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Better Monetary Control May Increase the Inflationary Bias of Policy

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I. Introduction

The model of monetary policy as developed by Barro and Gordon (1983) has acquired a stable position in the economic literature. One of the appealing properties of the model is that it enables us to examine the importance of credibility problems in economic policy. The monetary policy model revolves around an expectations augmented Phillips curve, according to which output varies with the difference between actual and expected money growth. The economy is ruled by a policymaker whose objectives are zero inflation and a high growth rate of output. The results derived from this model are well known. The policymaker has an incentive to create inflation surprises in order to increase output above its natural level, but since private agents anticipate the policymaker's temptation to surprise, the resultant inflation leaves output unaffected.

In this paper, the Barro–Gordon model is used to explore the implications of imperfect monetary control and uncertainty about the trade-off between output and inflation for discretionary policy. Imperfect monetary control may lead to deviations of planned money growth from actual money growth. It is the result of uncertainty about the policy effects on the intermediate target. Uncertainty about the trade-off between output and inflation also implies uncertainty about policy effects on targets. Thus, more generally, this paper deals with uncertainty about policy effects. The main results of the analysis are:

(i) Imperfect control of money growth may reduce the policymaker's incentive to create surprises and may increase welfare. As a consequence, the policymaker should not necessarily adopt the most efficient operating procedure available. In contrast to Cukierman and Meltzer (1986), this result does not hinge on an information advantage of the policymaker about his preferences.

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(ii) Uncertainty about the trade-off between output and inflation does not affect discretionary equilibrium policy. This finding conflicts with Brainard (1967), who showed that uncertainty in the parameters of the model leads to a conservative use of instruments.

This paper is organized as follows. The Barro–Gordon model is discussed briefly in Section II. The consequences of imperfect control of money growth for optimal monetary policy are examined in Section III. Next, in Section IV, the effects of this type of uncertainty on welfare are analysed. Section V deals with the welfare effects of uncertainty about the extent to which inflation surprises affect output. Section VI concludes.

II. A Simple Model

We begin by briefly discussing a simple model of monetary policy as developed by Barro and Gordon (1983). The economy is described by two equations:

$$y = m - p \tag{1}$$

$$y = \beta \cdot (p - p^e) \qquad \beta > 0 \tag{2}$$

where y, m, p and p^e are the growth rate of output, the growth rate of money, the inflation rate and the expected inflation rate, respectively. Equation (1) gives aggregate demand and (2) describes aggregate supply as a function of the difference between actual and expected inflation. From (1) and (2) we can write y and p as functions of money growth and expected money growth, m^e:

$$y = \zeta \cdot (m - m^e) \qquad \text{with} \qquad \zeta = \beta/(1+\beta) \tag{3}$$

$$p = m - \zeta \cdot (m - m^e). \tag{4}$$

The Barro–Gordon model describes economic policy as a game in which the policymaker chooses m^e and the public chooses m^e. The policymaker likes output growth and dislikes inflation. His preferences are represented by a quadratic loss function:

$$\begin{aligned} \mathscr{L} &= p^2 + \omega(y - x)^2 \qquad \chi > 0 \quad \text{and} \quad \omega > 0 \\ &= [m - \zeta(m - m^e)]^2 + \omega \cdot [\zeta \cdot (m - m^e) - \chi]^2 \end{aligned} \tag{5}$$

where χ is the target growth rate of output which exceeds the natural rate and ω is the relative weight attributed to deviations of the growth rate of output from its target rate.

The above model has served as a starting point for numerous studies on economic policy, among which an excellent survey is provided by Persson and Tabellini (1990). A well-known result from this literature is that the discretionary equilibrium, to which the usual Nash conditions apply, is characterized by inflation, but this inflation leaves output unaffected. In the above model, the discretionary equilibrium implies:

$$m = \frac{\omega \cdot \zeta \cdot \chi}{1 - \zeta} \quad \text{and } y = 0. \tag{6}$$

This literature furthermore reveals that in general, the policymaker is better off if he is able to commit himself to a policy rule. In the above non-stochastic model, the optimal policy rule is $m = 0$.

III. Imperfect Control of Money Growth

In the basic monetary model, it is assumed that the policymaker sets money growth directly. In this section we relax this assumption, but assume instead that the effects of policy on money growth are surrounded by uncertainty. As a consequence, actual money growth may differ from planned money growth, m^P. The policymaker faces two types of uncertainties:

$$\begin{aligned} m = \tau_1 \cdot m^P + \tau_2 \quad &\text{with } E(\tau_1) = 1,\ E(\tau_2) = 0, \quad E = \text{expectations operator} \\ &\operatorname{var}(\tau_1) = \sigma_{\tau 1}^2, \quad \operatorname{var}(\tau_2) = \sigma_{\tau 2}^2, \quad \operatorname{covar}(\tau_1, \tau_2) = 0, \end{aligned} \tag{7}$$

where $\sigma_{\tau 1}^2$ is related to multiplicative uncertainty and $\sigma_{\tau 2}^2$ is related to additive uncertainty. In the case of multiplicative uncertainty, the control of money growth is lower, the more m^P deviates from zero. In contrast, additive uncertainty is not related to m^P. In most stochastic models $\sigma_{\tau 1}^2$ and $\sigma_{\tau 2}^2$ are taken as exogenous parameters. In this study, however, $\sigma_{\tau 1}^2$ and $\sigma_{\tau 2}^2$ may reflect the properties of the operating procedure adopted by the policymaker; cf. Cukierman and Meltzer (1986).

Let us now return to the model. The policy problem becomes to choose m^P, so as to minimize the *expected* loss. To solve this problem, we insert (7) into (5) and differentiate with respect to m^P, yielding:

$$\begin{aligned} &E\{(1-\zeta)\cdot \tau_1 \cdot [(1-\zeta)\cdot(\tau_1 \cdot m^P + \tau_2) + \zeta \cdot m^e] \\ &\quad + \omega \cdot \zeta \cdot \tau_1 \cdot [\zeta \cdot (\tau_1 \cdot m^P + \tau_2 - m^e) - \chi]\} = 0 \end{aligned} \tag{8}$$

so that

$$m^P = \frac{[\omega \cdot \zeta^2 - (1-\zeta)\cdot \zeta]\cdot m^e + \omega \cdot \zeta \chi}{[(1-\zeta)^2 + \omega \cdot \zeta^2]\cdot E\{\tau_1^2\}}. \tag{9}$$

Equilibrium implies that $m^e \equiv E(m) = m^P$, thus:

$$m^{P} = \frac{\omega \cdot \zeta \cdot \chi}{1 - \zeta + [(1-\zeta)^2 + \omega \cdot \zeta^2] \cdot \sigma_{\tau 1}^2} \tag{10}$$

where we have used that $E(\tau_1^2) = \sigma_{\tau 1}^2 + 1$. Equation (10) shows that an increase in multiplicative uncertainty, implying a rise in $\sigma_{\tau 1}^2$, reduces m^P. Additive uncertainty does not affect policy.

In the absence of multiplicative uncertainty ($\sigma_{\tau 1}^2 = 0$), planned money growth corresponds to the discretionary outcomes discussed in the preceding section. In the extreme case of infinite uncertainty ($\sigma_{\tau 1}^2 \to \infty$), the policymaker abstains completely from intervention. These results are in line with the stochastic optimisation literature which shows that uncertainty about policy effects leads to a conservative use of instrument variables; cf. Brainard (1967) and Ghosh and Masson (1991).

IV. Welfare Effects of Imperfect Control of Money Growth

Suppose that the policymaker asks an established economist to do research on the controllability of money growth to reduce uncertainty about policy effects on money growth. After tedious work the economist completes a paper, in which two operating procedures are developed, one leading to a reduction in $\sigma_{\tau 1}^2$ and one leading to a reduction in $\sigma_{\tau 2}^2$. The question then arises: how do these operating procedures affect welfare?

To answer this question, we examine the effects of a change in $\sigma_{\tau 1}^2$ and $\sigma_{\tau 2}^2$ on the expected loss. To this end, insert equilibrium money growth, through (7), into the loss function, taking m^P as a function of $\sigma_{\tau 1}^2$ ($m^P = m^P(\sigma_{\tau 1}^2)$ and $m^e = m^P$), so that the loss function is written as a function of $\sigma_{\tau 1}^2$ and $\sigma_{\tau 2}^2$.

$$\begin{aligned} \mathscr{L}(\sigma_{\tau 1}^2, \sigma_{\tau 2}^2) &= E\{\{[\tau_1(1-\zeta) + \zeta] \cdot m^P(\sigma_{\tau 1}^2) + (1-\zeta) \cdot \tau_2\}^2 + \\ &\quad \omega \cdot \{\zeta \cdot (\tau_1 - 1) \cdot m^P(\sigma_{\tau 1}^2) + \zeta \cdot \tau_2 - \chi\}^2\} \\ &= [1 + \sigma_{\tau 1}^2 \cdot Q] \cdot [m^P(\sigma_{\tau 1}^2)]^2 + Q \cdot (1 + \sigma_{\tau 2}^2) + \omega \cdot X^2 \end{aligned} \tag{11}$$

where $Q = 1 - 2 \cdot \zeta + (1+\omega) \cdot \zeta^2 > 0$ (since $0 < \zeta < 1$ and $\omega > 0$). From (11) it is easy to see that $\partial \mathscr{L} / \partial \sigma_{\tau 2}^2 > 0$. Thus an increase in additive uncertainty reduces welfare.

Let us now consider the effect of an increase in $\sigma_{\tau 1}^2$ on the expected loss. Differentiating $\mathscr{L}$ with respect to $\sigma_{\tau 1}^2$, using (see equation 10)

$$\frac{\partial m^P(\sigma_{\tau 1}^2)}{\partial \sigma_{\tau 1}^2} = \frac{-Q}{1 - \zeta + Q \cdot \sigma_{\tau 1}^2} \cdot m^P$$

gives:

$$\frac{\partial \mathscr{L}}{\partial \sigma_{\tau 1}^2} = Q\cdot[m^{\mathrm{P}}(\sigma_{\tau 1}^2)]^2 - \frac{2\cdot[1+\sigma_{\tau 1}^2\cdot Q]\cdot Q}{1-\zeta+Q\cdot\sigma_{\tau 1}^2}\cdot[m^{\mathrm{P}}(\sigma_{\tau 1}^2)]^2$$

$$= -Q\cdot[m^{\mathrm{P}}(\sigma_{\tau 1}^2)]^2\frac{[1+\sigma_{\tau 1}^2\cdot Q+\zeta]}{1-\zeta+Q\cdot\sigma_{\tau 1}^2}<0. \tag{12}$$

Equation (12) shows that an increase in $\sigma_{\tau 1}^2$, thus an increase in multiplicative uncertainty, decreases the expected loss. What is the intuition behind this — at first glance — peculiar result? Equation (10) shows that uncertainty about policy effects on money growth reduces the policymaker's temptation to surprise. Due to this, multiplicative uncertainty pushes discretionary equilibrium policy in the direction of commitment policy.

The above suggests that the policymaker should not necessarily adopt the most efficient operating procedure. A similar result has been derived by Cukierman and Meltzer (1986), who showed that when private agents do not know the policymaker's preferences with certainty, an increase in additive uncertainty may increase welfare. Cukierman (1992, Ch. 13) examines the effects of uncertainty about real money demand on activism in a model where the policymaker has an information advantage about his objectives. In this model, higher (additive) uncertainty may also lead to smaller activism, because it reduces the policymaker's forecasting ability. In contrast to the above case of multiplicative uncertainty, Cukierman's result hinges on the existence of an information advantage of the policymaker. Our analysis shows that under symmetric information, the most efficient operating procedure may also be sub-optimal.

V. Uncertainty about the Slope of the Phillips Curve

We now examine equilibrium policy when the policymaker is uncertain about the value of ζ in (3) and (4). Thus the policymaker faces uncertainty about the slope of the Phillips curve. The policymaker is assumed to know the expected value of ζ, ζ^{e}, and the variance of ζ, σ_ζ^2. Suppose that in order to obtain an accurate notion of the value of ζ, the policymaker consults an econometrician, whose task it is to reduce the uncertainty about the value of ζ. Again we try to determine the implications of a decrease in uncertainty, σ_ζ^2, for equilibrium discretionary policy.[1]

As in Section II, the policymaker minimises the expected loss with respect to m, but now under uncertainty about ζ. Solving the optimization problem, for given m^{e}, leads to:

$$E\{(1-\zeta)[(1-\zeta)\cdot m+\zeta\cdot m^{\mathrm{e}}]+\omega\cdot\zeta\cdot[\zeta\cdot(m-m^{\mathrm{e}})-\chi]\}=0 \tag{13}$$

[1] For simplicity, we again assume that the policymaker perfectly controls money growth.

implying:

$$m = \frac{\{(1+\omega)\cdot[\zeta^{e2} + \sigma_\zeta^2] - \zeta^e\}\cdot m^e + \omega\cdot\zeta^e\cdot\chi}{(1+\omega)\cdot[\zeta^{e2}+\sigma_\zeta^2] + 1 - 2\cdot\zeta^e} \tag{14}$$

In equilibrium $m^e \equiv E(m) = m$ holds, so that

$$m = \frac{\omega\cdot\zeta^e\cdot\chi}{1-\zeta^e} \tag{15}$$

which is equal to equilibrium policy without uncertainty; see equation (10). Hence uncertainty in the parameter ζ leaves policy unaffected.[2] Similar to Brainard's result, uncertainty in ζ induces the policymaker to implement a conservative policy. In our model this implies that the policymaker is less inclined to deviate from m^e. Thus for any m^e lower than the equilibrium rate of money growth, the policymaker chooses a lower m than he would have chosen without uncertainty. On the other hand, for any m^e higher than the equilibrium money growth, the policymaker chooses a relatively high m. Thus uncertainty causes the reaction function of the policymaker to revolve at the point $m = m^e$. Hence uncertainty does not affect the point where the reaction function of the policymaker and the $m = m^e$ line intersect.[3]

VI. Concluding Remarks

A standard monetary policy model has been extended by introducing two types of uncertainty: uncertainty about policy effects on money growth and uncertainty about the impact of policy surprises on employment. These extensions of the model lead to some peculiar results. First, in a stochastic framework, it appears that an increase in multiplicative uncertainty about policy effects on money growth reduces the policymaker's incentive to create inflation surprises and increases welfare. On the other hand, additive uncertainty decreases welfare. Second, uncertainty about the slope of the Phillips curve leaves equilibrium discretionary policy and welfare unaffected. Within the model, these results are hardly surprising, since uncertainty reduces the policymaker's temptation to create (ineffective) inflation surprises. On the other hand, the results run counter to common sense. Gaining information about how the economy works is usually thought to increase social welfare.

[2] By substituting (15) into (5) and taking $m = m^e$ we find $\mathscr{L} = [\omega\cdot\zeta^e\cdot\chi/(1-\zeta^e)]^2 + \omega\cdot\chi^2$. Hence, σ_ζ^2 does not affect welfare.

[3] Equation (6) reveals that this result is simply caused by the structure of the model. Since in equilibrium, $m = m^e$ holds, ζ does not affect the welfare loss.

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