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**A THEORY OF CENTRAL BANK
ACCOUNTABILITY**

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ABSTRACT

A Theory of Central Bank Accountability*

In this Paper we investigate central bank accountability by looking at the effect of transparency in a simple monetary policy game with an overriding mechanism. Monetary policy is transparent if there is little uncertainty about the central banker's preferences for inflation stabilization relative to output stabilization. Transparency enhances the central bank's accountability. The Paper shows that transparency leads to a lower expected rate of inflation and less stabilization of supply shocks.

JEL Classification: E52, E58

Keywords: monetary policy, central banks, transparency, accountability

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NON-TECHNICAL SUMMARY

Nowadays, many countries have established an independent central bank. The government delegates monetary policy to an independent institution that focuses primarily on price stability. By delegating monetary policy-making to an independent central bank, the government can achieve a lower rate of inflation by reducing the inflationary bias. This benefit of enhanced *credibility* comes at the cost of less *flexibility* in reacting to supply shocks. However, there is an obvious risk in giving away control over monetary policy. There must be a mechanism that ensures that monetary policy is set in a way that is compatible with society's best interest. As Stiglitz (1998) notes 'Monetary policy is a key determinant of economic performance... [and that] ...this key determinant of what happens to society – this key collective action – should be so removed from control of democratically elected officials should at least raise questions.' One way or the other, central banks must be accountable to democratically elected institutions. Fischer (1994), Levy (1995), Briault, Haldane and King (1996), Schaling and Nolan (1998) and De Haan, Amtenbrink and Eijffinger (1998) have discussed the issue of accountability.

In this Paper we present a theoretical model of central bank accountability in which we focus on *transparency* of actual monetary policy.

Our model builds on earlier work by Lohmann (1992) and Schaling and Nolan (1998). The government delegates monetary policy to a conservative central banker. However, both the government and society do not know exactly the central banker's preferences for inflation stabilization relative to output stabilization. The extent to which the central bank has private information about its preferences is determined by the transparency of monetary policy. After the central bank has proposed its preferred rate of inflation, the government can decide to override the central bank at a fixed cost. In this set up, the central bank is partially independent. The cost of overriding is a determinant of the independence of the central bank. If this cost is prohibitive, the central bank is independent. If, on the other hand, this cost is negligible, the government determines monetary policy and the central bank is dependent.

In this Paper we want to discuss the implications of transparency for macroeconomic outcomes. In particular, we look at the effects on the level of inflation and the stabilization of supply shocks.

Shocks to the central bank's preferences influence the slope of the reaction function of the independent central bank. A positive shock makes the central bank less conservative so that it reacts stronger to supply shocks. The reaction function becomes steeper and the region of independence increases.

A negative preference shock has an opposite effect. The central bank becomes more conservative, the slope of the reaction function becomes flatter and the region of independence will be smaller. However, the effect of a positive preference shock is stronger than the effect of a negative preference shock. Because of this asymmetry, a lower variance of preference shocks makes the expected slope of the independent central bank's reaction function flatter. Therefore, the expected region of independence becomes smaller and the expected rate of inflation decreases.

Transparency leads to a lower expected rate of inflation and less accommodation of supply shocks within the region of independence. Clearly, transparency does not reduce the effective independence of the central bank in this model. Although the region of independence becomes smaller, the macroeconomic outcomes move in the central bank's preferred direction when transparency is increased.

Transparency can be achieved by a central bank through publication of relevant information. Publishing minutes of meetings and giving a motivation for the actions that are taken increase transparency and reduce the uncertainty about the central bank's preferences.

Introduction

Nowadays, many countries have established an independent central bank. The government delegates monetary policy to an independent institution that focuses primarily on price stability. By delegating monetary policy making to an independent central bank, the government can achieve a lower rate of inflation by reducing the inflationary bias. This benefit of enhanced *credibility* comes at the cost of less *flexibility* in reacting to supply shocks. However, there is an obvious risk in giving away control over monetary policy. There must be a mechanism that ensures that monetary policy is set in a way that is compatible with society's best interest. As Stiglitz (1998) notes "Monetary policy is a key determinant of economic performance... [and that] ...this key determinant of what happens to society – this key collective action – should be so removed from control of democratically elected officials should at least raise questions." One way or the other, central banks must be accountable to democratically elected institutions. Fischer (1994), Levy (1995), Briault, Haldane and King (1996), Schaling and Nolan (1998) and De Haan, Amtenbrink and Eijffinger (1998) have discussed the issue of accountability. In this paper we present a theoretical model of central bank accountability in which we focus on *transparency* of actual monetary policy.

Our model builds on earlier work by Lohmann (1992) and Schaling and Nolan (1998). The government delegates monetary policy to a conservative central banker. However, both the government and society don't know exactly the central banker's preferences for inflation stabilization relative to output stabilization¹. The extent to which the central bank has private information about its preferences is determined by the transparency of monetary policy. After

¹ Berger and Thum (1998) develop a model where the central bank exploits its information advantage. In this paper, we do not consider strategic news management.

the central bank has proposed its preferred rate of inflation, the government can decide to override the central bank at a fixed cost. In this set up, the central bank is partially independent. The cost of overriding is a determinant of the independence of the central bank. If this cost is prohibitive, the central bank is independent. If, on the other hand, this cost is negligible, the government determines monetary policy and the central bank is dependent.

In this paper we want to discuss the implications of transparency for macroeconomic outcomes.

In particular, we look at the effects on the level of inflation and the stabilization of supply shocks.

We show that more transparency leads, in expectation, to a lower rate of inflation and less stabilization of supply shocks.

The Model

We use a standard model for monetary policy games in which output is determined by a simplified Lucas supply function:

$$y = \pi - \pi^e + v \quad \text{with } v \sim N(0, \sigma_v^2) \quad (1)$$

where y is the log of output, π the actual rate of inflation, π^e the expected rate of inflation and v a random supply shock. The government and society do not like inflation and output to deviate from their desired levels (without loss of generality the desired rate of inflation is normalized at zero). Moreover, the government incurs a fixed cost c if it decides to override the central bank. As in Lohmann (1992), the nature of this cost is determined by the political institutions in the

society. The dummy variable δ takes a value of 1 if the central bank is overridden and a value of 0 if it is not overridden. The following loss-function for the government results:

$$L_G = \frac{1}{2} \pi^2 + \frac{1}{2} (y - y^*)^2 + \delta c \quad (2)$$

where $y^* > 0$ is the government's output target. The government delegates monetary policy to a conservative central banker with stochastic preferences. The central bank's conservativeness is embodied in a quadratic contract with parameter f . The central bank has private information about the realization of the uniformly distributed preference shock x . The central bank's loss function is as follows²

$$L_{CB} = \frac{1-x}{2} \pi^2 + \frac{1}{2} (y - y^*)^2 + \frac{f}{2} \pi^2, \text{ with } x \sim U[-h, h] \text{ and } h < f \quad (3)$$

Without delegation of monetary policy, the government would set a discretionary inflation rate that minimizes its loss:

$$\pi_G = \frac{y^* + \pi^e - v}{2} \quad (4)$$

If monetary policy is delegated to the central bank, the rate of inflation is set in order to minimize the central bank's loss function:

² We ensure that the central bank is always more conservative than the government by assuming $h < f$. Without this assumption, the central bank could be overridden for accommodating too much to supply shocks, which complicates the analysis considerably.

$$\pi_{CB} = \frac{y^* + \pi^e - v}{2 - x + f} \quad (5)$$

Since, as in Rogoff (1985), the central bank is always more inflation averse than the government ($f - x > 0$), the conservative central bank has a lower inflationary bias than the government but it responds less actively to supply shocks.

After monetary policy is delegated to the central bank and the central bank has set the inflation rate, the government has to decide whether to override the central bank or accept the central bank's inflation rate as is given in (5).

If the government overrides, we use (4) in (2) with (1) and $\delta = 1$ to find its loss to be:

$$L_G(\pi_G) = \frac{1}{4}(y^* + \pi^e - v)^2 + c \quad (6)$$

If the government chooses to accept the central bank's inflation rate, we use (5) in (2) with (1) and $\delta = 0$, to find its loss to be equal to:

$$L_G(\pi_{CB}) = \frac{1 + (x - 1 - f)^2}{2(x - 2 - f)^2}(y^* + \pi^e - v)^2 \quad (7)$$

The government's decision problem is whether to override the central bank or accept the inflation rate. Minimizing its loss, the central bank will be overridden if:

$$L_G(\pi_G) < L_G(\pi_{CB}) \quad (8)$$

If the government finds that the *cost* of overriding the central bank is higher than the *benefit* of setting the government's preferred inflation rate, the central bank is independent. The region of independence of the central bank depends on the cost of overriding (c), the degree of conservativeness of the central bank (f), the realization of the stochastic supply shock v and the preference shock x . Substituting the government's loss with overriding (6) and the government's loss with delegation of monetary policy (7) in the condition for overriding the central bank (8) we find that the central bank will be independent if

$$c \geq \frac{(x-f)^2}{4(x-2-f)^2} (y^* + \pi^e - v)^2 \quad (9)$$

However, if the cost of overriding is low enough ($c < \frac{(x-f)^2}{4(x-2-f)^2} (y^* + \pi^e - v)^2$) the central bank cannot set its preferred rate of inflation without being overridden. Instead, it will act in such a manner such that the government is indifferent between overriding or not.

Thus, depending on the realization of the shocks, the central bank will either be independent ($(x, v) \in I$) or it will accommodate ($(x, v) \in A$). In the latter case, the central bank will set a rate of inflation that is a weighted average of the government's preferred inflation (4) and the central bank's preferred rate (5):

$$\pi_{ACC} = \phi\pi_G + (1-\phi)\pi_{CB} = \frac{2-\phi(x-f)}{2(2-x+f)} (y^* + \pi^e - v), 0 \leq \phi \leq 1 \quad (10)$$

If the central bank sets this inflation rate, inserting **(10)** in **(2)** and using **(1)** we find that the government's loss will be:

$$L_G(\pi_{ACC}) = \frac{1 + (x-1-f)^2 - \phi(x-f)^2(1-\frac{1}{2}\phi)}{2(2-x+f)^2} (y^* + \pi^e - v)^2 \quad (11)$$

The central bank will always accommodate so that the government is indifferent between overriding or not. Therefore, the central bank chooses ϕ such that $L_G(\pi_{ACC}) = L_G(\pi_G)$.

Equalizing **(2)** and **(11)** we find that

$$\phi = \begin{cases} 1 - \frac{2(2-x+f)\sqrt{c}}{|y^* + \pi^e - v||x-f|} & \text{if } (x, v) \in A \\ 0 & \text{if } (x, v) \in I \end{cases} \quad (12)$$

Inserting the expression for the weight given to the government's preferred inflation rate **(12)** into **(10)** this results in the following rate of inflation if the central bank accommodates³

$$\pi_{ACC} = \frac{y^* + \pi^e - v}{2} - \sqrt{c} \operatorname{sgn}(f-x) \operatorname{sgn}(y^* + \pi^e - v)$$

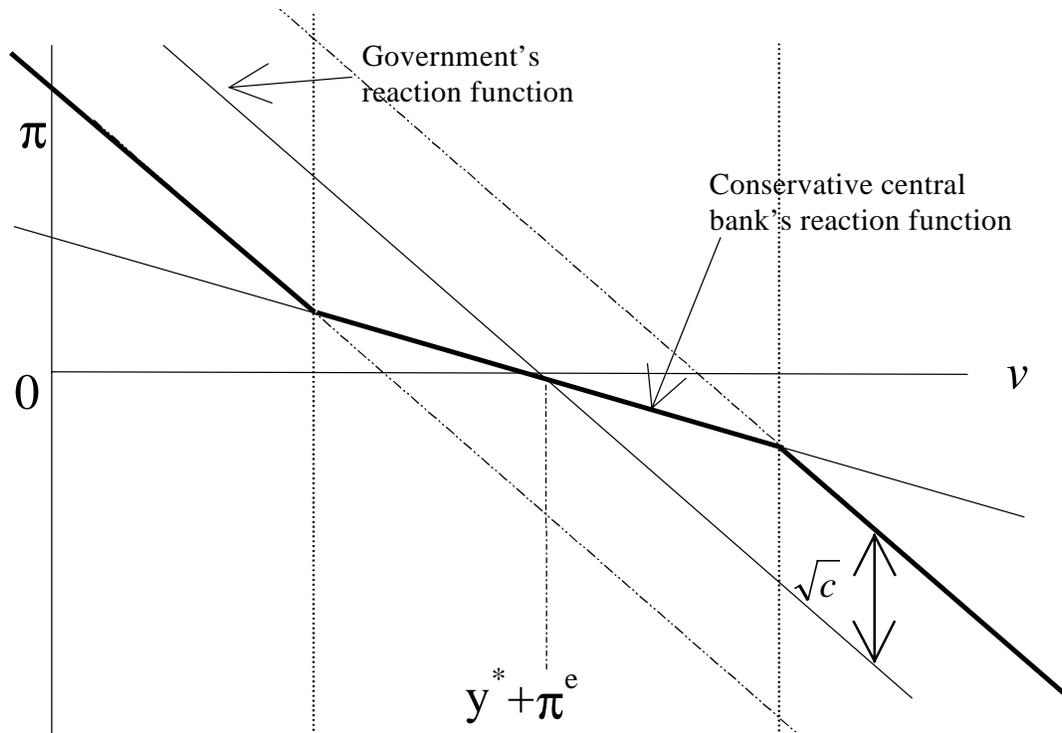
Using our assumption that the central bank will always be conservative, whatever its preference shock may be ($f > x$), we can write:

$$\pi_{ACC} = \frac{y^* + \pi^e - v}{2} - \sqrt{c} \operatorname{sgn}(y^* + \pi^e - v) \quad (13)$$

Figure 1 shows what monetary policy looks like if the government faces a positive cost of overriding a conservative central bank. In the center of the figure, around $v = y^* + \pi^e$, the central bank is independent and sets its preferred rate of inflation. However, on the left-hand side and on the right-hand side of this region of independence, the central bank must accommodate to the government's preferred rate of inflation. In these region of accommodation, the government finds the cost of the (in its view) insufficient stabilization of supply shocks so high that it will not accept the central bank's preferred rate. Parallel to the government's reaction function, at a distance that depends on the cost of overriding (\sqrt{c} to be precise) there are two lines representing all points where the government is indifferent between accepting and overriding. The crossings of these lines with the reaction function of the conservative central bank determine the region of independence, which lies between the two crossing points.

³ The signum-operator: $\operatorname{sgn}(x)=1$ if $x>0$, $\operatorname{sgn}(x)=-1$ if $x<0$ and $\operatorname{sgn}(x)=0$ if $x=0$.

Figure 1 Actual Monetary Policy with a Positive Cost of Overriding



Accountability through Transparency

Shocks to the central bank's preferences influence the slope of the reaction function of the independent central bank. A positive shock makes the central bank less conservative so that it reacts stronger to supply shocks. In the graph, the reaction function becomes steeper and the region of independence increases. A negative preference shock has an opposite effect. The central bank becomes more conservative, the slope of the reaction function becomes flatter and the region of independence will be smaller. However, the effect of a positive preference shock

is stronger than the effect of a negative preference shock. Because of this asymmetry, a lower variance of preference shocks makes the expected slope of the independent central bank's reaction function flatter, as is shown in Figure 2. Therefore, the expected region of independence becomes smaller and the expected rate of inflation decreases. This is our next proposition:

Proposition 1: The expected region of independence (conditional on the realization of supply shock v) decreases if the central bank becomes more transparent.

Proof: The central bank becomes more transparent if the central bank's preferences become less uncertain, or h decreases. From appendix B we know that less preference uncertainty makes the central bank effectively more conservative. From Figure 1 and 2 it is clear that more conservativeness, which means a flatter central bank's reaction function, makes the region of independence smaller. For a formal proof, see appendix A.

Next, we want to show the effect of accountability through transparency on the expected rate of inflation. We expect that transparency leads to lower inflationary expectations since lower preference uncertainty leads effectively to a more conservative central bank. This is formalized in the following proposition:

Proposition 2: If the transparency of monetary policy increases (h decreases), the expected rate of inflation decreases.

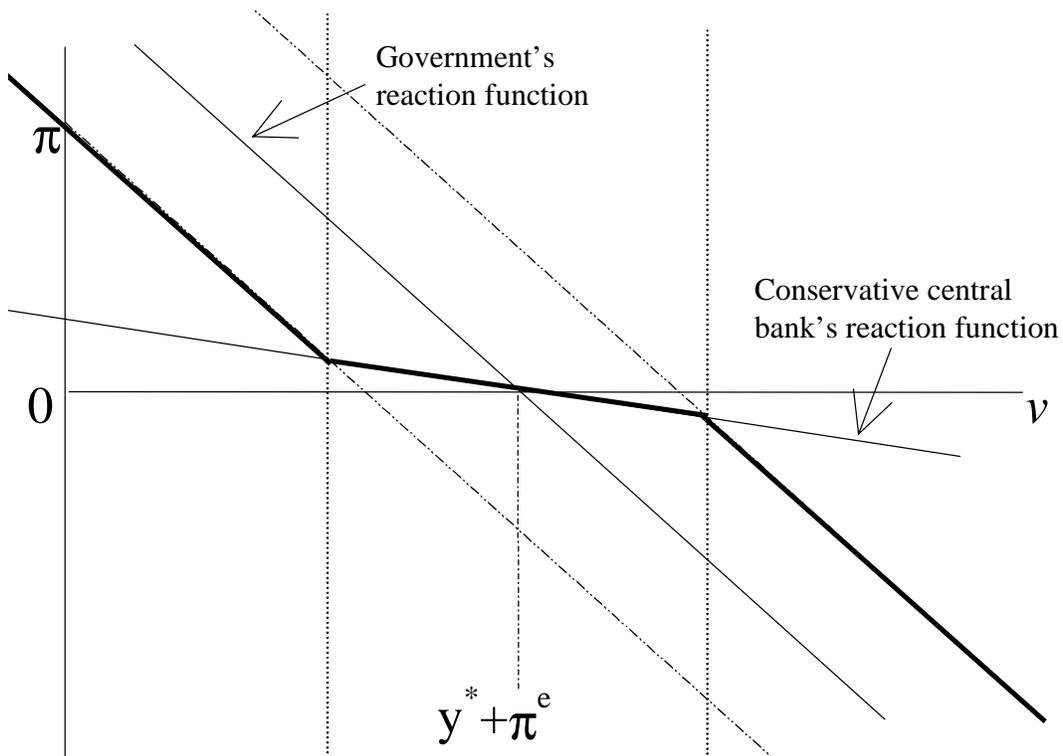
Proof: See appendix B

To complete the analysis of the effects of accountability through transparency, we have looked at the stabilization of supply shocks. This leads to the next proposition:

Proposition 3: If the transparency of monetary policy increases (h decreases), there is less stabilization of supply shocks.

Proof: See appendix B

Figure 2: The Central Bank Becomes More Conservative



Transparency leads to a lower expected rate of inflation and less accommodation of supply shocks within the region of independence. Clearly, transparency does not reduce the effective independence of the central bank in this model. Although the region of independence becomes smaller, the macroeconomic outcomes move in the central bank's preferred direction when transparency is increased.

Transparency can be achieved by a central bank through publication of relevant information. Publishing minutes of meetings and giving a motivation for the actions that are taken increase transparency and reduce the uncertainty about the central bank's preferences.

Conclusion

In this paper we have investigated the effects of accountability on macroeconomic outcomes. In the analysis, we have focused on accountability through transparency. Transparency reduces the uncertainty about the central bank's preferences and can be achieved by publication of relevant information. For instance, publishing minutes of meetings and inflation reports that give a motivation for the actions that the central bank has taken increases the transparency of monetary policy. We show that, although transparency makes the region of independence smaller, effective central bank independence increases with transparency. This leads to a lower expected rate of inflation and less stabilization of productivity shocks. So, more transparency shifts the balance of credibility vs. flexibility in the direction of credibility. Therefore, achieving accountability through transparency is especially attractive for countries that face a serious credibility problem relative to the flexibility problem.

Appendices

A. The Expected Region of Independence

The central bank is independent if

$$y^* + \pi^e - \frac{2\sqrt{c}(f+2-x)}{f-x} < v < y^* + \pi^e + \frac{2\sqrt{c}(f+2-x)}{f-x} \quad (\mathbf{A.1})$$

With $x \sim U[-h, h]$ the expected region of independence is:

$$y^* + \pi^e - 2\sqrt{c} - \frac{2\sqrt{c}}{h} \left(\log \frac{f+h}{f-h} \right) < v < y^* + \pi^e + 2\sqrt{c} + \frac{2\sqrt{c}}{h} \left(\log \frac{f+h}{f-h} \right) \quad (\text{A.2})$$

In order to show that the region of independence increases with h , it is sufficient to show that

$$\frac{\partial \left(\frac{1}{h} \log \frac{f+h}{f-h} \right)}{\partial h} > 0 \text{ with } 0 < h < f .$$

$$\frac{\partial \left(\frac{1}{h} \log \frac{f+h}{f-h} \right)}{\partial h} = \frac{1}{h^2} \left(\frac{2fh}{f^2 - h^2} - \log \frac{f+h}{f-h} \right) =: \frac{1}{h^2} H(h) \quad (\text{A.3})$$

It is easy to show that $H(h)$ is a continuous function for $0 < h < f$. Furthermore, $\lim_{h \rightarrow 0} H(h) = 0$

$$\text{and } \frac{\partial H(h)}{\partial h} = \frac{4h^2 f}{(h^2 - f^2)^2} > 0 \text{ and therefore } H(h) > 0 \text{ and } \frac{1}{h^2} H(h) > 0 .$$

Therefore, the expected region of independence becomes larger if h increases and, conversely, becomes smaller if h decreases (Proposition 1).

From (A.2) it is also easy to show that the expected region of independence becomes smaller if the cost of overriding (c) becomes lower.

B. The Expected Slope of the Central Bank's Reaction Function

The expected slope of the conservative central bank's reaction function is given by

$$\frac{1}{2h} \int_{-h}^h \frac{1}{2-x+f} dx = \frac{1}{2h} \log\left(\frac{2+h+f}{2-h+f}\right) \quad (\mathbf{B.1})$$

Along the same lines as the proof in appendix A, it is straightforward to show that this slope is increasing with h .

Lemma 1: Changes in the reaction function for supply shocks $v < y^* + \pi^e$ are weighted with more probability density than changes in the reaction function for supply shocks $v > y^* + \pi^e$.

Proof: It is important to note that the monetary reaction function of the conservative central bank, the government and the accommodating central bank have a point of symmetry in $v = y^* + \pi^e$. Therefore, changes in the position or the slope of the monetary reaction functions due to changes in h or c always have opposite effects on the realized rate of inflation on either side of this point of symmetry. However, the distribution of the random supply shocks v is symmetric around $v = 0$ and the probability density becomes smaller the larger the distance between the supply shock and point of symmetry $v = 0$. Because $y^* + \pi^e > 0$, the changes in the reaction function when $v < y^* + \pi^e$ will be weighted with more probability density than the (opposite) changes in the reaction function when $v > y^* + \pi^e$.

Lemma 2: The expected rate of inflation within the region of independence decreases if transparency of monetary policy increases.

Proof: As shown above, a lower h implies a flatter reaction function. So inflation decreases for $v < y^* + \pi^e$ and increases with the same amount for $v > y^* + \pi^e$. However, due to the probability density function of v , the expected rate of inflation in the region of independence decreases.

Lemma 3: The central bank's reaction to shocks that were within the expected region of independence before the decrease in h and in the expected region of accommodation after the change, will be weaker.

Proof: Monetary policy can be summarized as $\pi = \text{Max}\{\pi_{ACC}, \pi_{CB}\}$ if $v < y^* + \pi^e$ and $\pi = \text{Min}\{\pi_{ACC}, \pi_{CB}\}$ if $v > y^* + \pi^e$. If, due to a change in π_{CB} , the regime switches from independence to accommodation, then there must have been a decreasing inflation for $v < y^* + \pi^e$ and an increasing inflation for $v > y^* + \pi^e$.

When we apply the probability density function on Lemma 3 we are able to show that the expected rate of inflation for shocks that were within the expected region of independence before the decrease in h and in the expected region of accommodation after the change, will be lower. When we combine this with Lemma 2, then we can prove Proposition 2.

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