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ASYMMETRIC INFORMATION AND THE ROLE OF FED WATCHING

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The current institutional arrangement permits the Federal Reserve to delay releasing directives adopted at Federal Open Market Committee meetings. The directive instructs the trading desk how to conduct open market operations during the intermeeting period by indicating the desired "degree of pressure on reserve positions." Since the public is not privy to these instructions, deferring the announcement of the directive amounts to differentiating between the information sets of the monetary authority and the public. Policymakers have all the information the public has, plus some private information. Indeed, central bank secrecy is designed to maintain information asymmetry.

Kydland and Prescott (1977) and later Barro and Gordon (1983) described a non-cooperative game played by the monetary authority and the public. In this game, the monetary authority has an incentive to create surprise money growth. Barro and Gordon argued that such incentives lead to a sub-optimal equilibrium in the discretionary regime. In order to mitigate the central bank's incentive to create positive shocks to money growth, the public sets its expectations high so that the marginal benefit of a surprise money shock is less than or equal to the marginal costs of higher money growth. In equilibrium, therefore, the inflation rate is high and and surprise inflation is equal to zero. An inflation bias results because the monetary authority is not able to credibly "pre-commit" to a constant-growth rate policy. Instead, if expected money growth is constant, the policymaker's objective function is maximized when money growth is positve. Thus it is the absence of pre-commitment that leads to a Pareto inferior outcome.

Canzoneri (1985) argued that private information plays a very important role in this game. Taylor (1983) maintained that in games without private information, institutions would develop to resolve the pre-commitment problem. With private information, however, Canzoneri argued that the public was unable to discern between a policymaker reneging and a stochastic shock. Thus, observed policymaker behavior is a noisy signal of the monetary authority's "intention" to fight inflation.

In contrast to the benefits that private information bestows upon the monetary authority, individuals "lose" when actual money growth deviates from its forecasted value.1/ There is an incentive for the public to reduce its uncertainty about the monetary authority's preferences in order to minimize unanticipated money growth. Since private information plays a role in the monetary authority's ability to create surprise money growth, the public can (at least partially) offset this ability, and hence reduce uncertainty about the rate of money growth, by reducing informational asymmetries. The phenomenon of "Fed watching" is a practical application of this strategy. Individuals monitor Federal Reserve behavior seeking information to reduce uncertainty about money growth plans. Furthermore, Fed watching reduces the payoff to the monetary authority resulting from surprise money creation.

The purpose of this paper is to analyze the effect that augmenting people's information sets would have within the context of a macroeconomic policy game. The game between the monetary authority and agents is affected in two ways. First, agents acquire information strategically in order to restrain the monetary authority's incentive to create surprise money growth. Increased Fed watching, for example, lowers the monetary authority's welfare. Consequently, the likelihood increases that the monetary authority finds the payoff associated with committing to a constant-growth rule superior to that associated with discretionary policy actions.

Secondly, agents choose the "optimal" quantity of augmented information. Following Darby (1976) and Verrachia (1982), information acquisition is costly. Another strategic consideration in this game is how Federal Reserve secrecy affects the cost of acquiring information. Since Fed watching lowers policymaker's welfare, an effective counter-strategy may be additional secrecy, with the intention of lowering the optimal level of information acquisition. From the monetary authority's perspective, an increase in the "degree of secrecy" is justified if the marginal gain in the public's forecast error variance is greater than the marginal cost of such efforts.

The paper proceeds as follows. Section 2 describes a monetary policy game incorporating Fed-watching behavior. How monitoring can affect the policymaker's welfare under rules or discretion is discussed in Section 3. Section 4 introduces secrecy into the model as a decision variable for the central bank. Section 5 summarizes the results.

II. The Set-up of the Model

In formulating policy, the monetary authority is viewed as being subject to various political and economic forces. The impact of these forces is manifested as changes in policymaker "preferences." The term preferences refers to the weight policymakers place on stimulating economic activity versus controlling inflation. If the monetary authority did not value the benefits of unanticipated money growth, the policy game would be resolved.2/ The public is uncertain about the monetary authority's preferences. The presence of asymmetric information increases the incentive of the policymaker to avoid pre-commitment to a rate of monetary growth.

Before specifying the objective functions of the monetary authority and (a representative agent of) the public, we need to outline the structure of the policy game and make the sequence of events explicit. First, a policymaker preference shock occurs. The exact nature of this shock is the private information of the monetary authority. Next, the public forecasts this preference shock; the quality of this forecast depends on the level of resources devoted to "monitoring" the monetary authority.3/ Based on an information set "augmented" by Fed watching, the public then forms expectations of the preference shock and future money growth. Finally, the policymaker chooses the rate of money growth taking agent's expectations as given.

In the near-term, it is assumed that the policymaker chooses the rate of money growth based on two ultimate objectives: price stability and economic growth.4/ Money growth is positively related to money growth. The rate of growth of real economic activity is positively related to the unanticipated part of money growth. Consequently, the monetary authority's means of achieving changes in economic growth are through surprise inflation.

Formally, the policymaker's objective function is to

$$(1)\quad \max_{m_i} \sum_{i=0}^{\infty} \beta^{i} \{[m_i - E(m_i|I_i)]\phi_i - (m_i)^2/2\},\underline{5}/$$

where m_i denotes money growth in period i; $E(m_i|I_i)$ is the public's forecasts of m_i, given the information set, I_i; and β is the discount factor. The variable ϕ_i reflects the policymaker's preferences for stimulating economic activity relative to controlling inflation. As ϕ_i increases, the policymaker is willing to bear a higher rate of inflation in order to further stimulate economic activity. Because we assume that these preferences are not serially correlated, the monetary authority takes the public's current and future forecasts of money growth as given. Since future expectations are independent of the monetary authority's choice of current money growth, the monetary authority's maximization problem can be reduced to the one-period problem described by

$$(1a)\quad \max_{m_i} \ [m_i - E(m_i|I_i)]\phi_i - (m_i)^2/2.$$

Equations (1) and (1a) imply that non-zero money growth has a negative impact on the monetary authority's welfare, but that surprise money growth has a positive impact.

It is assumed that ϕ_i is random and is described by

$$(2)\quad \phi_i = A + v_i .$$

Policymaker preferences are on average A, and variable v_i is independently and identically distributed $N(0,\sigma_v^2)$.

Maximizing (1a) with respect to m_i yields

$$(3) \quad m_i = \phi_i = A + v_i .$$

According to equation (3), the selection of the rate of money growth depends directly upon the relative importance of stimulating economic activity versus creating additional inflation. Note that in the absence of any public information about v_i, the expected money growth rate is equal to A.

It is common in the macroeconomic policy game literature for the public to base their expectations on an information set that includes a conjecture of policymaker preferences. The approach taken in this paper, however, is to allow agents to augment their information sets by expending resources. The idea is that additional information returns less unanticipated money growth, and hence the public suffers lowers its losses to surprise inflation. Augmented information permits the public to get an estimate of what the policymaker's contemporaneous preference shock. Specifically, agents benefit from expending resources through lower variance of their money growth forecast errors. For the sake of simplicity, it is assumed that the public consists of a set of identical individuals. Consequently, the public's problem may be treated from the perspective of a representative agent.6/

Formally, the representative agent's behavior is characterized as

$$(4) \quad \max_{\sigma_e^2} \; -E\{(m_i - E[m_i | I_i(\sigma_e^2)])\}^2 - C(\sigma_e^2).$$

$I_i(\sigma_e^2)$ represents the information set from which agents form their expectations.7/ This information set consists of knowledge of the general motivation of the monetary authority (i.e., knowledge of the functional form of the monetary authority's maximization problem and that $m_i = \phi_i$), knowledge of the distribution of the monetary authority's preferences (i.e., $\phi_i = A + v_i$, $E(v_i) = 0$, $Var(v_i) = \sigma_v^2$), and an estimate of the contemporaneous policymaker preference shock, v_i^e. This estimate has the following properties:

$$E[v_i - v_i^e] = 0, \; E[(v_i - v_i^e)^2] = \sigma_e^2,$$

$$E[v_i^e(v_i - v_i^e)] = 0, \; E[(v_i(v_i - v_i^e)] = \sigma_e^2,$$ 8/ and

$$E[v_j(v_i - v_i^e)] = 0 \text{ for all } j \neq i.$$

The first two conditions indicate that the public's estimate of the preference shock is unbiased and has a variance σ_e^2. The public's forecast of the preference shock is assumed to be fixed and therefore does not covary with the forecast error. Alternatively, the preference shock does covary with the forecast error, with the covariance being equal to σ_e^2. Finally, the preference shock is not serially correlated with the forecast error.

The public can improve (in the sense of a lower forecast error variance) its estimate of the preference shock by expending resources on information acquisition. $C(\sigma_e^2)$ is the amount of resources expended to get a forecast of the policymaker's preference shock of quality σ_e^2. The properties of this "cost" function are: $C' < 0$, $C'' > 0$, $C(\sigma_v^2) = 0$, and $C(0) = \infty$. The more resources devoted to uncovering the monetary authority's preferences the better is the public's estimate of the preference shock, i.e., the lower σ_e^2. If no resources are expended then agents will have no information about the contemporaneous preference shock aside from knowledge of its distribution, i.e., $\sigma_e^2 = \sigma_v^2$. In the models where Fed-watching behavior is not considered, it is assumed that agents know the forecast error variance and it is fixed. Agents can improve their estimate of the preference shock, however, by increasing the amount of resources devoted to monitoring the monetary authority. In the limit, devoting an infinite quantity of resources to monitoring the policymaker would result in the information sets for monetary authority and the public being identical. Thus, as private information approaches zero, the limiting distribution of the forecast errors degenerates. Hence, forecast errors converge to zero with probability one.

Given an estimate of the policymaker's preference shock of quality σ_e^2, expected money growth is

$$(5) \quad E[m_i | I_i(\sigma_e^2)] = E[\phi_i | I_i(\sigma_e^2)] = A + v_i^e.$$

Substituting (3) and (5) into (4), the public's problem is to

$$(6) \quad \max_{\sigma_e^2} \; -E[(v_i - v_i^e)^2] - C(\sigma_e^2) \, ,$$

which is equivalent to

$$(6a) \quad \max_{\sigma_e^2} \; -\sigma_e^2 - C(\sigma_e^2).$$

The first order condition for an interior solution implies that the optimal degree of forecast accuracy, σ_e^{2*}, will satisfy

$$(7) \quad C'(\sigma_e^{2*}) = -1.$$

From equation (7) and the second order conditions, it is obvious that anything that increases the marginal cost of monitoring the monetary authority (i.e., shifts the C'( ) schedule downward) causes the public to acquire forecasts that are less accurate (σ_e^2 higher).

What effect does the public's ability to forecast policymaker preference shock have on the policymaker's welfare level? From equations (1a), (3) and (5), the monetary authority's welfare level is represented as

$$(8)\quad E[(A + v_i - A - v_i^e)(A + v_i) - (A + v_i)^2/2] = \sigma_e^2 - \sigma_v^2/2 - A^2/2.$$

Equation (8) represents the payoff to the monetary authority under different values of the forecast error variance. Accordingly, equation (8) indicates that the payoff to the monetary authority is directly related to the forecast error variance so that an increase in Fed watching lowers policymaker welfare. Obviously, the monetary authority would prefer agents to have less information about its preferences, since a higher σ_e^2 increases the monetary authority's welfare. If the public has a clearer picture of the objectives of the monetary authority, then it is less likely that the monetary authority will choose to generate surprise money growth as an optimal policy.

III. Rules vs. Discretion Revisited

How does incorporating the public's information-seeking behavior affect the policymaker's choice between rules and discretion? Following Barro and Gordon (1983), the issue concerns whether the policymaker attains a higher payoff with "binding commitments" (i.e., rules) or with discretionary policy.

To compare payoffs under the alternative institutions, we will consider two extreme cases of informational asymmetry. First, suppose that agents have perfect information about the preferences of the monetary authority. (This is the case analyzed in Barro and Gordon.) Perfect information is equivalent to private information being absent, hence, $\sigma_e^2 = 0$. From equation (8), the policymaker's welfare with discretionary monetary policy is $-\sigma_v^2 - A^2/2$. If, however, policymakers would follow a money growth rule, i.e., $m_i = 0$, then the welfare level is zero. Thus, consistent with the Barro and Gordon findings, when private information is absent the monetary authority prefers pre-commitment to a rule to discretion.

Secondly, consider a corner solution where the marginal costs of Fed watching are so high that monitoring activity is zero. Without further insight into the contemporaneous preference shock, agents are assumed to know that these shocks are distributed mean zero, variance σ_v^2. This essentially is the assumption invoked by Cukierman and Meltzer. Setting $\sigma_e^2 = \sigma_v^2$ in equation (8) yields a payoff equal to $\sigma_v^2/2 - A^2/2$. Provided the variance of preference shocks is larger than A^2, policymakers will prefer discretion to a zero-growth rule. Thus, with asymmetric information, the more variable are the monetary authority's preferences, the more likely is it that discretion will be the desired policy practice.

An analysis of the two extreme cases highlights the role that private information plays in determining whether commitment to a rule or discretion is the superior outcome from the monetary authority's perspective. Allowing the public to augment their information sets by monitoring Federal Reserve behavior directly affects the forecast error variance of the preference shock, and hence the Federal Reserve's payoff. Indeed, the analysis suggests that between the two extreme cases characterized by full and zero information, there exists an intermediate case where the policymaker is indifferent between committing to a rule and practicing discretion. If the public's monitoring yields a forecast error variance above this "critical" value (i.e., where the payoff to discretion is positive), then the monetary authority's welfare level is higher under discretion. Conversely, if the forecast error variance is below the critical value, policymakers achieve higher welfare level by pre-committing to a zero-growth rule policy. Thus, the degree to which monitoring of the policymaker is possible plays an significant role in the rules vs. discretion debate.

How does Fed-watching behavior relate to the points made by Taylor and Canzoneri concerning the pre-commitment problem? Canzoneri noted that private information makes resolution of the pre-commitment problem more difficult. There are primarily for two reasons why these difficulties arise. First, agents would not be able to infer the "source" of the shock. That is, deviations from expected money growth could reflect either central bank behavior or some stochastic event. Secondly, the monetary authority does not wish to be bound by a rule since discretion yields a higher payoff. In contrast, without private information the monetary authoroity obtains its highest payoff under a rule policy. Based on the payoffs with and without asymmetric information, the policymaker would likely facilitate the development of institutions to resolve the pre-commitment problem in a world where private information is absent. The policymaker, however, is more likely to deter the development of such institutions when asymmetric information exists.

One implication of this analysis is that the existence of asymmetric information is central to the policymaker's attitude concerning the resolution of the pre-commitment problem. The policymaker would not wish to pre-commit when private information is present because higher payoffs can be achieved under discretion. In this paper, however, the existence of private information is not a sufficient condition for discretion policy to be the dominant policy. Rather, it is the degree to which private information exists, represented by σ_e^2, which is important. Suppose σ_e^2 is positive and the payoff calculated using equation (8) is negative. The central bank could obtain a higher payoff, equal to zero, by pre-committing to a zero-growth rule. The dominance of the rule policy occurs despite a non-zero forecast error variance. Moreover, the central bank would prefer to pre-commit to attain the maximum payoff. Thus, public pressure on the monetary authority in the form of Fed watching may effectively resolve the pre-commitment problem.

IV. Secrecy as a Federal Reserve Strategy

Secrecy is crucial to maintaining informational asymmetry between the monetary authority and the public. As Goodfriend (1986) points out, "Release of the Directive would reduce the cost of acquiring information about FOMC policy." (pg. 79). Without secrecy, people could costlessly obtain information about Federal Reserve preferences. Conversely, efforts to obstruct the public's monitoring behavior, i.e., more secrecy, would raise the cost of acquiring information about the monetary authority's preferences. Indeed, the policymaker would have an incentive to become more secretive so that the costs of Fed watching are increased and the central bank's private information is maintained.

In the macroeconomic policy game literature, secrecy serves a very important purpose: agents cannot infer the policymakers "true" preferences because of the presence of asymmetric information.9/ Backus and Driffill (1985) and Barro (1986) show that secrecy permits the monetary authority to send "false" signals to agents about the policymaker's preferences toward fighting inflation versus stimulating economic activity.

In Cukierman and Meltzer (1986), the monetary authority is allowed to pre-commit to a degree of secrecy by selecting a technology which adds a random component to planned money growth. Only actual money growth is observed by individuals. Consequently, it is impossible to detect whether unanticipated money growth was the result of a preference shock or a control shock. The random control errors make secrecy possible because control shocks veil policymaker's preferences. Without these control errors, the public would be able to infer policymaker preferences through observed money growth rates.

In all three papers, the information sets available to the public are largely records of past observed policymaker behavior. Consequently, secrecy affects the value of this information through noisy historical data. Secrecy can affect the costs of acquiring information in the current period as well as affect the information content of past money growth observations.

To formally analyze the optimal degree of secrecy, the model specified in Section II is modified to include the effect of secrecy on the household's choice of information. The central bank is treated as the "dominant" player in this game, while agents act as followers and adjust their decisions according to the level of secrecy determined by the monetary authority.10/ The monetary authority decides on how much effort to devote to secrecy after the policymaker's preference shock occurs and before the public forecasts the preference shock.

3.1 The Agent's Problem

Formally, the public's objective function is characterized as:

$$(9)\quad \max_{\sigma_e^2} \; -\sigma_e^2 - C(\sigma_e^2, S)$$

where S denotes the policymaker's efforts to maintain secrecy. The properties of the cost function are: $C_1 < 0$, $C_{11} > 0$, $C_2 > 0$ and $C_1(\sigma_e^2, 0) = 0$. Equation (9) is also subject to the constraint that $\sigma_e^2 < \sigma_v^2$. Consequently, the Kuhn-Tucker conditions for the public's maximization problem are given by

$$(10a)\qquad -1 - C_1 - \lambda_1 \leq 0$$

$$(b)\qquad \sigma_e^2 [-1 - C_1 - \lambda_1] = 0$$

$$(c)\qquad (\sigma_v^2 - \sigma_e^2) \geq 0$$

$$(d)\qquad \lambda_1(\sigma_v^2 - \sigma_e^2) = 0.$$

where λ_1 is the Lagrangian multiplier. According to equations (10a-d), an interior maximum will exist (i.e., $\sigma_v^2 \geq \sigma_e^2$) provided the marginal cost of acquiring information is greater than -1 for given values of S. In other words, a sufficient condition for an interior maximum is that the marginal benefit exceed the marginal cost of the level of secrecy set by the monetary authority. If secrecy is absent, then the marginal cost of acquiring information is zero and the public would become perfectly informed about policymaker preferences.

What is the effect of changes in secrecy on the public's optimal forecast error variance? To answer this question, assume that the public's optimization problem has an interior solution and totally differentiate the equality in equation (10a). By doing so, we obtain

$$(11) \quad d\sigma_e^2 \,/\, dS \;=\; - C_{12} \,/\, C_{11}.$$

With $C_{11} > 0$, the direction of change in the forecast error variance induced by a change in secrecy depends on the sign of C_{12}. If the marginal cost of acquiring information increases as secrecy increases, hence C_{12} is negative. With $C_{12} < 0$, the sign of $d\sigma_e^2 / dS$ is positive. Thus, increased efforts devoted to secrecy will induce a higher optimal forecast error variance.

3.2 The Monetary Authority's Problem

The policymaker's problem takes into account the effect of changes in secrecy on the optimal forecast error variance. Since the decision regarding secrecy is taken after the preference shock occurs, the policymaker chooses the optimal effort so as to maximize the following

$$(12) \quad \max_{S} \quad \sigma_e^2(S) \; - \; \sigma_v^2/2 \; - \; A^2/2 \; - K(S).$$

The function K() represents the costs associated with increasing secrecy efforts and is strictly convex. It is also assumed $K(0) = 0$ and $K(\infty) = \infty$. The maximization problem is subject to the constraints that $\sigma_v^2 \geq \sigma_e^2(S)$ and $S \geq 0$.

In the agent's maximization problem, we found that the forecast error variance is positively related to secrecy. It is also assumed that the marginal increase in forecast error variance from an incremental increase in secrecy decreases, so that $\sigma_e^{2\prime\prime}(S)$ is negative.

The Kuhn-Tucker conditions for the policymaker's objective function are represented by:

$$\text{(13a)} \qquad \sigma_e^{2\prime}(S)(1 - \gamma_1) - K'(S) + \gamma_2 \leq 0,$$

$$\text{(b)} \qquad [\sigma_e^{2\prime}(S)(1 - \gamma_1) - K'(S) + \gamma_2]S = 0$$

$$\text{(c)} \qquad \gamma_1[(\sigma_v^2 - \sigma_e^2(S))] = 0$$

$$\text{(d)} \qquad \gamma_2 S = 0$$

$$\text{(e)} \qquad S \geq 0$$

$$\text{(f)} \qquad (\sigma_v^2 - \sigma_e^2(S)) \geq 0,$$

where $\gamma_i > 0$, i=1,2 denote the Lagrangian multipliers. The Kuhn-Tucker conditions incorporate three possible solutions, with two of these being corner solutions.11/ The meaning of each solution will be considered separately. $\sigma_e^{2\prime}(\ )$ is the marginal benefit of secrecy and represents the marginal increase in the public's forecast error variance due to secrecy. $K'(\ )$ is the marginal cost.

The first case is the corner solution with S = 0. With S = 0, the optimal degree of secrecy is zero. This case is depicted in Figure 1 with MC_1 as the relevant marginal cost curve. Since the marginal cost of effort devoted to additional secrecy exceeds the marginal benefit at every value of S, private information is effectively foregone. Agents can costlessly obtain information about the monetary authority's preference shock, and the distribution forecast errors degenerates. Without private information, the central bank could be better off if it could pre-commit to a zero-growth rule.

The second case examines the corner solution characterized by agents not seeking any information. The maximum forecast error variance is the population distribution, σ_v^2. The marginal benefit curve, denoted MB in Figure 1, indicates that the marginal benefit of secrecy falls to zero for levels greater than S_0. As the figure shows, the marginal cost curve, denoted MC_2, is not "equal" to marginal benefit at any level of secrecy. The implication is that the policymaker will choose S_0 as the optimal level of secrecy, which is sufficient to insure that agents will not seek information about the contemporaneous preference shock.

In the third case, the marginal benefit and marginal costs of secrecy are equal meaning that there is an interior solution for both the forecast error variance and secrecy. Graphically, the optimal level of secrecy, denoted S^*, occurs where the MB curve intersects MC_3. At this point, the public will invest in information gathering (Fed watching) while at the same time the central bank will opt for some level of secrecy.

The costs and benefits of secrecy ultimately determine whether pre-commitment is desirable to the monetary authority. If the optimal level of secrecy succeeds in creating a sufficient information asymmetry (i.e., σ_e^2 high enough), then the monetary authority might be better off in a discretionary regime than in a "rules" regime.12/ Thus, the technology of secrecy and information acquisition may play a decisive role in determining the type of monetary institutions (whether rules or discretion) that arise.

IV. Summary

The primary incentive for agents to monitor Federal Reserve behavior is the presence of asymmetric information. This note considers the effects on a macroeconomic policy game of accounting for Fed watching. Agents choose the optimal level of forecast error variance based on the cost of monitoring the monetary authority's behavior. Since agent's information acquisition affects policymaker welfare, the Nash equilibrium will determine whether people's information "strategy" results in the monetary authority finding discretion or, alternatively, a rule to be optimal. In other words, the model suggests that the public's monitoring Federal Reserve behavior may play a role in resolving the pre-commitment problem.

The other aspect which information acquisition addresses is the presence of Federal Reserve secrecy. An effective counter-strategy for the Federal Reserve is to raise the marginal cost of acquiring information. To offset the public's incentive, the policymaker may become more secretive. The degree of secrecy may ultimately determine whether pre-commitment is desirable.

APPENDIX

Analysis of the Kuhn-Tucker conditions.

Case I. $S = 0$.

If $S = 0$, then $\sigma_v^2 > \sigma_e^2$. Therefore, from equation (13c), $\gamma_1 = 0$. Since $\gamma_2 \geq 0$, this implies that $\sigma_e^2{}'(S) - K'(S) \leq 0$. Therefore, the marginal costs of secrecy are greater than or equal to the marginal benefits when secrecy is absent.

Case II. $\sigma_v^2 = \sigma_e^2$.

If $\sigma_v^2 = \sigma_e^2$, then $S > 0$. Therefore, from equation (13d), $\gamma_2 = 0$. Also, $[\sigma_e^2{}'(S)(1 - \gamma_1) - K'(S) + \gamma_2] = 0$ from equation (13b). Since $\gamma_1 \geq 0$, this implies that $\sigma_e^2{}'(S) > K'(S)$.

Case III. $S > 0$ and $\sigma_v^2 > \sigma_e^2$.

From equations (13c) and (13d), $\gamma_1 = \gamma_2 = 0$. Therefore, from (13b) $\sigma_e^2{}'(S) = K'(S)$. Therefore, the marginal benefit of secrecy equals the marginal cost.

FOOTNOTES

1. The potential losses due to surprise money creation are often characterized in the literature as stemming from labor contracting models such as Gray (1976) and Taylor (1980). In effect, agents contract labor services with firms for an expected real wage rate. With money growth positively related to the rate of inflation, unanticipated money shocks mean deviations from the expected real wage. It is assumed that firms are on the marginal product of labor schedule so that workers supply more labor at a lower real wage rate. Workers, therefore, are off their notional supply curve and, hence are worse off due to the surprise money growth. Consequently, the gains from surprise inflation to the policymaker are (at least partially) offset by the public's losses.

2. The point of optimal money growth is moot unless the monetary authority values unanticipated inflation. The policymaker would choose the path of money growth which achieves the price stability goal.

3. Here the term quality refers to the variance of the current period forecast error.

4. Actually, these objectives are spelled out in the Full Employment and Balanced Growth Act of 1978 (also known as the Humphrey-Hawkins Act). In testimony to the House Subcommitte on Domestic Monetary Policy in March 1988, Keran identified these two goals as being foremost in policymakers' objective function.

5. The model is essentially that used in Cukierman and Meltzer (1985,1986). The main difference is that Cukierman and Meltzer focused on a problem with serially correlated preference shocks. In our analysis, it is assumed that preference shocks are not serially correlated.

6. This assumption maintains the information asymmetry between the monetary authority and the public, not between individuals. The quadratic form in equation (5) reflects an assumption that the cost of forecast errors increases at a an increasing rate. Moreover, the information set upon which conditional expectations of money growth also include those elements which are "free."

7. The underlying assumption is that the variance of the forecast error is a monotonically decreasing function with respect to the agent's resource expenditure. Or, $\sigma_e^2 = f(R)$, with $f' < 0$, where R is the agent's resource expenditure. Clearly, R is the true choice variable. In order to minimize notation, we have chosen to substitute σ_e^2 as the choice variable in the agents objective function, i.e., $R = f^{-1}(\sigma_e^2) = C(\sigma_e^2)$.

8. Perhaps some justification for the assumption that $E[v_i(v_i - v_i^e)] = \sigma_e^2$ is necessary. First, note that $v_i = v_i^e + e_i$, where e_i is the public's prediction error of the policymaker's preference shock. Substituting for v_i in the expression above yields $E[(v_i^e + e_i)e_i]$. It is assumed that v_i^e, the public's forecast of the prediction shock, is orthogonal to the forecast error. Therefore, since e_i is distributed $N(0,\sigma_e^2)$, $E[v_i(v_i - v_i^e)] = \sigma_e^2$.

9. Studies by Dotsey (1987), and Tabellini (1987) also investigate the effects of secrecy. Dotsey and Tabellini do not explicitly model the secrecy decision. Moreover, the emphasis in these two papers is the effects of secrecy on observed financial market behavior.

10. The framework used to analyze the optimal degree of secrecy is basically a Stackleberg game. Since individuals do not form coalitions in the model, it seems reasonable to treat the Federal Reserve as a "leader."

11. Note that the forecast error variance, σ_e^2, is an increasing function of secrecy. Therefore, the inequality constraints effectively place an upper and lower bound on the values of S. Unfortunately, it is impossible to tell which constraint, if any, is binding at the equilibrium. Moreover, it is impossible for both boundary conditions to be simultaneously satisfied. Consequently, three possible conditions exist. An interior solution marked by $\sigma_e^{2\prime}(\ ) = K'(\ )$. It is also possible for the objective to be negatively sloped for all non-negative values of S so that the optimal value occurs when S = 0. Alternatively, the value of the objective function may be positively sloped over the relevant range of S. In this case, the optimal S occurs when $\sigma_e^2 = \sigma_v^2$.

12. Whether society is better off will depend on the resources lost in the public's acquisition of information.

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Figure 1:
Alternative Scenarios for the Optimal Degree of Secrecy