

Monetary Uncertainty, the Appropriate Choice of Central Banker and Social Welfare

Phillip Lawler¹

ABSTRACT

A number of papers have identified the possibility that less precise monetary control or, alternatively, increased uncertainty with regards to the effects of monetary policy on the economy may enhance social welfare. The present paper introduces monetary uncertainty into a model of monetary policy delegation. It is shown that an increase in uncertainty has an ambiguous effect on the appropriate degree of conservatism of an optimally chosen central banker, but produces an unambiguous fall in welfare.

1. INTRODUCTION

A NUMBER OF PAPERS have identified the possibility that a reduction in the precision of monetary control or, alternatively, an increase in the degree of uncertainty surrounding the effects of monetary policy on the economy may improve welfare. The explanation for this counterintuitive result lies in terms of the inflation bias which results from discretionary policymaking when the natural level of output is sub-optimally low (Kydland and Prescott, 1977; Barro and Gordon, 1983). Specifically, greater monetary uncertainty may, by changing the incentives facing the monetary authorities to create inflation surprises, reduce the inflation rate which prevails in equilibrium.

In Devereux (1987, 1989) and Fukuda (1993)² wages are partially indexed to movements of the price level. Greater monetary variability then induces an increase in the value of the endogenously determined indexation parameter, as in Gray (1976). A higher degree of wage indexation increases the inflationary cost to the monetary authorities of achieving a temporary output gain and, therefore, reduces their temptation to attempt to generate surprise inflation. Although the benefits of the consequent reduction in the mean equilibrium inflation rate have to be weighed against an increase in the variability of output and inflation as a consequence of supply shocks, a net improvement in welfare occurs over certain ranges of parameter values.

Swank (1994), Letterie (1997) and Pearce and Sobue (1997) arrive at similar conclusions. However, in these papers the potentially beneficial effect of greater monetary variability operates through a different mechanism. Monetary uncertainty is incorporated into the instrument-target relationship as a multiplicative term, reflecting the assumption that higher monetary growth leads to less perfect control of the money supply (Swank, 1994; Letterie, 1997) or, alternatively, renders the impact of monetary policy less predictable (Pearce and Sobue, 1997). An increase in uncertainty, as represented in this way, then makes the policymaker less inclined to use monetary policy actively (Brainard, 1967) and thus acts to reduce the inflation bias. Although in the presence of a stabilization role for monetary policy there is, as in Devereux (1987, 1989) and Fukuda (1993), an increase in the variability of output and inflation, greater monetary uncertainty may, nonetheless, be beneficial.

Each of the aforementioned papers assumes, implicitly or explicitly, that the objective function of the policymaker coincides with the social loss function. In the present paper we extend the analysis to embed monetary policy uncertainty within a model of monetary policy delegation. Specifically, we assume, as in Rogoff (1985), that monetary policy decisions are made by a central bank with potentially different preferences to those of society. Although in the presence of supply shocks an optimally designed inflation contract, as identified by Walsh (1995), in principle provides a superior solution to Rogoff's concept of central bank independence, the extent to which the contractual approach satisfactorily resolves the underlying dynamic inconsistency problem has been questioned. McCallum (1995), for example, argues that a central bank contract merely 'relocates' the problem.³ Moreover, recent extensions of the basic delegation model reintroduce a role for a central banker who is more inflation averse than society.⁴ On these grounds, the strategic choice of central banker, as considered by Rogoff, remains an issue of practical relevance for policymaking.

The model focuses on the relationship between monetary uncertainty and social welfare emphasised by Swank, Letterie, and Pearce and Sobue. In particular, it abstracts from the mechanism operating through economic agents' indexation decisions as identified in Devereux and in Fukuda. Although we would expect much of the analysis to extend to this latter context, the interaction between central bank preferences and the degree of wage indexation raises additional considerations, which would distract from the main focus of interest.⁵

The questions we consider in this context are twofold. First, how does monetary uncertainty affect the optimal choice of central banker; in particular, does greater uncertainty make the optimal appointment more or less conservative? Second, given an optimally chosen central banker, what is the effect of an increase in monetary uncertainty on social welfare? We find that the answer to the first of these questions is ambiguous. However, with regard

to the second, we show that, unlike when the central bank's objective function is identical to society's, given an appropriate specification of central bank preferences an increase in monetary uncertainty must inevitably lead to a fall in welfare.

The remainder of the paper is organized as follows. Section 2 outlines the model. Section 3 considers the consequences of monetary uncertainty for the appropriate specification of central bank objectives, while in Section 4 the impact of increased monetary uncertainty on social welfare is examined. Finally, Section 5 draws some brief conclusions.

2. THE MODEL

The model provides a standard representation of monetary policy delegation with the additional feature of monetary uncertainty. Output determination is represented by a surprise supply function:

$$y_t - y_n = \beta(\pi_t - \pi_t^e) + u_t, \quad u_t \sim WN(0, \sigma_u^2), \quad (1)$$

where y_t (y_n) is the actual (natural) level of output, π (π^e) the actual (expected) inflation rate, and u_t represents a white-noise productivity disturbance. The social loss function is:

$$L = (y_t - y^*)^2 + \lambda(\pi_t)^2, \quad y^* > y_n, \quad (2)$$

with y^* the socially optimal output level, assumed to be greater than y_n and where the desired inflation rate is implicitly zero. The deviation of the natural level of output from the socially optimal value can be rationalized on a variety of grounds: for example, distortionary taxation (Ball and Cecchetti, 1991), imperfect competition in the goods market (as in Blanchard and Kiyotaki, 1987) or union wage setting (Agell and Ysander, 1993). However, in taking y_n to be fixed, we abstract from the potential influence of central bank objectives on the mean level of output, as identified in recent literature relating to unionized economies (for example, Cukierman and Lippi, 1999, and Lawler, 2000).

Monetary policy decisions are placed in the hands of a central bank with the following objective function:

$$L^{cb} = (y_t - y^*)^2 + (\lambda + \varepsilon)(\pi_t)^2 \quad (3)$$

Due to the presence of ε in the weight placed on inflation, central bank objectives potentially differ from those of society. The problem of making the appropriate appointment of central banker is essentially that of determining the optimal value of ε . Significantly, the central bank is assumed to control inflation imperfectly:

$$\pi_t = (1 + v_t)\bar{\pi}_t, \quad v_t \sim WN(0, \sigma_v^2) \quad (4)$$

where $\bar{\pi}_t$ represents the value of inflation which the central bank aims to achieve by use of its policy instruments. π_t differs from $\bar{\pi}_t$ due to the multiplicative error term, v_t , which can be interpreted as reflecting imprecise control of policy instruments, uncertainty with regards to the effects of these instruments on inflation, or both.⁶ The introduction of an additive disturbance term, in addition to the multiplicative error, as in Letterie, would not materially affect the results derived in what follows.⁷

3. MONETARY UNCERTAINTY AND THE OPTIMAL CHOICE OF CENTRAL BANKER

Using (1) and (2) in combination with (3), we find the central bank's optimal setting of $\bar{\pi}_t$.

$$\bar{\pi}_t = \beta[\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)]^{-1}(y^* - y_n) - (\beta^2 + \lambda + \varepsilon)^{-1}(1 + \sigma_v^2)^{-1}\beta u_t \quad (5)$$

The first term indicates the mean equilibrium inflation rate and, with $y^* > y_n$, is strictly positive, reflecting the inflation bias which characterizes this discretionary policy environment. It can be seen, however, that the value of this first term decreases as σ_v^2 increases. As noted in the introduction, it is this fact that underlies the potential improvement in welfare associated with an increase in monetary uncertainty identified in previous work.

The implied actual value of inflation can be seen directly by combining (4) and (5):

$$\pi_t = (1 + v_t)\beta[\{\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)\}^{-1}(y^* - y_n) - (\beta^2 + \lambda + \varepsilon)^{-1}(1 + \sigma_v^2)^{-1}u_t] \quad (6)$$

whilst the resulting level of output is given by:

$$y_t - y^* = [1 - \{\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)\}^{-1}\beta^2 v_t](y_n - y^*) + [1 - (\beta^2 + \lambda + \varepsilon)^{-1}(1 + \sigma_v^2)^{-1}\beta^2(1 + v_t)]u_t \quad (7)$$

Substituting the expressions for output and inflation into the social loss function, (2), and taking expectations:

$$E(L) = [1 + \{\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)\}^{-2}\{\beta^2\sigma_v^2 + \lambda(1 + \sigma_v^2)\}\beta^2](y^* - y_n)^2 + [1 - (\beta^2 + \lambda + \varepsilon)^{-2}(1 + \sigma_v^2)^{-1}(\beta^2 + \lambda + 2\varepsilon)\beta^2]\sigma_u^2 \quad (8)$$

Differentiating (8) with respect to ε and setting the resulting expression equal to zero defines the optimal value of ε implicitly as a function of the parameters of the model:

$$[\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)]^3(\beta^2 + \lambda + \varepsilon)^{-3}\varepsilon\sigma_u^2 = (1 + \sigma_v^2)^2[\beta^2\sigma_v^2 + \lambda(1 + \sigma_v^2)](y^* - y_n)^2 \quad (9)$$

It is readily shown that, for $(y^* - y_n)^2 / \sigma_u^2 \in (0, \infty)$, the optimal value of ε (denoted as ε^*) is strictly positive but less than infinity. Hence Rogoff's (1985) identification of a 'conservative' as the appropriate appointment of central banker applies equally to cases where monetary uncertainty is present. For future reference it is useful to note that ε^* is a monotonic increasing function of the ratio $(y^* - y_n)^2 / \sigma_u^2$, with $\varepsilon^* \rightarrow 0$ as $(y^* - y_n)^2 / \sigma_u^2 \rightarrow 0$, and $\varepsilon^* \rightarrow \infty$ as $(y^* - y_n)^2 / \sigma_u^2 \rightarrow \infty$.

By differentiating (9) with respect to σ_v^2 we can find how the degree of monetary uncertainty affects the optimal specification of central bank preferences: ⁸

$$d\varepsilon^* / d\sigma_v^2 = [3\beta^2\varepsilon(\beta^2 + \lambda + \varepsilon)^{-1} + \beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)]^{-1} \\ [\{\beta^2\sigma_v^2 + \lambda(1 + \sigma_v^2)\}^{-1}\varepsilon - 2(1 + \sigma_v^2)^{-1}]\beta^2\varepsilon \quad (10)$$

With the expression on the right-hand side of (9) evaluated at the optimal value of ε it is clear that:

$$\text{sgn}(d\varepsilon^* / d\sigma_v^2) = \text{sgn}[\varepsilon^* - 2(1 + \sigma_v^2)^{-1}\{\beta^2\sigma_v^2 + \lambda(1 + \sigma_v^2)\}] \quad (11)$$

But, as indicated above, ε^* may lie anywhere within the (open) interval $(0, \infty)$, depending on the value of the ratio $(y^* - y_n)^2 / \sigma_u^2$. It follows that $d\varepsilon^* / d\sigma_v^2$ is indeterminate in sign, implying that an increase in the degree of monetary uncertainty has an ambiguous effect on the appropriate degree of conservatism of an optimally-chosen central banker.⁹

For future reference, it is useful to decompose the overall expected loss, given by (8), as follows:

$$E(L) = L_1 + L_2 \quad (12)$$

where

$$L_1 = [1 + \{\beta^2\sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)\}^{-2}\{\beta^2\sigma_v^2 + \lambda(1 + \sigma_v^2)\}\beta^2](y^* - y_n)^2$$

$$L_2 = [1 - (\beta^2 + \lambda + \varepsilon)^{-2}(1 + \sigma_v^2)^{-1}(\beta^2 + \lambda + 2\varepsilon)\beta^2]\sigma_u^2$$

Thus L_1 is the component of the overall expected loss which results from the deviation of the natural level of output from its socially-optimal value, including the effects of the implied positive mean inflation rate and, given imperfect control of π , the consequent fluctuations in inflation and output. L_2 , on the other hand, represents the component of the overall expected loss associated with productivity shocks. Whilst L_1 is monotonically decreasing in ε , L_2 possesses a global minimum at $\varepsilon = 0$.

4. MONETARY UNCERTAINTY AND SOCIAL WELFARE WITH AN OPTIMALLY CHOSEN CENTRAL BANKER

The effect of an increase in monetary uncertainty on the expected social loss is found by differentiating (7) with respect to σ_v^2 .¹⁰

$$\begin{aligned} \partial E(L)/\partial \sigma_v^2 = & \\ & [\beta^2 \sigma_v^2 + (\lambda + \varepsilon)(1 + \sigma_v^2)]^{-3} [\beta^2 \varepsilon - (\beta^2 + \lambda + \varepsilon)\{\beta^2 \sigma_v^2 + \lambda(1 + \sigma_v^2)\}] \beta^2 (y^* - y_n)^2 \\ & + (\beta^2 + \lambda + \varepsilon)^{-2} (1 + \sigma_v^2)^{-2} (\beta^2 + \lambda + 2\varepsilon) \beta^2 \sigma_u^2 \end{aligned} \quad (13)$$

In terms of the decomposition of the overall expected loss into L_1 and L_2 , an increase in monetary uncertainty raises L_2 , since it implies less active stabilization in respect of supply shocks, whilst the effect on L_1 is indeterminate in direction. The latter ambiguity reflects the potentially opposing effects on welfare of a decline in the mean equilibrium inflation rate but a possible increase in the variability of inflation and output.¹¹ Thus the expression on the right-hand side of (13) is ambiguous in sign for any arbitrarily given value of ε . Given that $\partial E(L)/\partial \sigma_v^2$ may be negative, (13) can be interpreted as providing a generalization, to any arbitrarily-specified central bank objective function, of previous results which have identified a potential welfare improvement arising from increased monetary uncertainty.

However, in the present context, ε is chosen optimally and satisfies the first-order condition represented by (9). Using (9) in combination with (13), we find after some straightforward algebraic manipulation:

$$\begin{aligned} \partial E(L)/\partial \sigma_v^2 = & \\ & (\beta^2 + \lambda + \varepsilon)^{-3} (1 + \sigma_v^2)^{-2} [\{\beta^2 \sigma_v^2 + \lambda(1 + \sigma_v^2)\}^{-1} \beta^2 \varepsilon^2 + (\beta^2 + \lambda + \varepsilon)^2] \beta^2 \sigma_u^2 \end{aligned} \quad (14)$$

It can be seen directly from (14) that $\partial E(L)/\partial \sigma_v^2$ is strictly positive. The ambiguity present in (13), concerning the welfare implications of an increase in σ_v^2 , arises principally from the opposing effects on the expected loss of the induced decline in mean inflation and the reduction in active intervention to stabilise the economy in the face of supply shocks. However, with ε set appropriately, the optimal trade-off between inflation reduction and effective macroeconomic stabilization has already been achieved. Thus it follows that, given an optimal specification of central bank objectives, an increase in monetary uncertainty must necessarily reduce social welfare.

5. CONCLUSIONS

This paper has extended recent work concerned with the effects on social welfare of monetary uncertainty, to incorporate such uncertainty within a model of monetary policy delegation. Two key results emerge. First, greater uncertainty has an ambiguous effect on the appropriate specification of central bank objectives, in terms of the optimal weight to be attached to inflation stabilization by the central bank. Second, an increase in the degree of monetary uncertainty has an unambiguously detrimental effect on welfare. Whilst analyses which take the central bank's objective function to coincide with the social loss function imply that reducing monetary uncertainty might be coun-

terproductive, this second result indicates that an optimally-chosen central banker should always attempt to keep such uncertainty to a minimum.

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ENDNOTES

1 Department of Economics, University of Wales Swansea, Singleton Park, Swansea, SA2 8PP. E-mail: p.lawler@swansea.ac.uk. I am grateful to an anonymous referee for valuable comments on an earlier version of the paper.

2 In addition to considering the direct impact of monetary variability, Fukada also examines the implications of the precision of the policymaker's information concerning monetary shocks.

3 See Jensen (1997) for an elaboration of this argument.

4 Examples include Herrendorf and Lockwood (1997) and Muscatelli (1998).

5 See, for example, Mourmouras (1997).

6 The alternative interpretations give rise to the same formal representation.

7 See Pearce and Sobue for a justification of the multiplicative form of the error.

8 To derive (10), it is helpful to write (9) as: $\theta(\sigma_v^2, \varepsilon^*) = \phi(\sigma_v^2)$. Hence:

$$d\varepsilon^* / d\sigma_v^2 = (d\phi / d\sigma_v^2 - \partial\theta / \partial\sigma_v^2)(\partial\theta / \partial\varepsilon^*)^{-1}$$

9 Note from our earlier remarks with respect to the influence of the ratio $(y^* - y_n)^2 / \sigma_u^2$ on ε^* , it is clear that the larger is this ratio the greater is the presumption that an increase in σ_v^2 will increase the optimal degree of inflation-aversion of the central bank.

10 For given values of the other parameters of the model, the expected social loss can be expressed as a function of σ_v^2 and ε : $E(L) = L(\varepsilon(\sigma_v^2), \sigma_v^2)$. But with ε set optimally, by virtue of the envelope theorem we need take account only of the direct effect of σ_v^2 on $E(L)$.

11 From (13) it can be seen that for $\varepsilon = 0$ the beneficial effect on L_1 of the decline in mean inflation is dominant.

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