter indicates that growing attention to inflation variability can have a beneficial effect (i.e. reduce) on the expected loss function of the government if the "democratic deficit" (s_z^2) is serious enough to overcome the negative consequence of decreasing flexibility to stabilize supply shocks.

Increasing attention to inflation variability by the government (higher ϕ) has two contrasting consequences on the social loss function. While it contains the negative effects of preference variability, therefore reducing its negative consequences on the government loss function ($\partial^2 E(L^{G,CB,A})/\partial s_z^2 \partial f < 0$), a higher ϕ might also amplify the need for stabilization ($\partial^2 E(L^{G,CB,A})/\partial s_e^2 \partial f > 0$ if $s_z^2 < (1+d)^2 f$).

C. Expected gain from delegation of monetary policy to an accountable central bank

We calculate the expected gain from delegating monetary policy to an accountable central bank

$$E\left(L^{GD} - L^{G,CB,A}\right)$$

$$E\left(L^{G,D} - L^{G,CB,A}\right) = \bar{y}^2 \left[\frac{(1+2d)}{f(1+d)^2} - \frac{(1+f)}{f^2} H^2 s_z^2 \right] - s_e^2 \left[\frac{d^2 s_a^{2^2}}{(1+f)\left[(1+f)+d\left(1+f+s_a^2\right)\right]^2} + \frac{s_z^2(1+f)}{\left[(1+f)+d\left(1+f+s_a^2\right)\right]^2} \right] \quad \text{(iv)}$$

(1) (2) (3) (4)

where $H = \dfrac{\left(d+(1+f)(1+d)\right)}{(1+d)\left((1+f)+d\left(1+f+s_a^2\right)\right)}$

We express the gain/loss of delegation in terms of credibility (1 & 2) and stabilization (3 & 4). (2) and (4) isolate the impact of the preference shock variability. It is clear that while the government takes advantage of delegation in terms of lower inflation bias (1), this gain might be offset by the cost of delegating to a central bank with highly volatile preferences (2).

Uncertainty about the evaluation procedure, s_a^2, mitigates the negative effect of preference variability s_z^2 both on credibility (2) and stabilization (4), because it induces the bank to be more cautious. As to the impact of a higher d, while it decreases the gains accruing from a lower inflation bias (1), it limits the loss of credibility linked to the stochastic preferences of the central bank (2). More strict accountability requirements also mitigate the effect of preference variability on the stabilization coefficient (4) but reinforce the consequences of uncertainty on stabilization needs (3).

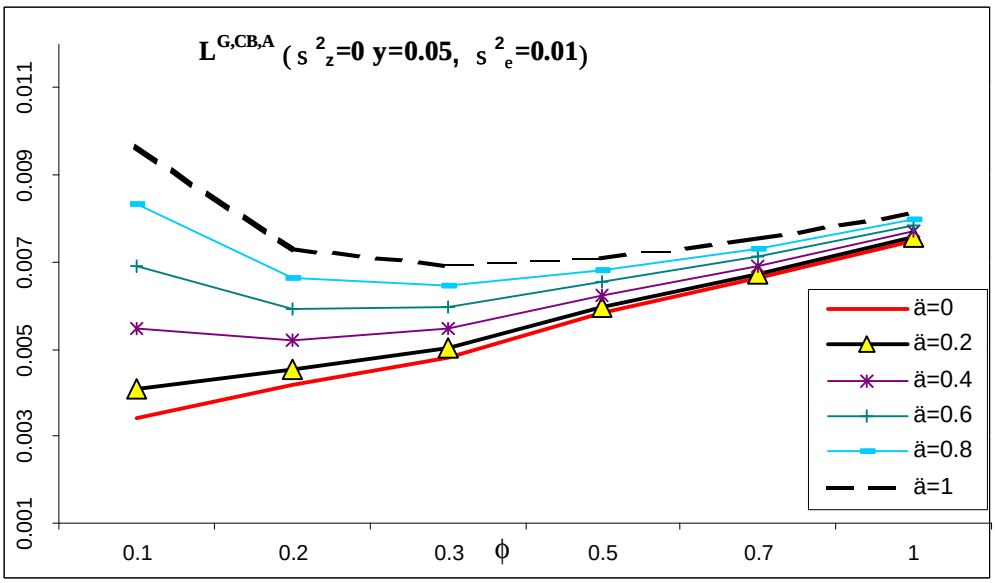
APPENDIX 2

In the simulations we impose realistic constraints to make delegation of monetary policy to an independent central bank profitable, be it accountable or not. So, (11) and (19) hold. The results hold $\forall$ ϕ.

Property 1

Figure 1 shows the value of the government loss function once monetary policy is delegated to an accountable central bank, $L^{G,CB,A,}$ where $y=0.05,\ s_e^2=0.01,\ s_a^2=0,\quad s_z^2=0$

Figure 1



Then, ä* should be zero.

Property 2

Figure 2 shows the value of the government loss function once monetary policy is delegated to an accountable central bank, $L^{G,CB,A,}$ where $y=0.025, s_e^2=0.01, s_a^2=0, f=0.5,$ with growing preference shock variability. Table 2 indicates the values of δ*.

Figure 2

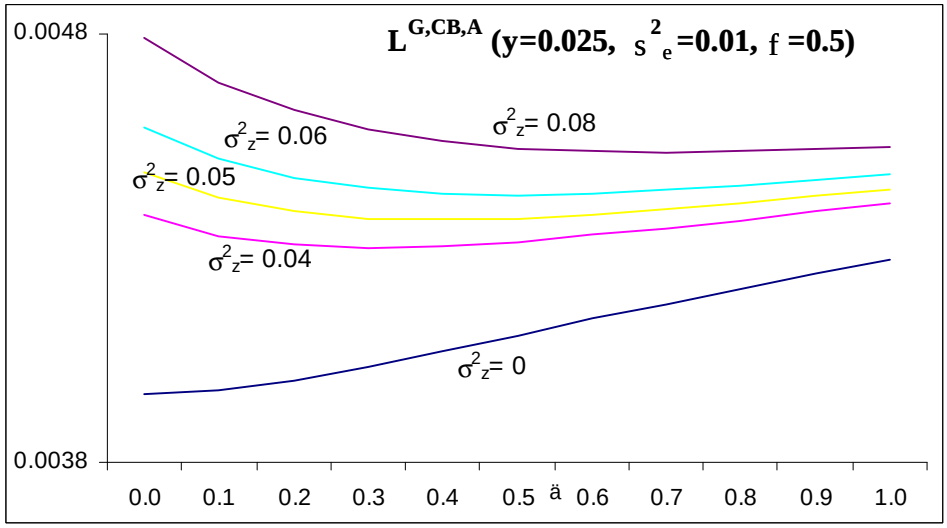


Table 2

y=0.025, s_e^2=0.01, ϕ=0.5, s_a^2=0	
	d*
s^2_z=0	0
s^2_z=0.015	0.1
s^2_z=0.02	0.2
s^2_z=0.04	0.3
s^2_z=0.05	0.4
s^2_z=0.06	0.5
s^2_z=0.06	0.6
s^2_z=0.08	0.7

Property 2A

Table 2A.1 and 2.A.2 show the values of δ* and d in the case of $L^{G,CB,A,}$ where $y = 0.025, s_e^2 = 0.01, f = 0.1$ with growing preference shock variability.

Table 2A.1

	d*	$d^{\bullet}$
s^2_z=0	0	-
s^2_z=0.01	0.	0
s^2_z=0.015	0.1	0.11
s^2_z=0.02	0.1	0.15
s^2_z=0.025	0.12	0.2
s^2_z=0.03	0.2	0.4
s^2_z=0.035	0.3	0.6

$^{\bullet}$ Upper bound

Property 3

Table 3 shows the values of δ* in the case of $L^{G,CB,A,}$ where $y = 0.025, s_e^2 = 0.01, s_z^2 = 0.08, f = 0.2$ with growing uncertainty about the evaluation mechanism put in place by the government.

Table 3

y=0.025, s_e^2=0.01, ϕ=0.2, s_z^2=0.08	
	d*
σ^2_a=0	0.8
σ^2_a=0.05	0.8
σ^2_a=0.1	0.8
σ^2_a=0.15	0.8
σ^2_a=0.2	0.7
σ^2_a=0.25	0.7
σ^2_a=0.3	0.7
σ^2_a=0.4	0.6
σ^2_a=0.5	0.5
σ^2_a=0.7	0.4
σ^2_a=0.9	0.4
σ^2_a=1	0.3

Property 4

Table 4 shows the values of δ* in the case of $L^{G,CB,A,}$ with varying output target.

Table 4

s_e^2=0.01, s_z^2=0.08								
	ϕ=0.1	ϕ=0.2	ϕ=0.25	ϕ=0.3	ϕ=0.35	ϕ=0.4	ϕ=0.45	ϕ=0.5
				d*				
y=0.03	1.0	0.7	0.6	0.5	0.5	0.5	0.5	0.5
y=0.035	0.9	0.6	0.5	0.5	0.4	0.4	0.4	0.4
y=0.04	0.9	0.6	0.4	0.4	0.4	0.4	0.4	0.4
y=0.045	0.8	0.5	0.4	0.4	0.3	0.3	0.3	0.3
y=0.05	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.3
y=0.055	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.3
y=0.06	0.8	0.5	0.4	0.3	0.2	0.2	0.2	0.2
y=0.065	0.7	0.4	0.3	0.3	0.2	0.2	0.2	0.2

Property 5

Table 5 shows the values of δ* in the case of $L^{G,CB,A,}$ with growing variability of supply shocks.

Table 5

y=0.05, ϕ=0.2, s_z^2=0.08	
	d*
σ^2_ε=0	0.3
σ^2_ε=0.01	0.5
σ^2_ε=0.02	0.6
σ^2_ε=0.03	0.7
σ^2_ε=0.04	0.8
σ^2_ε=0.05	0.9

Property 6

Table 6 shows the values of δ* for different combinations of the model parameters.

Table 6

$s_a^2=0$	s^2_z=0.1 s^2_e=0 y=0.025	s^2_z=0.1 s^2_e=0.01 y=0.04	s^2_z=0.1 s^2_e=0.03 y=0.05	s^2_z=0.15 s^2_e=0.01 y=0.03	s^2_z=0.15 s^2_e=0.01 y=0.05
	d*	d*	d*	d*	d*
ϕ=0.2	0.65	0.90	1.00	2.1	1.80
ϕ=0.3	0.30	0.60	0.80	1.45	1.10
ϕ=0.4	0.21	0.51	0.75	1.27	0.80
ϕ=0.5	0.18	0.49	0.75	1.21	0.70
ϕ=0.7	0.15	0.49	0.77	1.19	0.63
ϕ=1.0	0.13	0.51	0.85	1.23	0.61
ϕ=1.2	0.12	0.52	0.87	1.27	0.62
ϕ=1.5	0.12	0.54	0.92	1.32	0.62
ϕ=1.7	0.12	0.55	0.94	1.35	0.63
ϕ=2.0	0.11	0.57	0.97	1.39	0.64
ϕ=2.5	0.11	0.59	1.00	1.45	0.65

Bibliography

al-Nowaihi, A. and P. Levine (1996), "Independent but Accountable: Walsh Contracts and the Credibility Problem", CEPR Discussion Paper, No.1387.

Barro, R. (1986), "Reputation in a Model of Monetary Policy with Incomplete Information", *Journal of Monetary Economics*, 17, 1-20.

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

Beetsma, R. and H. Jensen (1998), "Inflation Targets and Contracts with Uncertain Central Banker Preferences", *Journal of Money, Credit and Banking*, 30, pp. 384-403.

Binder, A., C. Goodhart, P. Hildebrand, D. Lipton and C Wyplosz (2001), How do Central Banks Talk?, CEPR.

Bini Smaghi, L. (1998), "The Democratic Accountability of the European Central Bank", *Banca Nazionale del Lavoro-Quarterly Review*, 51, 119-43.

Brainard, W. C. (1967), "Uncertainty and the Effectiveness of Policy", *American Economic Review*, 57, 411-25.

Briault, C. V., A.G. Haldane and M. King (1996), "Independence and Accountability", Bank of England Working Paper No. 49.

Buiter, W. (1999), "Alice in Euroland", *Journal of Common Market Studies*, 37, 181-209

Canzoneri, M. (1985), "Monetary Policy Games and the Role of Private Information", *American Economic Review*, 75, 1056-1070.

Castellani, F. (2001), "Central Bank Independence and Accountability under Complete Information", The Graduate Institute of International Studies Working Paper Series, WP05/2001.

Castren, O. (1999), "Accountability of the ECB and a Government's Incentives to Rebel against the Common Monetary Policy", Bank of Finland Discussion Papers, n.2/99.

Cukierman, A. (2000), "Accountability, Credibility, Transparency and Stabilization Policy in the Eurosystem", in: Charles Wyplosz (ed.), The EMU and its Impact on Europe and the World, Oxford University Press.

Cukierman, A. and Meltzer, A. H. (1986), "A Theory of Ambiguity, Credibility, and Inflation under Discretion and Asymmetric Information", *Econometrica*, 54, 1099-1128.

Eijffinger, S., M. Hoeberichts and E. Schaling (2000), “A Theory of Central Bank Accountability”, CEPR Discussion Paper No. 2354.

Faust, J. and L. Svensson (1999), “The Equilibrium Degree of Transparency and Control in Monetary Policy”, NBER Working Papers No. 7152.

Faust, J. and L. Svensson, (1998), “Transparency and Credibility: Monetary Policy with Unobservable Goals”, CEPR Discussion Paper No. 1852, forthcoming in *International Economic Review*.

Geraats, P. (2001), “Why Adopt Transparency? The Publication of Central Bank Forecasts”, European Central Bank Working Paper No. 41.

Haan, J. de (1997), “The European Central Bank: Independence, Accountability and Strategy: A Review”, *Public Choice*, 93, 395-426.

Haan, J. de, Amtenbrink, F. and Eijffinger, S. (1999), “Accountability of Central Bank: Aspects and Quantification”, *Banca Nazionale del Lavoro Quarterly Review*, No. 209.

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

Jensen, H. (2000), “Optimal Degrees of Transparency in Monetary Policy Making”, Manuscript, University of Copenhagen.

Kydland, F. and E. Prescott (1977), "Rules Rather than Discretion: the Inconsistency of Optimal Plans", *Journal of Political Economy*, 85, 473-491.

Lohmann, S. (1992), "Optimal Commitment in Monetary Policy: Credibility versus Flexibility", *American Economic Review*, 82, 273-286.

Muscatelli, A. (1998), ”Optimal Inflation Contracts and Inflation Targets with Uncertain Central Bank Preferences: Accountability through Independence?”, *The Economic Journal*, 108, 529-542.

Muscatelli, A. (1999), “Inflation Contracts and Inflation Targets under Uncertainty: Why We Might Need Conservative Central Bankers”, *Economica*, 66, 241-254.

Orphanides, A. (2001), “Monetary Policy Rules Based on Real-Time Data”, *American Economic Review*, 91, 964-985.

Padoa-Schioppa, T. (2001), “An Institutional Glossary of the Eurosystem” in Randzio-Plath, C. and T. Padoa-Schioppa, “The European Central Bank: Independence and Accountability”, ZEI Policy Paper B00-16.

Pearce, D.K. and M. Sobue (1997), "Uncertainty and the Inflation Bias of Monetary Policy", *Economics Letters*, (57) 2, 203-207.

Persson, T. and G. Tabellini (1994), "Designing Institutions for Monetary Stability", in Persson, T. and G. Tabellini (eds.), Monetary and Fiscal Policy, Volume 1: Credibility, The MIT Press.

Rogoff, K. (1985), "The Optimal Degree of Commitment to an Intermediate Monetary Target", *The Quarterly Journal of Economics*, 100, 1169-1190.

Schaling, E. and C. Nolan (1998), "Monetary Policy Uncertainty and Inflation: the Role of Accountability", *De Economist*, 146, 585-602.

Schellekens, P. (2002), "Caution and Conservatism in the Making of Monetary Policy", *Journal of Money, Credit and Banking*, forthcoming.

Stiglitz, J. (1998), "Central Banking in a Democratic Society", *De Economist*, 146, 199-226.

Svensson, L. (1997), "Optimal Inflation Targets, Conservative Central Banks and Linear Inflation Contracts", *American Economic Review*, 87, 98-111.

Tabellini, G. (1999), "Inflation Targeting and the Accountability of the European Central Bank", *Economic Notes*, 28, 15-23.

Walsh, C. (1995), "Optimal Contracts for Central Bankers", *American Economic Review*, 85, 150-167.

Walsh, C. (1999), "Announcements, Inflation Targeting and Central Bank Incentives", *Economica*, 66, 255-269.

Winkler, B. (1999), "Which Kind of Transparency? On the Need for Clarity in Monetary Policy Making", mimeo, European Central Bank.